Psychology in Total Knee Replacement Surgery: Patient Needs, Interventions and Personality Traits

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Thesis Declaration

I, Samantha Sher-Ni Bay, certify that:

This thesis has been substantially accomplished during enrolment in this degree.

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Written patient consent has been received and archived for the research involving patient data reported in this thesis.

This thesis contains published work and/or work prepared for publication, some of which has been co-authored.

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Abstract

Total knee arthroplasty (TKA), also known as total knee replacement, is often undergone due to chronic pain at end-stage osteoarthritis. It is a cost-effective surgical procedure to relieve pain and instability in the knee. However, many patients still reported experiencing undesirable levels of pain one year after surgery despite having normal clinical and radiographic findings. Variation in outcomes after TKA can be attributed to surgical or medical factors, but there is evidence that psychological factors may also influence the success of TKA outcomes. The literature on the effectiveness of psychological interventions for TKA is currently limited, and the nature of relationships between psychological factors and TKA outcomes remain relatively unclear. This thesis aimed to explore three broad questions: Firstly, what patient needs should psychological interventions target for patients undergoing TKA? Secondly, can psychological interventions improve patient outcomes after TKA? Thirdly, are personality traits related to TKA outcomes?

Chapter one provides an overview of osteoarthritis and its treatments, TKA, and the existing literature on factors that influence outcomes of TKA.

Chapter two (*study one*) is a systematic review of the literature that aimed to investigate whether there was current evidence that psychological interventions were effective in improving TKA outcomes. The results indicated a lack of high-quality randomised control trials with few follow ups extending past the first few days post-surgery, and that psychoeducation alone was ineffective in improving outcomes.

The research reported in *Chapter three* (*study two*) involved interviews with TKA patients with findings used to inform the design of a manualised psychological intervention. Interviews revealed that patients needed an intervention that provided opportunities to manage unrealistic expectations, addressed anxiety/fears, provided assistance in preparing for TKA and education regarding TKA and recovery, and provision of support and strategies to

manage physical and psychological difficulties. Interviews also revealed that patients needed support during the first few weeks after surgery, as they reported it to be the most difficult time period after TKA.

Chapter four outlined the design and rationale of the manualised psychological intervention for TKA.

The research reported in *Chapter five* (*study three*) had two aims: to investigate the feasibility of conducting clinical trials to assess the effectiveness of the designed manualised intervention, and to investigate the relationships between personality traits and TKA outcomes. A pilot study with three follow ups was conducted (i.e., four weeks, three months, and six months post-surgery). Results indicated that it is feasible to conduct future clinical trials to assess its effectiveness, though improvements to the protocol are needed to increase recruitment rates, retention of control group participants at baseline, and reliability of objective measures of TKA outcomes. Neuroticism, extraversion, openness, agreeableness and trait anxiety were found to be correlated with TKA outcomes at six months after surgery.

Chapter six summarizes the findings of this thesis and discusses implications and future directions for research.

This thesis contributes data to the accumulating evidence that psychological factors play an important role in recovery from TKA. The current literature about the effectiveness of psychological interventions in improving TKA outcomes is still in its infancy, and therefore future high quality randomized control trials are warranted. Future interventions should go beyond psychoeducation in order to increase the likelihood of being relevant and effective. Personality can be associated with the way patients cope with the challenges of TKA, and hence interventions and rehabilitation programs should be designed with an awareness of the influence of personality. More research about the relationships between the five-factor model of personality and TKA outcomes are needed.

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Authorship declaration: co-authored publications

This thesis contains work that has been published and prepared for publication.

Details of the work: Study one, a systematic review, was published under the title "A Systematic Review of Psychological Interventions in Total Hip and Knee Arthroplasty" in BMC Musculoskeletal Disorders (2018) **Reference:** Bay, S., Kuster, L., McLean, N., Byrnes, M., & Kuster, M. S. (2018) A systematic review of psychological interventions in total hip and knee arthroplasty. *BMC Musculoskeletal Disorders, 19 (1), 201.*
Location in thesis: Chapter two
Student contribution to work: The candidate conducted the systematic search, analysis, interpretation of results and was the primary author for the manuscript (completed preparations and revisions of each section).
Co-author signatures and dates:  04/03/2021 04/03/2021 04/03/2021 04/03/2021 12/03/2021

Details of the work: Study two, the write up following interviews with patients, was prepared for publication. It was titled "Total knee arthroplasty and psychological intervention needs: Through patients' eyes" **Co-authors:** Bay, S., McLean, N., Byrnes, M., & Kuster, M. S.
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Student signature:  Date: 04/03/2021
I, Murray Maybery certify that the student's statements regarding their contribution to each of the works listed above are correct. Coordinating supervisor signature:  Date: 23/3/2021

A note about the format of the thesis

This thesis was presented as a series of papers, with a general introduction at the beginning and a general discussion at the end. This thesis contained a total of six chapters.

Chapter one is a general introduction that provided an overview of background information and key aims of the thesis and was not published.

Chapter two (*study one*: A Systematic Review of Psychological Interventions in Total Hip and Knee Arthroplasty) was published in a peer-reviewed journal. Reference: Bay, S., Kuster, L., McLean, N., Byrnes, M., & Kuster, M. S. (2018) A systematic review of psychological interventions in total hip and knee arthroplasty. *BMC Musculoskeletal Disorders, 19* (1), 201.

Chapter three (s*tudy two*: Total knee arthroplasty and psychological intervention needs: Through patients' eyes) was prepared for publication and is planned to be submitted to a peer reviewed journal.

Chapter four outlines the design of the intervention manual and components of the manual for *study three* and was not published.

Chapter five (*study three*: Psychological intervention, and relationships between personality and TKA outcomes: A pilot study) has not been submitted for publication.

Chapter six is a general discussion which summarized findings, implications, limitations, and future directions for research, and was not published.

Chapter One:

General Introduction

The knee is a hinge-type joint with complex kinematics that is normally covered with hyaline articular cartilage which provides surfaces with low friction (Townley & Hill, 1974). A healthy, normal knee joint has great strength and stability in its ability to combine a full range of flexion and extension with a few degrees of rotation (Townley & Hill, 1974). Its basic functions are reliant upon the ability to have smooth, uninterrupted motion, which are dependent upon stability, lubrication, and low friction on the articular cartilage surfaces (Townley & Hill, 1974). These factors are interdependent, as a failure in one would cause a breakdown in others, which leads to the eventual destruction of the knee joint (Townley & Hill, 1974). Osteoarthritis is a disease that causes disruption to the normal functions of knees (Rubin, 2012).

In the 21st century, humans are living longer than ever with the life expectancy of Australian males is approximately 84.7 years, and 87.3 years for females (Australian Institute of Health and Welfare, 2019a). Amongst the many health conditions associated with ageing, osteoarthritis is a very common disease in older adults (World Health Organization, 2018). It is estimated that osteoarthritis affects 2.2 million Australians (Australian Institute of Health and Welfare, 2019b), and 240 million people worldwide (Osteoarthritis Research Society International, 2016). It is predicted that the prevalence of osteoarthritis will increase along with the ageing population and rise of obesity rates (Osteoarthritis Research Society International, 2016).

Osteoarthritis and implications

Osteoarthritis is the most common type of joint disease, and as a degenerative disease it involves progressive wear and destruction of articular cartilage of joints (Felson, 1988; Rubin, 2012). Osteoarthritis is characterized by four sets of radiological criteria: (a) the

narrowing of the joint space due to loss of articular cartilage; (b) thickening of the subchondral bone; (c) cysts at the subchondral bone; and (d) osteophytes, which are peripheral growth of bone and cartilage in the joint (Rubin, 2012).

The earliest pathological sign of osteoarthritis is manifested in wear on the cartilage surface which increasingly progresses to deeper layers of cartilage that eventually becomes completely eroded (Felson, 1988; Pritzker et al., 2006). Complete erosion of cartilage causes bone damage due to the subjacent bone becoming the articular surface (Pritzker et al., 2006). Osteoarthritis can be classified by six grades, with grade zero indicating normality and grade six indicating deformation of bone (Pritzker et al., 2006). The depth of lesion to cartilage defines the severity of arthritis while the surface of degeneration area represents the extent of the disease (Pritzker et al., 2006). Several etiological factors that contribute to the development of osteoarthritis include increased amounts of forces applied on the joint, resilience of the articular cartilage, and stiffness of the subchondral coarse cancellous bone (Rubin, 2012).

In Australia, it has been determined that three out of five people with osteoarthritis are female (Australian Institute of Health and Welfare, 2019b) with additional evidence to suggest that osteoarthritis may be hereditary (Rubin, 2012). The largest risk factors for osteoarthritis are old age and obesity (Arden & Nevitt, 2006). Osteoarthritis is more prevalent in older adults, with approximately 4% of 18 to 24 year-olds affected in comparison to approximately 85% of people aged 75 to 79 (Rubin, 2012). A longitudinal study showed that obesity was associated with more severe osteoarthritis (Felson, Anderson, Naimark, Walker, & Meenan, 1988). Obesity increases the amount of force applied to the joint, while joint tissues become more vulnerable to effects of biomechanical insults with age (Arden & Nevitt, 2006). Other factors such as bone density and joint injuries, also affect the risk of developing osteoarthritis (Arden & Nevitt, 2006). Studies have hypothesized that high bone density

increased the risk of developing osteoarthritis due to increased presence of osteophytes and increased stresses on the cartilage during joint loading (Arden & Nevitt, 2006). Joint injuries can impact the quality of joint tissues and therefore disrupt the biomechanics within the damaged joint which can lead to an increased risk of developing osteoarthritis (Arden & Nevitt, 2006).

Besides pain, patients with osteoarthritis also experience sensory and motor functional changes in their knees (Hunter, McDougall, & Keefe, 2009) in addition to psychological distress (Calfas, Ingram, & Kaplan, 1997). A functional magnetic resonance imaging (fMRI) study by Shanahan and colleagues (2015) identified a difference in the organisation and representation of pain sensation centres in the brain of people with osteoarthritis compared to asymptomatic people. It has been proposed that these findings may explain some of the differences in sensory and functional changes in patients with osteoarthritis (Shanahan et al., 2015).

Treatment of osteoarthritis

Currently, osteoarthritis has no known cure, with current management of osteoarthritis involving oral pain medications, patient education, lifestyle changes, and surgery (Felson et al., 2000). Treatment approaches for mild to moderate symptomology usually involve a combination of drug therapy to reduce pain, and physical exercises or biomechanical techniques such as the use of braces or corrective footwear (Felson et al., 2000). Surgery is usually only carried out following the failure of non-surgical treatments (Felson et al., 2000). There are four types of surgeries that may be used to treat osteoarthritis including osteotomy, arthroscopy, arthrodesis, and arthroplasty (Felson et al., 2000).

The goal of an osteotomy is to adjust the weight bearing axis of the joint such that parts of the joint that are still intact take the load, and that the affected part of the joint is moved away from excessive mechanical stress (Michael, Schlüter-Brust, & Eysel, 2010).

Osteotomies are generally undergone by younger patients in the early stages of osteoarthritis, in order to relieve symptoms and slow down the rate of disease progression (Millis, Murphy, & Poss, 1996).

Arthroscopies involve lavage and debridement procedures in which a surgical scope is used to remove cartilage fragments and calcium crystals in the joint, and where the cartilage surface and osteocytes are surgically smoothened (Kirkley et al., 2008). Arthroscopies are particularly helpful in alleviating symptoms when there are degenerative meniscal tears (Felson et al., 2000), but there is some evidence that arthroscopies may be an ineffective treatment for osteoarthritis (Kirkley et al., 2008; Moseley et al., 2002).

Arthrodesis involves the fusing of joints to alleviate pain, and is often conducted on bones in the spine, wrists, hands, and feet (Felson et al., 2000). Although effective in reducing pain, arthrodesis results in loss of motion in the joint and therefore is usually not the treatment of choice for hips and knees, and is often reserved for young patients requiring salvage therapy (Felson et al., 2000).

Arthroplasty, also known as joint replacement, refers to the surgical restoration of a joint using artificial implants (Townley & Hill, 1974). Joint arthroplasties are generally conducted on hips, knees, and shoulder joints (Felson et al., 2000). These procedures are highly successful and are considered to be the most effective medical intervention for reducing or eliminating pain and disability of end-stage osteoarthritis, and restoring normal day-to-day functioning (Felson et al., 2000; Laupacis et al., 1994; Räsänen et al., 2007). There are different types of arthroplasty procedures including hemiarthroplasty, total arthroplasty, and unicompartmental arthroplasty (Townley & Hill, 1974). Hemiarthroplasty involves surgically resurfacing one of the two articulating joint surfaces, in contrast to total arthroplasty which involves replacement of both sides of the joint. The procedure of unicompartmental arthroplasty involves the reconstruction of either the medial or lateral

compartment of the knee joint and may also involve resurfacing one or both of the articular surfaces (Townley & Hill, 1974).

The development of total joint replacements has been one of the great successes in medical care history due to its capacity to relieve pain and restore joint function (Bunker, Frazier, & Mosteller, 1994). Total joint arthroplasty was first reported by Haboush in 1953 (Haboush, 1953). Since then, a range of new implants and techniques have been developed and advanced over time, to improve practicality and outcomes.

Total knee arthroplasty (TKA)

Most total knee arthroplasties (TKA) are undergone due to chronic pain experienced because of osteoarthritis (Robertsson et al., 2010). TKA, also known as total knee replacement, refers to the replacement of both sides of the two articulating surfaces of the knee (Townley & Hill, 1974). TKA is usually required at the end-stages of osteoarthritis, rheumatoid arthritis and occasionally for severe joint distortions due to fractures in the knee (Townley & Hill, 1974). Although there are other more conservative interventions for chronic knee pain, TKA has been demonstrated to be the intervention with the largest effect size for relieving chronic knee pain (Jüni, Reichenbach, & Dieppe, 2006). It is also a cost-effective surgical option for patients with osteoarthritis when more conservative treatments fail to relieve knee pain and alleviate limitations in physical function of the knee (Räsänen et al., 2007).

As with most major surgeries, TKA requires patients to be either under regional or general anaesthetics (American Association of Hip and Knee Surgeons, 2014). The surgery involves an incision of approximately 15cm made to the front of the knee, followed by the release of ligaments and meniscus (Rodriguez-Merchan & Oussedik, 2015). During the surgery, the anterior cruciate ligament is sacrificed and removed (Rodriguez-Merchan & Oussedik, 2015). TKA is conducted in two stages with the prosthesis either placed on the

femur first, then the tibia, or vice versa (Rodriguez-Merchan & Oussedik, 2015). The surgeon measures, marks, drills, and resects the joint, before inserting the prosthesis in place of the old joint (Rodriguez-Merchan & Oussedik, 2015). The surgeon then cleans up osteophytes, repositions the patella, stitches up the surgical site and tests the stability and flexion of the new knee (Rodriguez-Merchan & Oussedik, 2015). Prostheses are generally made of metal and plastic, with the materials used differing according to manufacturers and models of prostheses. Pictured below is an example of a TKA prosthesis (Figure 1), and an X-ray of a knee following TKA (Figure 2).

Figure 1

An example of a prosthesis for TKA

Note. Picture from Keller and Amis (2015)

Figure 2

An example of a knee X-ray following TKA

Note. Picture from Sancheti, Patil, Gugale and Shyam (2015)

Prevalence of total knee arthroplasty in Australia

In Australia, there were 66,113 knee arthroplasties performed in 2019, 7780 of which were performed in Western Australia (Australian Orthopaedic Association, 2020). In the last 15 years, the number of knee arthroplasty surgeries performed more than doubled, with 30,202 procedures performed in 2004 (Australian Orthopaedic Association, 2020). With the longevity of our aging population, it is expected that the rate of TKA surgeries will continue to increase (Chinachoti, Attawattanakul, & Luansritisakul, 2016).

Outcomes following TKA

TKA has been shown to be a cost-effective and beneficial surgery in fulfilling its primary purposes in relieving pain and restoring stability and motion to the joint (Daigle, Weinstein, Katz, & Losina, 2012; Jüni et al., 2006; Losina et al., 2009; Shan, Shan, Suzuki,

Nouh, & Saxena, 2015). Räsänen and colleagues (2007) found significant improvements in patients' movements, discomfort, distress, usual activity, and vitality after TKA with quality of life also demonstrated to be positively affected by total knee replacements (Shan et al., 2015).

Although TKA has been found to be successful in treating osteoarthritis at its end stages, studies have found that 11% to 19% of patients have reported dissatisfaction with the outcome of their TKA (Anderson, Wixson, Tsai, Stulberg, & Chang, 1996; Baker, van der Meulen, Lewsey, & Gregg, 2007). There has also been evidence that some patients experience physical disabilities after TKA (Boutron et al., 2003; Wylde, Dieppe, Hewlett, & Learmonth, 2007). The dissatisfaction with TKA has been attributed to various causes including aseptic loosening, malposition, infection, instability or other mechanism problems (Al-Hadithy et al., 2012; Fehring et al., 2008; Toms, Mandalia, Haigh, & Hopwood, 2009). Alternatively, it has been found that dissatisfied patients experience a range of problematic outcomes such as pain, instability, swelling and a reduced range of motion of the knee (Hirschmann & Becker, 2015). In contrast, a significant percentage of patients have what appear to be successful surgical/physical outcomes that contrast with their reports of dissatisfaction and pain (Becker, Döring, Denecke, & Brosz, 2011; Fisher, Dierckman, Watts, & Davis, 2007). It has been reflected that over the career of a surgeon, he/she would treat patients who are constantly in contact to complain about their pain, requesting narcotics, and making additional appointments despite not having any physical issues with their joints post-surgery as indicated by radiographs and other physical measurements (Brander, Stulberg, & Kirk, 2015). It is clear that the surgeons would like to manage these distressed patients differently and improve their pain levels and quality of life.

Pain after TKA

As chronic pain is the main reason for undergoing TKA in the first place, pain relief is a key desirable outcome after surgery (Wylde et al., 2007). The majority of patients experience low to mild levels of pain immediately after TKA (Wylde et al., 2007), which mostly declines to half the pain intensity after 3 months (Brander et al., 2003). Subjective improvement of pain and functionality of the knee occurs over a period of two years, and reaches a plateau after this period (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008). The majority of patients had improvements in pain and functionality scores in the first year following TKA, although 1% noted worse pain in their knee at one year post TKA than prior to surgery (Wylde, Penfold, Rose, & Blom, 2019). Healthcare workers emphasized that a short- to medium- period of pain was considered to be 'normal', however many patients expected to be free of pain following their surgery (Mackichan, Wylde, Gooberman-Hill, 2015). It has been estimated that approximately 20% of TKA patients experienced chronic pain after TKA (Beswick, Wylde, Gooberman-Hill, Blom & Dieppe, 2012; Petersen & Arendt-Nielsen, 2016). Interviews by Bardgett et al. (2016) showed that patients' persistent and increased pain after TKA had impacted on work participation and ability to concentrate, resulting in reduced productivity and increased sick leave.

It is evident in the literature that pain following TKA is a major factor that needs to be addressed differently. Pain was found to be a major reason for delay in discharge from hospital even though patients fulfilled the home-readiness criteria (Chung, 1995). One study showed that levels of pain can be severe for some patients up to 4 years after TKA (Wylde, Hewlett, Learmonth, & Dieppe, 2011). Some of the problematic outcomes may be attributed to physical causes (Al-Hadithy et al., 2012; Fehring et al., 2008; Toms et al., 2009), but may also be attributed to psychological causes when they are medically unexplained (Wylde et al., 2007). There is a concerning number of patients that experience problematic outcomes

following TKA in-spite of surgical success as indicated by physical measures (Wylde et al., 2007). One in eight patients reported experiencing moderate to severe levels of pain one year after surgery despite having normal clinical and radiographic findings (Brander et al., 2003). This is of great concern to patients and healthcare systems, considering the exponential number of patients undergoing TKA over the years (Lewis, Rice, McNair, & Kluger, 2015). A focus-group interview conducted by Mackichan et al. (2015) showed that healthcare professionals such as doctors and physiotherapists were unsure how to assist patients complaining of chronic pain when X-rays and scans fail to identify any mechanical cause of the pain.

Ongoing and unrelieved postoperative pain in the short- and medium- period are risk factors for developing chronic pain (Shipton & Tait, 2005). The sensitization model explains that chronic pain is developed because inhibitory neurons die due to excessive activation of receptors, and long lasting nociceptive stimulation results in new neural connections, thus resulting in augmented pain signals (Van Wilgen & Keizer, 2012). It should also be noted that cognitive and emotional factors also influence the experience of pain (Ahmad & Abdul Aziz, 2014). The experience of pain perception is subjective, and is modulated by the amount of attention paid to the pain, which is dependent on the threat value assigned to the stimulus (Weich, Ploner, & Tracey, 2008). Expectations and beliefs about one's ability to cope also affect the subjective experience of pain (Koyama, McHaffie, Laurienti, & Coghill, 2005; Weich et al., 2008). Individuals rated their pain as less intense when they were expecting a lower intensity of pain, despite having the same stimulus applied (Koyoma et al., 2005). When individuals believe that they have the resources to cope with pain, they have a perceived sense of control over their pain and are more likely to engage in active strategies and persevere (Weich et al., 2008). There is evidence that psychological therapies such as

cognitive-behavioural therapy, mindfulness-based therapy, and acceptance and commitment therapy are effective in managing chronic pain (Sturgeon, 2014).

Factors influencing outcomes of TKA

It has been found that variables such as age, sex, body mass index (BMI) and medical comorbidities influence outcomes of TKA, where poorer outcomes are associated with patients being younger, female, having higher body mass index (BMI) and medical comorbidities (Fisher et al., 2007). Smoking has been found to be a significant risk factor for developing post-surgical complications and increased length of hospital stay (Møller, Pedersen, Villebro, & Munksgaard, 2003).

There is evidence that pre-surgical pain can predict post-surgical pain after TKA with studies showing that pre-surgical pain predicts post-surgical pain at six months (Judge et al., 2012), one year (Lingard, Katz, Wright, & Sledge, 2004) and two years after TKA (Forsythe et al., 2008; Lingard et al., 2004). Pre-surgical function has also been found to be a predictor of post-surgical function at six months (Judge et al., 2012), one year (Ramaesh et al., 2014), and two years after TKA (Lingard et al., 2004). The severity of osteoarthritis before surgery has been found to be negatively correlated with pain after TKA, with less severe osteoarthritis according to radiographs being associated with higher levels of pain after TKA (Valdes et al., 2012).

There is evidence that psychological factors influence recovery in many surgical fields, including orthopaedic, abdominal, breast and oncology surgeries (Hall-Lord, Steen, & Larsson, 1999; Masselin-Dubois et al., 2013; Singh & Lewallen, 2013). Giesinger and colleagues (2013) found demographic and psychological variables explained 38% of variance on the Forgotten Joint Score (FJS-12) which is a measure of awareness of the joint in daily activities, and 68% of variance on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), which measures pain, stiffness, and function of the joint and

is commonly used following TKA and total hip arthroplasty (THA). Psychological factors can influence perception of pain, participation in rehabilitation and other outcomes after TKA (Filardo et al., 2016). There is evidence that disability after surgery is not only derived from severity of pain, but also from patients' interpretations and management of their pain (Burns et al., 2015; McCracken, Spertus, Janeck, Sinclair, & Wetzel, 1999; Turk & Wilson, 2010). Higher levels of anxiety, depression, pain catastrophizing, and psychological distress pre-surgery were found to be associated with patients experiencing more pain, stiffness, and worse functionality of their knees after TKA (Giesinger et al., 2013; Hirschmann, Testa, Amsler, & Friederich, 2013).

Catastrophizing is a thinking style that can be defined as viewing or presenting a situation to be considerably worse than it actually is (Oxford Dictionary of English, 2015), or [to catastrophize] "to imagine the worst possible outcome of an action or event" (Merriam-Webster Dictionary, 2012). In the context of surgeries, patients often engage in pain catastrophizing with a tendency to magnify the threat of pain and their pain symptoms (Chaves & Brown, 1987). Pain catastrophizing has been associated with an increased length of hospital stay (Witvrouw et al., 2009), use of pain medication (Papaioannou et al., 2009) and visits to health-care professionals (Gil et al., 1993). When compared to other psychological factors (e.g., depression, anxiety, pain-related beliefs, self-efficacy and fear of movement), pain catastrophizing has been found to be the most powerful and consistent predictor of poor outcomes after TKA (Riddle, Wade, Jiranek, & Kong, 2010).

However, it is arguable that pain catastrophizing is not an independent construct in itself, as it has been found to have significant associations with broader negative affect constructs such as anxiety (Badura-Brzoza et al., 2009; McCracken & Gross, 1993), neuroticism (Badura-Brzoza et al., 2009; Goubert, Crombez, & Van Damme, 2004; Ramaesh et al., 2014) and depression (Turner, Jensen, & Romano, 2000). Catastrophizing is likely to

be caused by social, cognitive, emotional, and physiological factors (Sullivan et al., 2001). In brain imaging studies, pain catastrophizing was found to be associated with activation of cortical areas associated with anticipation, attention and emotional aspects of pain, and cortical areas associated with motor control (Jensen, 2010). Rumination and attention to pain sensations has been hypothesised to be a mechanism that contributes to altered central thresholds of excitability or amplified pain signals, which results in increased sensitivity in patients' neural mechanisms (Crombez, Eccleston, Baeyens, & Eelen, 1998; Sullivan et al., 2001). It has been proposed that provision of excessive support and comfort by family members or carers in response to situations that elicit pain may shape the development of catastrophic reactions, and hence an entrenched reaction to pain over time (Sullivan et al., 2001).

Multiple studies have established that pre-operative anxiety was associated with post-operative pain (Bierke & Petersen, 2017; Ip, Abrishami, Peng, Wong, & Chung, 2009; Munafò & Stevenson, 2001; Vaughn, Wichowski, & Bosworth, 2007). Bierke and Petersen (2017) also found that anxious patients had worse functionality and satisfaction at six and twelve months follow ups. It is clear that anxiety can evoke physical and psychological effects, altering the way one thinks, feels and acts (Munafò, 1998) resulting in higher levels of anxiety pre-surgery being associated with poorer outcomes one year after joint arthroplasty (Duivenvoorden et al., 2013).

Depression prior to surgery has been found by some studies to be associated with poor outcomes after TKA (Browne, Sandberg, D'Apuzzo, & Novicoff, 2014; Duivenvoorden et al., 2013; Edwards, Haythornthwaite, Smith, Klick, & Katz, 2009). Symptoms of depression include dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and lack of initiative (Lovibond & Lovibond, 1995). A systematic review by Hughes (2015) showed a negative association between outcomes after

TKA and depression with higher levels of depression associated with poorer outcomes. Depression has also been found to be associated with medical complications such as anaemia, infection and pulmonary embolism after TKA (Browne et al., 2014).

Although patients with higher levels of depression have poorer pre-operative measures (e.g., pain, stiffness, and physical function) and post-operative outcomes when compared to patients with lower levels of depression, it was found that levels of depression decreased significantly for most patients one year after surgery (Drewett, Minns, & Sibly, 1992; Pérez-Prieto et al., 2014). Postoperative knee pain has been identified as a significant contributor in elevating anxiety and depression levels in patients (Blackburn, Qureshi, Amirfeyz, & Bannister, 2012), with the association still found one year after surgery (Harden et al., 2003). Thus, it is often difficult to determine the cause and effect of depression and anxiety on TKA outcomes, as it appears that depression and anxiety could be both a cause and effect of pain and other problematic outcomes after TKA.

Given the enduring nature of personality (Allemand, Zimprich, & Hendriks, 2008), the impact of personality is less prone to the questions of cause and effect that make it difficult to tease out causal links between surgical outcomes and post-operative anxiety or depression. Personality traits such as neuroticism and extraversion have been found to be associated with TKA outcomes (Gong & Dong, 2014; Qi et al., 2016). Neuroticism is the general tendency to experience negative affect and psychological distress, whereas extraversion can be defined as being sociable, liking the company of large groups of people, being assertive, active, and talkative (McCrae & Costa, 2010). Neuroticism was found to be associated with worse knee function (Gong & Dong, 2014; Qi et al., 2016), more stiffness and pain (Gong & Dong, 2014) after TKA. In contrast, extraversion was associated with better knee function (Gong & Dong, 2014; Qi et al., 2016), less stiffness and less pain (Gong & Dong, 2014) after TKA. More research is needed to explore the relationships between

personality traits and TKA outcomes, as most studies measured personality using a three-factor model of personality (Gong & Dong, 2014; Qi et al., 2016; Ramaesh et al., 2014) with the premise that a five-factor model of personality may explain more variance in personality compared to a three-factor model (Draycott & Kline, 1995). Three-factor models of personality classify personality on three dimensions; for example, the Eysenck Personality Questionnaire measures personality on three subscales: extraversion, neuroticism, and psychoticism (Eysenck & Eysenck, 1975). Five-factor models of personality classify personality on five dimensions; for example, the NEO Five-Factor Inventory measures personality on personality on five subscales: neuroticism, extraversion, openness, agreeableness and conscientiousness (McCrae & Costa, 2010). A more extensive five-factor model explains more variance in personality than a three-factor model (Draycott & Kline, 1995).

Given the evidence to suggest that psychological factors (e.g., anxiety, depression, catastrophizing, personality) may play a significant role in TKA outcomes, it would seem logical that these factors should be appropriately addressed and managed as part of the preparation for recovery from surgery. Previous meta-analyses and systematic reviews (Devine, 1992; Johnston & Vögele, 1993; Nelson et al., 2013) have concluded that psychological interventions can be effective in improving physical and psychological outcomes after various surgeries.

Summary and thesis aims

Osteoarthritis is a common disease, and its prevalence is on the rise as life expectancy and obesity rates increase. TKA is the most effective procedure for relieving symptoms of end-stage osteoarthritis. However, many patients experience unexpected problematic outcomes (e.g., increased levels of pain, decreased functionality) following surgery despite non-problematic radiographic findings.

Many patients describe the recovery process after TKA to be challenging, as patients are required to persevere through their fears, tolerate pain and adhere to a regular exercise regime as part of rehabilitation (Brander et al., 2015). Many factors influence outcomes of TKA, including demographical factors (Fisher et al., 2007; Giesinger et al., 2013), pre-surgical factors (Forsythe et al., 2008; Rakel et al., 2012; Valdes et al., 2012), and psychological factors (Belford et al., 2020; Bierke & Petersen, 2017; Brander et al., 2003; Browne et al., 2014; Duivenvoorden et al., 2013; Edwards et al., 2009; Gong & Dong, 2014; Ip et al., 2009; Munafò & Stevenson, 2001; Qi et al., 2016; Vaughn et al., 2007). Considering the large variance that psychological factors account for in outcomes for TKA (Giesinger et al., 2013), an evidence-based intervention conducted by appropriately qualified professionals may be warranted to improve outcomes. The orthopaedic surgeon's office may not be the ideal nor appropriate place to address patients' psychological issues, as this is not a surgeon's specialty.

This thesis had two broad aims. Firstly, to explore TKA patient needs and psychological interventions targeted at improving TKA outcomes. Secondly, to explore relationships between personality and TKA outcomes. This thesis aimed to design and evaluate a psychological intervention targeted at improving TKA outcomes in a sample of patients undergoing TKA. This thesis also aimed to extend investigation of the relationships between personality dispositions and TKA outcomes such as range of motion, pain, knee symptoms, functionality, quality of life, and awareness of the knee during daily activities by including a comprehensive measure of personality. This thesis aimed to answer the following questions:

1. What patient needs should psychological interventions target?
2. Can psychological interventions improve patient outcomes after TKA?
3. Are personality traits related to TKA outcomes?

In order to achieve the aims above, it was necessary to review existing psychological interventions for elective joint replacements (e.g., hip replacements, knee replacements), and to explore the effectiveness of these interventions. The first study in this thesis (*Chapter two*) was a systematic review of the literature, to determine the effectiveness of evidence-based psychological interventions (e.g., cognitive behaviour therapy, psychoeducation, relaxation therapy) in improving patient reported outcomes after THA and TKA.

After establishing that there was a gap in the clinical literature for comprehensive psychological interventions that went beyond patient education, patients who were on a waitlist to undergo TKA, and/or who had undergone TKA were interviewed about their expectations, concerns and difficulties experienced surrounding the surgery and recovery. They were also interviewed about their opinions on topics and components which should be included in a psychological intervention that aimed at facilitating recovery from TKA (*study two*). The information gleaned from these interviews (reported in *Chapter three*) was used to inform the development of a psychological intervention to complement TKA.

A therapist manual and patient booklet for the intervention was subsequently designed (*Chapter four*) based on findings from the first two studies. The final study (*study three; Chapter five*) was a pilot study, which aimed to investigate the feasibility of conducting clinical trials assessing the effectiveness of the designed intervention, and to explore the relationships between personality dispositions and outcomes following TKA. This thesis then concluded with a general discussion (*Chapter six*) which detailed various insights, conclusions and future directions.

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Chapter Two:

A Systematic Review of Psychological Interventions in Total Hip and Knee Arthroplasty

The current practice in elective orthopaedics does not involve routine psychological interventions, despite evidence that psychological factors influence outcome and recovery from surgery (Feeney, 2004; Giesinger, Kuster, Behrend, & Giesinger, 2013; Hirschmann, Testa, Amsler, & Friederich, 2013). One in eight patients experience moderate to severe levels of pain one year after total knee arthroplasty (TKA) despite having normal clinical and radiographic findings (Brander et al., 2003). Many studies have suggested that psychological factors such as personality, anxiety, depression and negative thinking styles influence outcomes and recovery from surgery (Edwards, Haythornthwaite, Smith, Klick, & Katz, 2009; Feeney, 2004; Giesinger et al., 2013; Goubert, Crombez, & Van Damme, 2004; Hirschmann et al., 2013). Giesinger et al. documented that psychological and demographic factors accounted for more variance in patient reported outcomes after hip and knee arthroplasty, than surgical factors (Giesinger et al., 2013). Therefore, it would seem logical that inclusion of psychological interventions to facilitate recovery from arthroplasty may enhance patient satisfaction and outcomes, as psychological factors can influence perception of pain, participation in rehabilitation and other outcomes after surgery (Filardo et al., 2016).

Previous meta-analyses and systematic reviews (Devine, 1992; Johnston & Vögele, 1993; Nelson et al., 2013) of psychological interventions found some to be effective in improving physical and psychological outcomes after surgeries. For example, in the most recent review, Nelson et al. investigated 20 studies with patients undergoing abdominal, cardiac, and orthopaedic surgery, and documented that there was some evidence for relaxation therapy in improving psychological well-being, such as reducing tension, anger,

anxiety and pain, and evidence that guided imagery reduced post-surgical pain levels, and reducing analgesic intake (Nelson et al., 2013).

Most reviews include a wide range of surgical procedures, which makes it difficult to draw conclusions and frame recommendations specific to TKA and total hip arthroplasty (THA). Arthroplasty is an elective surgery and is often undergone by healthy individuals with relatively low rates of comorbidities (Singh & Lewallen, 2014), and is thus very different from other surgeries, for example, coronary artery bypass grafting where patients require surgery in order to prolong life.

This systematic review aimed to bring more clarity with respect to the effectiveness of psychological interventions in improving joint outcomes following hip and knee arthroplasty. The following questions were addressed: Are psychological interventions beneficial in improving recovery and joint outcomes after TKA and THA? If so, are all types of psychological interventions equally effective?

Descriptions of psychological interventions in reviewed articles:

Cognitive behaviour therapy, psycho-education, motivational interviewing, relaxation therapy and guided imagery are some examples of well-established evidence-based psychological therapies in the literature.

Cognitive Behaviour Therapy

Cognitive behaviour therapy seeks to reduce symptoms by modifying maladaptive thought patterns and behaviours (Brewin, 2006; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). It is based on the works of Beck (1970) and Ellis (1962). Ellis proposed the ABC model of irrational beliefs, which cognitive behaviour therapy is based upon (Ellis, 1991). In the ABC model, an activating event (A), such as pain after surgery, in combination with a negative/irrational Belief (B), thinking that surgery is only successful if there is no pain at all,

leads to a maladaptive behavioural or cognitive consequence (C), thinking that the pain will last forever and that the procedure had failed (Ellis, 1991). Cognitive behaviour therapy aims to help the patient understand and alter beliefs and thought processes, in order to positively influence consequences (Beck, Rush, Shaw, & Emery, 1979; Blagys & Hilsenroth, 2002; Ellis, 1962). The therapist guides the patient to actively recognise maladaptive beliefs and thoughts, and to effect changes in emotional and behavioural consequences (Blagys & Hilsenroth, 2002).

Psycho-education

Psycho-education is the systematic education of patients about their condition, along with discussion of coping strategies that might be used to manage and cope with current and future problems (Colom, 2011; Goldman, 1988; Hayes & Gantt, 1992). Psycho-education is often part of cognitive behaviour therapy (Freeman, 2005; Lukens & Mcfarlane, 2004), but unlike cognitive behaviour therapy, Psycho-education does not aim to change emotional and behavioural consequences by exploring and changing a patient's belief, but rather gives the patient information about their condition and offers suggestions of behaviour changes that they can implement when faced with problems.

Motivational interviewing

Motivational interviewing is a counselling style that is targeted at eliciting behaviour changes (Rollnick & Miller, 1995). Unlike persuasion, which generally increases resistance from the patient, motivational interviewing aims to explore and resolve the patient's ambiguity to change (Rollnick & Miller, 1995). The counsellor uses empathy and acknowledges resistance, to guide the patient to create a discrepancy between reasons for and against change (Rollnick & Allison, 2004). It is paramount that the patient reaches the

conclusion on their own accord, with guidance from the counsellor (Rollnick & Allison, 2004).

Relaxation therapy

Relaxation therapy encompasses a range of techniques designed to reduce muscle tension and autonomic arousal (Van Dixhoorn & Duivenvoorden, 1999). This is achieved by using skills that focus on the internal state of the individual such as controlled breathing, focused muscle relaxation and postural awareness and management.(Van Dixhoorn & Duivenvoorden, 1999). Techniques typically focus on the redirection of attention of the patient from their thoughts and emotions (Van Dixhoorn & White, 2005).

Guided imagery

Guided imagery is a type of relaxation therapy in which patients deliberately form mental representations of positive images to promote relaxation and body awareness (Giedt, 1997; Halpin, Speir, CapoBianco, & Barnett, 2002). While many relaxation therapies focus on physical components such as breathing and muscle tension, guided imagery most commonly focuses on sensory information such as sound, smell, touch, vision and taste (Giedt, 1997; Lewandowski & Jacobson, 2013).

Method

Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines were applied (Please refer to *Appendix A* for the PRISMA checklist). There was no published protocol for this review.

Search Strategy

The search included empirical articles published in peer-reviewed journals, conference abstracts, and unpublished articles between January 1980 and mid-May 2017. An extensive literature search was conducted by searching electronic databases (Keyword and

MeSH explode) for published articles and conference abstracts (MEDLINE, PsycInfo, EBSCO, PubMed, CINAHL, Web of Science, Scopus), grey literature (PsycExtra, Cochrane Library), and dissertations and theses (ProQuest Dissertations and Theses). Hand-searching was also conducted by reviewing the references cited in previous systematic reviews, and articles included in this study.

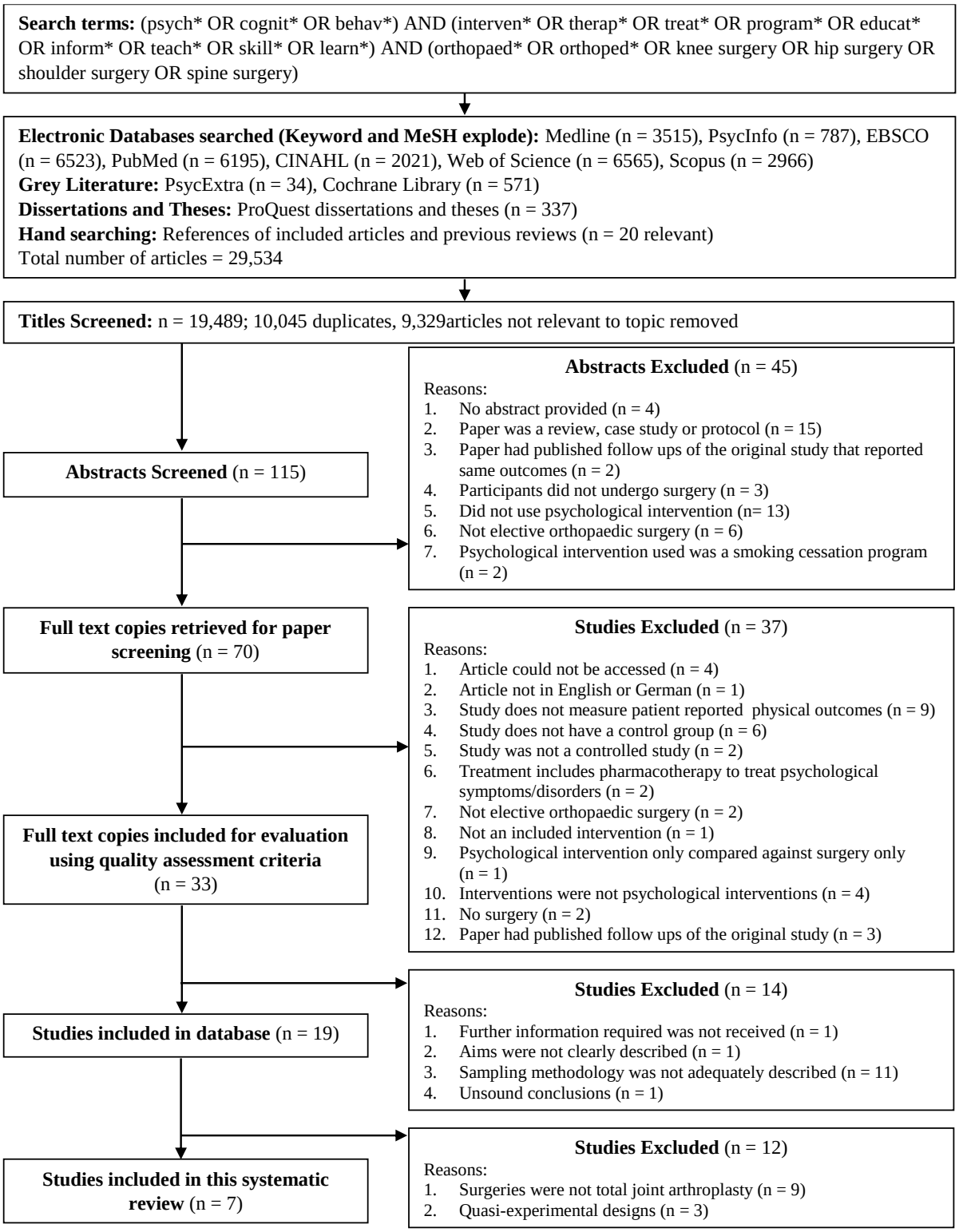
Unpublished dissertations, theses and grey literature were included in the search in order to avoid publication bias. Authors of conference abstracts, who reported collecting data on patient reported outcomes in elective orthopaedic surgery after psychological interventions were contacted by email for further information about their studies. The date of the last search was 17 May 2017. The search methodology is detailed in Figure 1.

The following search terms were used: (psychological OR cognitive OR behavioural) AND (intervention OR therapy OR treatment OR program OR education OR information OR teaching OR skill OR learning) AND (orthopaedic OR orthopedic OR knee surgery OR hip surgery OR shoulder surgery OR spine surgery). Boolean truncations were used to allow for a more expansive search.

The terms chosen covered were broad in focus to allow inclusion of all studies that investigated the role of psychological intervention in elective orthopaedic surgery. However, in order to understand the more specific effects of psychological interventions on patients undergoing hip and knee arthroplasty, articles included in this review were further restricted.

Figure 1

Flow chart of search, retrieval and inclusion process



Selection Criteria

Studies included in this review satisfied the PICOS criteria:

Participants: elective orthopaedic patients undergoing knee or hip arthroplasty;

Interventions: psychological interventions involving active patient participation;

Comparisons: control groups including placebos, sham treatments, treatment as usual, education only or physical exercise only;

Outcome: Patient reported joint outcomes including pain, and/or functionality, and/or disability;

Study designs: Randomised controlled trials (RCTs)

Studies were excluded if participants did not undergo surgery, and/or if psychological intervention was compared to surgery. Studies were also excluded if they did not include a control group, and if a patient reported joint outcome was not measured. Articles that were in languages other than English and German were excluded. Only randomised control trials were reviewed.

Quality assessment

Only articles that fulfilled the requirements of the quality assessment were included in the review. In order to be considered good quality, an article must: 1) clearly describe the aims of the study; 2) adequately describe the methods undertaken in the study such that it may be replicated, which required clear descriptions of the recruitment of participants, timeline of interventions and data collection; and 3) have logical and sound conclusions drawn from results of the study.

Two authors (SB and LK) conducted the systematic searches and reviewed articles independently, according to the selection criteria. When there were disagreements regarding

whether an article should be included, the issue was discussed with a third author (MK), and a decision was made when all authors came to an agreement.

Data Extraction

Data on participants, type of surgery, type of intervention, intervention timeline, sample size, follow ups, drop outs, outcome measures, professional backgrounds of therapists, power calculations, and major findings regarding patient reported joint outcomes were documented on pre-designed spreadsheets. Interventions were classified as effective if at least one outcome related to the arthroplasty was significantly improved for the treatment group compared to control group, after surgery. Data was extracted by the first author and checked by the second author.

Risk of Bias Assessment

All included papers were reviewed for risk of bias, by assessing seven criteria adapted from the Cochrane Risk of Bias Tool (The Cochrane Collaboration, 2017): 1) adequate randomization (selection bias); 2) dropout rate was not a threat to power (attrition bias); 3) demand effect - assessor of outcomes should not be the therapist/clinician (detection bias); 4) complete reporting of outcome data in results section; 5) significant and non-significant findings reported appropriately in the discussion section (reporting bias); 6) monitored intervention integrity; and 7) appropriate use of statistical analyses. Advice from a statistician about the appropriateness of statistical analyses was obtained.

There were two stages in defining risk of bias. Firstly, the articles were assessed according to the seven criteria, and rated with a risk score of “high” or “low” for each criterion. If there was inadequate information in articles to determine whether a criterion was satisfied, then a risk score of “high” was given. Secondly, a pre-defined classification of overall risk of bias assessment was agreed upon by the authors. Each article was rated to have

either low, moderate or high overall levels of risk of bias, according to the following classification: low risk (A) where the article satisfies all 7 criteria in stage one; moderate risk (B) where 1-3 criterion were not satisfied in stage one; and high risk (C) where more than 3 criterion were not satisfied in stage one.

Results

Study Selection

A total of 19,489 titles of studies were screened. Seven studies met criteria, and were included in this review (Figure 1).

Study Characteristics

Characteristics of the included studies are presented in Table 1.

Participants

The seven reviewed studies consisted of seven randomized controlled trials (Berge, Dolin, Williams, & Harman, 2004; Doering et al., 2000; Forward & Greuter, 2015; Frost, 2003; Grossman, 2016; Jacobson et al., 2016; McGregor, Rylands, Owen, Doré, & Hughes, 2004). A total of 573 participants were involved, where 280 participants underwent a total knee arthroplasty (TKA), while 293 underwent a total hip arthroplasty (THA).

Analysis of studies

The data extracted from studies were categorised according to effectiveness in improving patient reported outcomes, and are presented in Table 2. Table 2 also summarises the joint outcomes that were found to be improved by interventions, and joint outcomes that were not found to be improved by interventions.

Table 1

Summary of reviewed studies

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in **bold**)	Main findings about patient reported joint outcomes
Berge, Dolin, Williams & Harman (2004)	Total N = 44 Mean age = 71.6 (PMP), 71.0 (controls) Age range = NS	THA	N = 21 TAU	Pain Management Training: education, cognitive behaviour therapy, relaxation (CBT + RT)	Total = 21.5 hours; Occurred over 6 weeks; 1 to 2 mornings a week (In-person)	Pre; at least 6 months before surgery	Total = 3; Pre intervention, 3 and 12 months after PMP	**Pain (numerical rating scales)**, Analgesic drug use, **function (Arthritis Impact Measurement Scale),** metres walked in 4 minutes	Treatment group had sig. better function than controls at 12 month follow up. No sig. difference in pain was found between groups at 12 month follow up.
Doering et al. (2000)	Total N = 100 Mean age = 58.7 (treatment), 60.4 (control) Age range = NS	THA	N = 54 TAU	Educational video + discussion (PE)	Total = 1 x 12min video watched with psychologist/psychiatrist (Video recording)	Pre: afternoon of the pre-operative day	Total = 8; 5 consecutive days starting on pre-operation day, 3 months post-surgery	Anxiety (STAI), Depression (Von Zerssen Depression Scale), **Pain (VAS),** Blood pressure, Heart rate, Stress hormones (Urine samples), intake of analgesics and sedatives	No sig. difference in pain was found between groups at all time points.

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in **bold**)	Main findings about patient reported joint outcomes
Forward & Greuter (2015)	Total N = 224 TKA = 154 THA = 70 Mean age = NS Age range = NS	THA + TKA	N = 75 TAU TKA = NS THA = NS	Guided Imagery: Guided Meditation for Procedures or Surgery (GI)	Total= 4 x 18-20min sessions: pre-surgery day, post-surgery day 0, 1 and 2 (Audio recording)	Pre and Post: began after admission	Total= 8; pre and post intervention on pre-surgery day, post-surgery day 0, 1 and 2	**Pain (Numeric Rating Scale)**, Anxiety (Numeric Visual Anxiety Scale, Hamilton Anxiety Scale)	No sig. differences in pain between GI and controls during overall hospital stay.
Frost (2003)	Total N = 24 Mean age = 66.2 (treatment), 65.9 (control) Age range = 57-75	THA	N = 11 Telephone contact only	Motivational Interviewing (MI)	Total = 3 sessions; 1 x 1hr in person, 2 x bi-monthly 15-30min telephone session (In-person and over the telephone)	Post: began 3 months post-surgery	Total = 2; Pre intervention, 5months post-surgery	Exercise (diary), Physical activity (Modifiable Activity Questionnaire), Mobility (Gait Speed), Muscle force/balance (Timed Chair Rise), **Pain/Stiffness/physical function (WOMAC), physical health and mental health (SF-36),** Self-efficacy (Self Efficacy for Exercise Questionnaire), Depression (CESD-10)	No sig. differences found between groups for all measures at 5 months post-surgery.

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in **bold**)	Main findings about patient reported joint outcomes
Grossman (2016)	Total N = 60 TKA = 44 THA = 16 Mean age = 66.1 Age range = NS	THA + TKA	N = 15 Education only TKA = 10 THA = 5	Guided Imagery (GI)	Total = not standardised: 6min recording pre-surgery twice a day for 1-2 weeks (At least once on day of surgery), encouraged to listen to recording post-surgery but no specific instruction. (Audio recording)	Pre: before admission and before surgery	Total = 3; pre intervention, post intervention (during hospital admission), post-surgery (before discharge)	Anxiety (STAI-S), Stress (Perceived Stress Scale), Coping Strategies (CSQ), **Pain (VAS)**, compliance (Training survey), medication use, length of hospital admission	No sig. differences between groups for pain overall.
Jacobson et al. (2016)	Total N = 82 Mean age = 65.0 Age range = 41-81	TKA	N = 40 Placebo audio recordings	Guided Imagery (GI)	Total = 35 self-directed sessions; Every day for 2 weeks before, and 3 weeks after surgery; 19-21min each session for treatment, 17-21min each session for control (Audio recording)	Pre and post: began 2 weeks pre-surgery	Total = 4; 2-3weeks before surgery (pre-intervention), day of surgery, 3 weeks after surgery (post-intervention), 6months after surgery	Gait velocity (Timed 10-Meter Walk), **functional status (SF-36), Pain/stiffness/function (WOMAC),** imaging ability (Imaging Ability Questionnaire), optimism/pessimism (TKR Outcome Expectancy), **daily pain (VAS)**, self-efficacy (Self-Efficacy for Rehabilitation Scale), pain catastrophizing (PCS), fear of movement (Tampa Kinesophobia Scale), CD use questionnaire, Physiological variables (Lymphocytes, macrophages and cytokines)	Treatment group had sig. reduced pain levels compared to baseline 3 weeks after surgery than control group. No sig. differences between groups in improvements of knee function at 6 months post-surgery.

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in **bold**)	Main findings about patient reported joint outcomes
McGregor et al. (2004)	Total N = 39 Mean age = 71.9 Age range = 51-92	THA	N = 20 TAU	Education + discussion (PE)	Total = 1 x advise class (In-person)	Pre surgery: 2-4weeks before surgery	Total = 4; Pre-intervention, at admission, at discharge, 3 months post-surgery	**Function (WOMAC, Harris Hip Score, Berthel Activities of Daily Living Index), Pain (VAS),** Mood states (Positive Affect Negative Affect Scale), helplessness (subscale of Rheumatology Attitudes Index), **Fatigue (VAS),** expectations of pain/function/satisfaction (VAS), Life satisfaction (Cantril Life Satisfaction Ladder)	No sig. difference was found between groups for pain and function 3 months post-surgery. No results were reported for differences between groups in fatigue.

Note. "NS" indicates information not specified by papers. The word "significant" was abbreviated with "sig.". CBT = Cognitive Behaviour Therapy, MI = Motivational Interviewing, GI = Guided Imagery, PE = Psycho-education, RT = Relaxation Therapy, TAU = Treatment as usual, PMP = Pain management program, STAI = State-Trait Anxiety Inventory, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, PCS = Pain Catastrophizing Scale, CESD-10 = The Centre for Epidemiologic Studies Depression scale 10.

Table 2

Effectiveness of interventions in improving patient reported outcomes after surgery

Not effective					Effective					
Study	Psychological intervention (Surgery)	Mode of delivery	Timing of Intervention	Joint outcomes measured	Study	Psychological intervention (Surgery)	Mode of delivery	Timing of intervention	Joint outcome improved	Joint outcomes measured but not sig.
Doering et al. (2000)	Psycho-education (THA)	Video	Pre-surgery	Pain	Berge et al. (2004)	CBT + Relaxation (THA)	In-person	Pre-surgery	Function	*Pain*
Grossman (2016)	Guided Imagery (THA + TKA)	Audio	Pre-surgery	Pain	Jacobson et al. (2016)	Guided Imagery (TKA)	Audio	Pre- and Post-surgery	Pain	*Function, Stiffness*
Frost (2003)	Motivational Interviewing (THA)	In-Person + Telephone	Post-surgery	Pain, Stiffness, Function, Physical Health						
Forward & Greuter (2015)	Guided Imagery (THA + TKA)	Audio	Pre- and post-surgery	Pain						
McGregor et al. (2004)	Psycho-education (THA)	In-person	Pre-surgery	Function, Pain						

Note. The word "significant" was abbreviated with "sig."

Types of psychological interventions

Two studies used psycho-education (Doering et al., 2000; McGregor et al., 2004), one used motivational interviewing (Frost, 2003), and three used guided imagery (Forward & Greuter, 2015; Grossman, 2016; Jacobson et al., 2016). One study used a combination of cognitive behaviour therapy and relaxation therapy (Berge et al., 2004).

Effectiveness of interventions

Patient reported outcomes included pain, physical health status, physical function, stiffness and fatigue. The most common parameter was pain, either measured on a numerical rating scale, visual analogue rating scale (VAS), or as part of the Western Ontario and McMaster Universities Arthritis Index (WOMAC).

Overall, two out of seven studies (total n = 126, 65 treated) found psychological interventions to be effective in improving at least one patient reported joint outcome (Berge et al., 2004; Jacobson et al., 2016). Of these two studies, one study (total n = 44, 23 treated) used a combination of cognitive behaviour therapy and relaxation therapy and was found to significantly improve hip function at the 12 month follow-up (Berge et al., 2004), and one study (total n = 82, 42 treated) used guided imagery and was found to significantly decrease knee pain three weeks after surgery (Jacobson et al., 2016). Psycho-education, guided imagery, and motivational interviewing were amongst the types of interventions that were found to be ineffective in improving patient outcomes after TKA and THA.

The number of sessions of interventions varied widely, ranging from one to 35 sessions. Interventions that were effective in improving patient reported joint outcomes ranged from six to 35 sessions (Berge et al., 2004; Jacobson et al., 2016). All interventions with less than six sessions were not effective in improving patient reported outcomes

(Doering et al., 2000; Forward & Greuter, 2015; Frost, 2003; McGregor et al., 2004), and one intervention with more than 14 sessions was found to be ineffective(Grossman, 2016). However one intervention with six to 12 sessions (Berge et al., 2004) and another intervention with 35 self-directed sessions (Jacobson et al., 2016) were found to improve patient reported outcomes.

Mode of delivery

Mode of delivery varied across the studies with interventions delivered face to face, by video, by audio and by a mix of telephone and face to face contact. Effective interventions were delivered face to face (Berge et al., 2004), and by audio recording (Jacobson et al., 2016). However, not all interventions delivered face to face and by audio recording were effective. Of two studies that delivered psychological interventions in-person (i.e., face to face) (Berge et al., 2004; McGregor et al., 2004), one (Berge et al., 2004) was effective (total n = 44, 23 treated). One study delivered interventions partially over the telephone and partially in-person (Frost, 2003), and was found to be ineffective. One study used video recordings (Doering et al., 2000), and was found to be ineffective. Three studies used audio recordings to deliver psychological interventions (Forward & Greuter, 2015; Grossman, 2016; Jacobson et al., 2016), and one (Jacobson et al., 2016) was effective (total n = 82, 42 treated).

Timing of interventions

Interventions were delivered either pre-surgery, post-surgery, or both pre and post-surgery, and varied considerably in terms of the number of sessions conducted. Four studies delivered psychological intervention sessions pre-surgery (Berge et al., 2004; Doering et al., 2000; Grossman, 2016; McGregor et al., 2004), while one study delivered sessions post-

surgery (Frost, 2003). The number of sessions in pre-surgery interventions ranged from one to 28 sessions (Berge et al., 2004; Doering et al., 2000; Grossman, 2016; McGregor et al., 2004), while the post-surgery intervention had three sessions (Frost, 2003). Two studies (Forward & Greuter, 2015; Jacobson et al., 2016) delivered psychological intervention sessions both pre-surgery and post-surgery. The number of pre-surgery sessions ranged from one to 14 sessions, and post-surgery sessions ranged from three to 21 sessions (Forward & Greuter, 2015; Jacobson et al., 2016).

There was no clear trend as to the effectiveness of interventions according to the timing in which interventions were delivered. One intervention that was effective in improving at least one patient-reported outcome after surgery (Jacobson et al., 2016) was delivered both pre- and post-surgery (total n = 82, 42 treated), while the other intervention that was effective (total n = 44, 23 treated) was delivered pre-surgery (Berge et al., 2004). The intervention delivered post-surgery only was not found to be effective (Frost, 2003), the other intervention delivered both pre and post-surgery was found to be ineffective (Forward & Greuter, 2015), and the other three interventions delivered pre-surgery only were found to be ineffective (Doering et al., 2000; Grossman, 2016; McGregor et al., 2004).

Length of follow up

The timing of follow up measurements was variable and ranged between one day and 12 months post-surgery. One study conducted a follow up 12 months post-surgery (Berge et al., 2004), one study at 6 months post-surgery (Jacobson et al., 2016), one study at five months post-surgery (Frost, 2003), two studies at three months post-surgery (Doering et al., 2000; McGregor et al., 2004), and two studies conducted follow ups less than one week post-surgery (Forward & Greuter, 2015; Grossman, 2016).

Risk of bias across studies

Of seven studies, five had moderate risk of bias (Berge et al., 2004; Doering et al., 2000; Forward & Greuter, 2015; Frost, 2003; Jacobson et al., 2016) and two had high risk of bias (Grossman, 2016; McGregor et al., 2004).

The most adhered to criteria were adequate randomization and complete reporting of findings in the discussion section. The least adhered to criterion was having an independent researcher (i.e., not therapist or clinician) to collect outcome measures, which increased detection bias. As expected, none of the studies blinded participants or clinicians providing the interventions, as it is not possible due to the nature of psychological interventions. A summary of the risk of bias assessment is displayed in Table 3.

Table 3

Risk of bias assessment

Authors	Risk of bias	Selection bias	Attrition bias	Detection bias	Complete outcome data (results)	Reporting bias	Compromised Intervention integrity?	Appropriate use of statistics?
Berge et al. (2004)	B	Low risk	**High risk**	**High risk**	Yes	Low risk	**High risk**	Yes
Doering et al. (2000)	B	Low risk	Low risk	**High risk**	**No**	Low risk	Low risk	Yes
Forward & Greuter (2015)	B	Low risk	Low risk	**High risk**	**No**	**High risk**	Low risk	Yes
Frost (2003)	B	Low risk	**High risk**	Low risk	Yes	Low risk	Low risk	Yes
Grossman (2016)	C	Low risk	**High risk**	**High risk**	Yes	Low risk	**High risk**	**No**
Jacobson et al. (2016)	B	Low risk	**High risk**	Low risk	Yes	Low risk	Low risk	**No**
McGregor et al. (2004)	C	**High risk**	Low risk	**High risk**	**No**	Low risk	**High risk**	Yes

Note. Overall risk of bias: low risk (A), moderate risk (B) and high risk (C). Highlighted cells indicate unsatisfied criterion. No = high risk.

Discussion

Five out of seven RCTs did not show a benefit for psychological interventions in TKA and THA, questioning whether psychological interventions should be part of routine arthroplasty surgery. However, it should be noted that the literature for psychological interventions in conjunction with TKA and THA is still in its infancy, considering that 10 data-bases were searched, and only seven RCTs met criteria to be reviewed. Many studies had small sample sizes and moderate levels of risk of bias despite being RCTs. The sub-optimal quality of articles exploring the effects of psychological interventions on patient reported joint outcomes is concerning, and the gap in the literature is surprising, considering the importance of the role of psychological factors in recovery.

Across the seven studies, many different types of interventions were applied, and the timing and mode of delivery was variable, making comparisons difficult. Despite this, some interesting conclusions and directions for future research can be drawn.

Firstly, psycho-education was found to be ineffective in improving patient reported joint outcomes. Both RCTs applying psycho-education only found no significant differences between treatment and control groups (Doering et al., 2000; McGregor et al., 2004). Imparting information alone to patients, while necessary, seems insufficient to change behaviour and therefore does not improve outcomes. This is in keeping with previous findings (Herbert, 1996; Newman, Mulligan, & Steed, 2001). Many studies have shown that psychological factors such as personality, anxiety, depression, and negative thinking styles influence the outcomes after surgeries (Edwards et al., 2009; Feeney, 2004; Giesinger et al.,

2013; Goubert et al., 2004; Hirschmann et al., 2013). Given that psycho-education alone is not effective in improving patient-reported joint related outcomes after surgery, these psychological factors need to be addressed using more comprehensive interventions that go beyond educating patients. In other words, changing patients' thinking styles and providing strategies for managing physiological states are important in achieving improved patient reported outcomes after TKA and THA.

Secondly, interventions with less than six sessions were found to be ineffective, but beyond this, there was no clear relationship between the number of sessions and effectiveness of interventions. There was also no clear indication for the effectiveness of the different modes of delivery, or timing of interventions (i.e., pre/post-surgery). Further research is needed to define the optimal nature and duration of psychological intervention for TKA and THA.

There was promising evidence from two RCTs which integrated some form of relaxation therapy in their interventions, that psychological interventions improved outcomes post-surgery (Berge et al., 2004; Jacobson et al., 2016). Both studies showed a lasting effect beyond the allocated therapy period. One study that delivered cognitive behaviour therapy and relaxation therapy with a clinical psychologist found improvements in patient-reported functionality 12 months after surgery (Berge et al., 2004), and the other study found that guided imagery improved patient-reported pain 3 weeks after surgery (Jacobson et al., 2016).

Limitations

This systematic review identified a growing body of literature that explored the use of psychological interventions in TKA and THA. The quality of studies was sub-optimal with various sources of bias identified. Most studies did not account for a demand effect, where

therapists or clinicians that administered interventions also collected outcome data. The demand effect is related to response-biases, where patients respond to questions in order to maintain socially desirable appearances (van de Mortel, 2008). It is possible that patients report improvements in order not to disappoint their therapist, or to maintain an image of being a "good patient". Future studies can account for the demand effect by having an independent researcher administer the questionnaires to patients and by including objective measures of outcomes, for example, measuring the range of motion to assess functionality of the knee or hip.

One of the main limitations of the current literature is the lack of long-term follow ups. Many studies focused on early postoperative outcomes, often only exploring outcomes during hospitalisation. It has been found that majority of patients experience low to mild levels of pain immediately after TKA (Wylde, Dieppe, Hewlett, & Learmonth, 2007), which mostly declines to half the intensity after three months (Brander et al., 2003). Subjective perception of pain and functionality of the knee improves over a period of two years, and reaches a plateau after this period (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008). Thus, it would be important for studies to monitor patient outcomes over a longer period, as the rate of recovery varies over months (Brander et al., 2003; Forsythe et al., 2008; Wylde et al., 2007).

Only one study in this review conducted a follow up at 12 months post-surgery (Berge et al., 2004) and one study conducted a follow up at 6 months post-surgery (Jacobson et al., 2016). Thus, a conclusion as to whether psychological interventions have a lasting influence on patient outcomes cannot be drawn.

Most studies in the literature did not have specific intervention programs targeting different groups of patients in recovery from TKA and THA, rather, they were implemented as general concepts to every patient. Many patients will do well after TKA and THA, and psychological interventions may be more beneficial for patients with higher levels of catastrophic thinking styles, depression or anxiety as patients with these traits tend to have worse outcomes after surgery (Edwards et al., 2009; Feeney, 2004; Giesinger et al., 2013; Goubert et al., 2004; Hirschmann et al., 2013). Future studies may wish to include measures of these psychological variables, to gauge whether psychological interventions are more beneficial for some patients compared to others. Additionally, most studies lacked a multi-disciplinary approach, where there was a lack of input from both mental health practitioners (e.g., psychologist or psychiatrist) and a surgical team member (e.g., surgeon). Future studies may wish to explore whether psychological interventions targeting recovery from TKA and THA specifically, with involvement of a multi-disciplinary team are effective.

Conclusions

The current literature does not support the effectiveness of psychological interventions in improving patient reported joint outcomes after TKA and THA as most interventions explored by studies were found to be ineffective. Specifically, psycho-education alone was shown to be ineffective. It should be noted that the literature for psychological interventions in conjunction with TKA and THA is still in its infancy. This gap in the literature is surprising, considering the importance of the role of psychological factors in recovery. Further RCTs with long term follow ups (e.g., at least one year), with more comprehensive and focused interventions that go beyond educating patients are needed. Future studies should account for the demand effect by involving an independent researcher

and including objective measures of joint outcomes, include measures of psychological variables to determine whether psychological interventions are more beneficial for some patients compared to others, involve a multidisciplinary team, and compare the different modes of delivery and timing of interventions to determine the optimal nature and duration of psychological interventions for TKA and THA.

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Chapter Three:

Total knee arthroplasty and psychological intervention needs: Through patients' eyes

Total knee arthroplasty (TKA) is a cost-effective surgical option for patients with osteoarthritis when more conservative treatments fail to relieve knee pain and alleviate limitations in physical function of the knee (Räsänen et al., 2007). Additionally, it has been demonstrated to be an intervention with the largest effect size for relieving chronic knee pain (Jüni, Reichenbach, & Dieppe, 2006). However, the recovery process after TKA can be a painful and challenging process, as patients are required to persevere through their fears, tolerate pain and adhere to an aggressive and regular exercise regime as part of post-surgical rehabilitation (Brander, Stulberg, & Kirk, 2015).

Psychological factors can influence the perception of pain, participation in rehabilitation and other outcomes after TKA (Filardo et al., 2016). There is evidence that disability after TKA is often derived from patients' interpretations and management of their pain (Burns et al., 2015; McCracken, Spertus, Janeck, Sinclair, & Wetzel, 1999; Turk & Wilson, 2010). Higher levels of pain catastrophizing, depression, anxiety and psychological distress were found to be associated with patients experiencing more pain and reporting more stiffness and worse functionality of their knee after surgery (Giesinger, Kuster, Behrend, & Giesinger, 2013; Hirschmann, Testa, Amsler, & Friederich, 2013). Therefore, it is important to design and implement psychological interventions that might contribute to improved outcomes of TKA.

Despite the importance of the roles of psychological factors in recovery from TKA, it appears that few psychological interventions for TKA have been designed and evaluated, and the effectiveness of current interventions are poor (Bay, Kuster, McLean, Byrnes, & Kuster,

2018). An important first step in designing an intervention is to identify the symptoms and difficulties experienced by patients with a particular condition within their individual contexts, otherwise it is likely that the intervention would be either inadequately developed or ineffective (Campbell et al., 2007). Thus, it is important to explore the experiences, difficulties and expectations of patients undergoing or who have undergone TKA, so that psychological interventions can be developed to target the issues they specifically identify.

In this study, interviews were conducted to gain an understanding of patient experience before and after TKA. This chapter explores the expectations and fears of patients awaiting surgery and the challenges experienced by those who have had the surgery. We also explored coping strategies and sought patient views on what might have helped them better manage their experience of the surgery. This chapter draws on the findings obtained from patient reflected experiences to enable suggestions for the designs of psychological interventions for TKA to meet patient needs.

Method

Study Design and Participants

Patients who had a knee replacement, or who were on a waitlist to undergo TKA were recruited for this study. Information sheets were distributed to potential participants by secretaries at a private orthopaedic clinic, and those who indicated that they were interested in participating were then contacted to confirm their participation and obtain informed consent. Additionally, the information sheet was mailed to patients on a list (including pre- and post-operations) provided by the waitlist coordinator from a local public hospital. Patients were contacted via telephone, and an interview was arranged with those interested in participating.

Participants were recruited for interviews until saturation was obtained (i.e., no new information was being collected). Participants were interviewed between June 2017 and February 2018, at the university psychology clinic or in hospital.

Semi-structured interviews were conducted in-person with standard questions asked of all participants. Follow up questions were used to encourage participants to elaborate and reflect on their experiences in response to this set of standard questions. Patients on a waitlist for TKA were asked about their expectations of the surgery and recovery, while those who had undergone the procedure were asked about their expectations and experiences of the surgery and recovery. Participants on a waitlist who had a previous TKA on their other knee were asked about their expectations of their upcoming surgery and recovery, and about their previous experiences of TKA and recovery. Participants were also asked to consider topics that should be included in psychological interventions for TKA.

Table 1 displays the standard questions asked in interviews. In order to inform the design of a psychological intervention, it was important to understand how participants' expectations differed from their experiences, difficulties encountered, helpful strategies used, and suggestions for the intervention; the standard questions asked participants to explore these topics of interest.

All interviews were audio recorded and conducted by the first author (SB) who was a provisional psychologist, under supervision of two clinical psychologists (NM and MB) and an orthopaedic surgeon (MSK).

Ethics approvals were obtained from the Sir Charles Gairdner Human Research Ethics Committee, Hollywood Private Hospital Research Ethics Committee, and the University of Western Australia Human Research Ethics Office.

Table 1

Standard questions asked during interviews

Questions for all patients	What made you decide that you needed a knee replacement? What were/are your expectations of having the surgery?
	Are you currently experiencing pain or restrictions in your knee?
	What have you done to cope with or try to get rid of pain or restrictions?
	What difficulties are/were you experiencing because of your knee?
	Did your surgeon explain the surgery procedure to you in a way that you could understand? How long did you have to wait for your knee replacement surgery?
	Did you talk to anyone else who had a knee replacement, before going into your surgery? What did they say? What do you think will be important to include in a psychological program that helps people in their recovery from knee replacement surgery?
Questions for post-surgery patients only	How long ago was your knee replacement surgery? On a scale of 1-10, how satisfied are you with your new knee?
	What was the worst part about having your surgery?
	What was the best part about having your surgery?
	How did your expectations compare with the reality of your surgery and recovery? Which time period after your surgery did you find the most difficult?
	Did you have any fears or concerns after being discharged from the hospital? What did you find most difficult to do after surgery?
	What did you do when you were unable to engage in activities, after surgery? Were your family members/friends helpful?
	How would you describe your hospital experience?
	Did you feel that the length of stay in hospital was appropriate?
	If you had to go through a knee replacement again, is there anything would you do differently before and/or after the surgery?
	If I were a new patient going into get a knee replacement, what advice would you give me?

Questions for waitlist patients only	When is your knee replacement surgery scheduled? What impact is your knee having on your day to day life? Do you have any concerns about the surgery or rehabilitation after surgery? How worried are you about the pain that will follow surgery? What do you think your family/friends can help you with? What do you think will be most challenging about your surgery and recovery from surgery?

Data Analysis

All interview recordings were transcribed and analysed using NVivo version 11 Plus (QSR International). Content Analysis method was used to analyse the data; the analysis was guided by the a priori framework provided by the themes of standard questions asked. Data from the two groups (waitlist and post-surgery groups) were analysed separately and conclusions about expectations, challenges, coping and suggestions for topics to include in psychological interventions were drawn. Coding nodes included: expectations of surgery, fears/worries, most difficult time after surgery, problems or difficulties experienced, coping strategies, suggestions for the intervention, and advice given by participants.

Results

Participants

A total of 25 participants were recruited, with 22 of these interviewed and three participants not attending the interview. There were 15 females and 7 males, ranging in age between 53-80 years (mean age = 68 years). Fourteen participants had previously undergone TKA (post-surgery group). Eight patients were on a waitlist to undergo TKA (waitlist group). Two participants from the waitlist group had previously undergone TKA on their other knee.

Duration of interviews ranged from 29 minutes to 102 minutes, with an average of 55 minutes. Participants from the post-surgery group were interviewed between two days and five years after their surgeries (median = 1 year). Four of the eight participants in the waitlist group did not have a confirmed date of surgery as they were waiting on the hospital or surgeon to allocate a date, while the remaining four participants were interviewed between two weeks and four months before their surgery.

Findings

The following conclusions were drawn from interview transcripts, which were participants' responses to standard questions (see Table 1) and participants reflecting on their experiences when asked to elaborate on their responses.

Expectations

Expectations of both groups tended to focus on physical rather than psychological outcomes, referring to the length of the recovery period, positive outcomes such as increased mobility, a reduction of pain or even becoming pain free, and having a straight leg. No one explicitly discussed expectations about their psychological well-being, although one participant from the post-surgery group alluded to it by stating that "My interpretation about what was going to happen - the first couple of weeks it would be hell, then after six weeks I should start to see some normality.", "I just want to feel safe on my two legs". Also, one participant from the waitlist group who had a previous TKA reflected that "I understand it will be a bit of a struggle for about three months, but that will be OK."

Participants from both groups commented on their expected recovery period. Participants in the post-surgery group commented that their recovery period was much longer than expected. For example, one participant said "[I expected] that I should be where I am

now, six months ago.", and another stated that "I had expectations that I would be off crutches earlier". Two post-surgery participants reflected that they expected to be recovered in less than six weeks by stating that "I wanted to be playing golf within three weeks. I had the expectation that within a month- six weeks - on the other side I'[d] be as good as gold", and "I [was] expecting to be up there and going in three, four or five weeks' time."

Participants from the waitlist group also expressed overly optimistic expectations about the length of recovery and the impact of the surgery. For example, one waitlist participant reflected that "I'll have the operation, and then it might take two months or what-to heal, but after that I hope I can go pain free and not have the pain I had before", and another said "I think it's (the recovery period) about six to eight weeks. I've read the booklet, [and know] what is expected. [It] all depends on how quick[ly] you heal and your own proactivity."

Fears/worries

The fears discussed were similar in both groups and reflected worries about unknown future outcomes, and developing medical complications. Worries about unknown future outcomes (i.e., 'the unknown'), included uncertainty about being able to cope with pain and with life in general, and uncertainty about achieving good physical outcomes after surgery. Many participants echoed what one man from the post-surgery group said, "I suppose going into the unknown. I've had operations on my knee in the past, but it's still the unknown. You're not sure how it's going to turn out and what's going to happen."

Fear of falling was common in the post-surgery group. For examples participants said, "The one thing I did give up was bike riding, because I didn't want to fall."; "I've still got a fear of falling"; "[Surgeon] said some people do play tennis, but I've had thoughts about it

but I'm thinking if I fall over, it wouldn't be worth the risk"; "I've always had a fear of falling down the stairs".

Other fears expressed by the post-surgery group included integrity of the prosthesis "You got to trust it… You feel like it doesn't feel right."; dying during the operation "I thought it was really bad because it puts the fear in you that you might not survive"; being unable to complete activities of daily living "…maybe I couldn't go in the shower"; the surgery process "…the fact that you're going to cut part of your body, metal in my knee, and the fact they're going to cut that off… the process."; loss of control of their leg "When you wake up it was still numb and you got no feeling in it, while you're waiting for it to become good. You sort of have that funny feeling. Is it going to work? Is it going to come back?"; medical complications "…about maybe getting infection or a blood clot or something like that."; and side effects of medications "…the medication causing your memory problems.".

Fears expressed by the waitlist group included pain following surgery "I'm a bit afraid I'll have a lot of pain, but I've been reading so much now about asking for pain killers so that you are comfortable.", "I'm afraid that I will have more pain after than before. That's a big thing at the back of my mind."; fear of falling "…because I don't want to be falling over.", waking up during surgery "…if I heard the hammer or drill I would be fighting with myself to get off that table."; medical complications "The worst thing I've been told is that you get an infection and it has to be done again"; integrity of the prosthesis "…that it doesn't attach properly."; dying after the operation "I do have a psychological fear, [my] dad died three weeks later. I do have a bit of subconscious fear [of the same thing happening], so I'll be very specific with my anaesthetist."; having to take medication "I'm not one for medication."; and driving after surgery "I'm afraid to drive - short distances [will] be ok. I wouldn't dare to

drive to Kalgoorlie, because the knee is locked in for so long, and I would be afraid that it would cramp up."

Some participants from both waitlist and post-surgery groups were able to identify the role of psychological processes in their fears. One participant in the post-surgery group acknowledged her thought process and habitual behaviour concerning her fear of falling and fear about instability of her prosthesis by reflecting that "When I do the stairs and stuff like that, I still think I'm going to fall. So I'm still doing the core thing (referring to tensing up), I know she (physiotherapist) told me not to, the knee is not going to go anywhere, it's stuck in there and it's not going to break, but I still do it. I think it's because I limped for so many years - about three years. It's just a habit." In another example, a participant in the post-surgery group recalled worrying about going into surgery and identified thoughts that had contributed to her anxiety, "When I was lying in the room waiting to go into the theatre, it wasn't aching, so I was thinking: what have I done? It's not that bad. I was having second thoughts. I thought, what am I doing? He's going to saw my knee out! The enormity of what I was going to do hit me then, and I got a bit panicky." Another participant from the waitlist group commented, "My fears are: Am I doing this wrong? Am I going to end up with a leg that can't bend properly? [Will] it [be] a waste of time having this operation done? Will this come undone?"

Difficulties experienced

The difficulties discussed by the post-surgery group were both physical and psychological in nature. The most common physical difficulties experienced by the post-surgery group were managing pain, and inability to complete activities of daily living. Two participants compared the pain experienced to the pain in childbirth with one reporting that

her TKA was more painful than childbirth and the other said that the pain was equivalent to childbirth; “I was just thinking about child birth…I think the knee was more painful.”; “It's very painful, like giving birth, but you go home and you forget about how painful it was because there’s a lovely baby there.”. Participants also reported that pain in their knees were present for many months following surgery. For example, one man said, “The pain really only completely went [away] at about 12 months [after surgery].”

Other physical difficulties experienced by the post-surgery group included numbness “I think afterwards, the numbing of the knee. My whole leg was quite numb. I couldn't lift it, it was quite numb.”; medical complications “I had a bit of skin that had grown over, so I had a bit of a skin infection.”; restrictions in mobility “My bend is less than 90 degrees. It is a total disaster. I'm almost disabled.”; adverse reactions to medications “I threw up and lost weight and couldn't eat. [I’m] not sure if it was the anaesthetic.”; uncontrolled swelling “I went to the physio[therapist]. He was getting concerned about my leg, because the swelling kept getting bigger.”; stiffness “I was just a bit stiff “, weight gain “I've put on that much weight. I blew out to 110kg.”; falling “So I got up, then I fainted. Then I may have twisted my leg.”; cramps “I started to get violent cramps in my right leg, to the point where it [the cramps] tried to bring my knee up to my shoulder.”; fatigue “When I stand on my feet, if I stand still, I get very tired.”; loss of control of the limb “I told it to move, but nothing happened. I have been told since that the brain probably had been wired all its life to move in some direction, and the leg simply didn't respond to the command from the brain to move, because it was different now.”; surgical error “the knee cap was sitting a little bit too low. It was veering on the edge of acceptable, but it was crunching and grinding.“; and locking

sensations “Post-op[eration], maybe [for] a few months, I had a bit of a locking sensation. I would grab it, and ease it around and it would go”.

Psychological difficulties experienced by the post-surgery group included depressed mood, anxiety, frustration, impatience, irritability, lack of knowledge about the procedure and management of their recovery, and dissatisfaction with the appearance of the scar. A lack of knowledge about the procedure and management of their recovery, followed by depressed mood, and anxiety were the most common psychological difficulties experienced by the post-surgery group. For example, one participant reflected on her mood, “I didn't think I would have a week or two of being gloomy. I didn't want to do anything. I didn't want to get up, I didn't want visitors. I didn't want to do anything for about one or two weeks.” Another reflected similarly that “I'm such a crotchety old bag, that I was down in the dumps. I didn't want to see anyone, I just wanted to curl up and die. I felt so awful, with the pain.” Two participants identified that comparison of their progress with that of other people had contributed to their depressed mood with a statement of “why is everyone else getting better but not me”, and “You think: I'm in pain, I must just be an odd one that this is happening to, why me. Woe is me.”

Participants discussed a lack of knowledge about a range of topics including the surgery and its risks, rehabilitation, medications, and how to prepare at home prior to surgery. For examples, “…your exercises…I mean they don't tell you how long to do them for. Like three or four months?”, “Instructions for taking medications were very wordy and unclear.”.

Other difficulties experienced by the post-surgery group included interpersonal conflict with hospital staff “…but naturally that was my fault. I got shouted at. On which I shouldn't have been.”; finances related to hospital “there seems to be issues with the finances

and bills. I'm still waiting for hospital and insurance company to sort them out."; inadequate prescriptions when discharged "Then we found out that the medication that we came home with wasn't adequate for what I needed. I had some anti-inflammatories which probably lasted two to three days when I got home. To my knowledge, I thought that was all I needed."; insufficient leave from work "…only went back to work because of no sick days.", lack of transport "Someone had to come in every day, then I had to ring up the surgery, because I couldn't drive,", and being unprepared at home after discharge "There was no preparation. They didn't check if you had the correct aids at home. It was sort of trial and error when I got home."

Participants in the waitlist group reported high levels of pain and discomfort in the knee waiting to undergo surgery. Difficulties experienced by the waitlist group included managing other health problems "[I was] told to come off the orthopaedic list until my back had settled.", weight gain "The last time I saw some body I was 12 kg lighter.", depression "I have moderate to severe depression." , anxiety "I have anxiety issues. Doing things on your own is difficult.", lack of knowledge about the procedure and recovery "We don't know the right questions to ask - we don't have that knowledge.", and feeling confused after hearing about other participants' experiences "When I talked to someone, they said that they wished they had theirs done 3 years ago. But then I talked to the lady who said not to go. That put the cat among the pigeons.". Two participants acknowledged the impact that their pain had on their mood, for example one participant said, "If it's (pain) really bad, I get really down in the dumps."

Difficult period after surgery

The majority of participants who underwent TKA reported that the most difficult period was during the first few weeks after surgery, while others thought that the first few days were most challenging. However, it is difficult to draw clear conclusions about the relative challenges posed across the recovery period as participants were interviewed at varied times after their surgery. For example, one participant was unable to comment as she only had her surgery a few days prior to the interview, while another, with a longer period post-surgery, thought that the first 12 months was the most difficult time period.

Despite differences in opinion on which time period was the most difficult, most participants reported that the level of pain experienced was the key challenge. For examples, different participants said "The first 12 months. I had a lot of pain", "That first two weeks. That was because of the pain, I couldn't get it under control", and "I suppose the first month or so. [The] first one or two months. I found that the recovery was worse than the surgery. Doing the exercises. That was probably the hardest thing to do, as far as [I was in] pain. Even though you're taking the drugs that you're given." Other factors that made life difficult included restricted mobility and difficulties completing everyday activities. For example, one participant said "I think the recovery, the pain, the cleaning, changing [clothes]. That is a difficult time… the first few weeks. It's the adjusting to the after [surgery] pain, and restriction in movements."

Coping strategies

Participants in the post-surgery group identified a wide range of coping strategies to manage difficulties after their surgery, including taking alcohol/marijuana "I started to smoke marijuana. Which settled the nerves…I like to have a drink, so I would have a couple of

scotches at dinner time, then have a smoke. That will put me to sleep for quite a few hours.”; breathing exercises “The breathing, I've used that for years. Breathing is the best.”; denying pain “Don't even think about it, it's not there.”; distractions “Just watching TV. If you're in pain, you just have to sit and try to put your mind on something else”; finding alternative ways to do things “Find an alternative, like if I can't get off the ground or chair, [I] use my arms. Find an alternative, it's out there.”, using a heated pool “The physiotherapist I went to, he had a heated pool. It was bliss to get into that pool. I could walk in the warm water and do anything without any pain at all.”, hot showers “I'll either forget [about the pain] or have a hot shower and that's always good for me.”; cold-packs “I found that cold packs were very good as well. I used them regularly every couple of hours. I used to put cold packs on my knee.”; taking prescribed medications “The tablets obviously. [I] wouldn't be able to do anything without the tablets.”; physical movement “Just doing the exercises meant that next time you do them, the pain was a little less.”; praying “I do pray, that's a spiritual thing.”, engaging professional services “I got Silver Chain to come in once a fortnight. That was helpful.”; resting “When I came home I rested a lot too, I thought I was entitled to.”; self-talk “Mentally, I just tell myself that each day, when I wake up, it will be better than the last day. Tomorrow I will feel much better.”; taking things slowly “I think just taking it slowly.”; setting specific goals “I thought about the future. I thought about something I wanted to achieve by having this, and that was how I helped myself.”; using social support “I got people to visit me, or met people for coffee.”; and using aids “…use my Zimmer frame, the ones where old people have a seat on. [It was] not for me to sit [on], but to get the food out [from] the microwave, put it on the seat and wheel it to where I want to go.”.

The most common strategies used by the post-surgery group were taking prescribed medications, followed by using distractions , using heat (e.g., hot shower, heated pool, using cold-packs and self-talk. Self-talk was the only psychologically based strategy that was commonly used with one participant reflecting that positive self-talk helped her get through the recovery period:

Suggestions for interventions

All participants had at least one suggestion for topics or components to include in a program addressing the psychological needs of those who have had or are about to undergo TKA with the suggested topics similar between groups. Participants suggested that an intervention should teach strategies such as breathing exercises, finding distractions, getting help, pacing activities (i.e., breaking up tasks into manageable chunks), problem-solving skills, self-talk, talking to other people, and the use of cold-packs.

The most common topics discussed by the post-surgery group were managing pain “I think the pain management. I don't know how you could do it differently in hospital because you can't leave it open with narcotics.“, “How to deal with pain. A lot of mental exercises now to deal with pain, reaffirmations and breathing exercises.”; managing negative mood “Talk about how pain affects their mood and the ripple effect of that.”, “Listen to the positivity and weigh out the good and bad.”; and receiving education about TKA and recovery “I think people need to have a thorough understanding of what is going to happen, with times and medicines and pain.”. Other suggestions by the post-surgery group included addressing fears/worries, preparation before surgery (e.g., ensuring good social support, removal of trip hazards at home, and strengthening of legs by exercising), managing expectations, setting goals/rewards, monitoring progress, and reflecting on case studies.

The most common topics discussed by the waitlist group were receiving education about TKA and recovery “Maybe a webpage or something that you can look up the background information about the particular operation. This is what they do, this is what you can expect…I think maybe if we could get answers to some of the questions that I asked you earlier, that would save a lot of time.”; managing negative mood “Some positive mental training, positive reinforcements, mantras, or something like that.”; and motivation/perseverance “Changing people's behaviour. A lot of people are lazy, I'm lazy.”. Other suggestions from the waitlist group included pain management, addressing fears/worries, managing expectations, goal setting/rewards, and preparation before surgery.

One participant from the post-surgery group and one participant from the waitlist group suggested that the psychological intervention should start before surgery and continue after surgery. They reflected that “I think it would be useful to have a session both before and after surgery”, and “Try to get the attitude right, then you can work with them afterwards. You probably need to start getting them beforehand (before the surgery).”

Advice

When asked about suggestions for topics to include in psychological interventions, some participants, particularly those who had undergone TKA, tended to give advice instead of specific topics. The standard set of questions for post-surgery participants also included a question about advice that they would give (please refer to Table 1). Many participants emphasized the importance of doing rehabilitation exercises, followed by doing pre-surgery exercises, and listening to instructions given by health professionals. For example, one participant said, “Make sure you follow to the letter what they tell you”, and another reflected that “people shouldn't skimp on the physiotherapy”. Additional comments included “It's a

partnership. The doctor and the health services are one partner, and you're the other partner. If they don't both work, then the partnership hasn't worked." Other advice included asking for help, allowing to be helped, being patient, using cold packs, educating self about the procedure and risks, doing hydrotherapy, listening to the body, to persevere, to prepare before commencing activities, prepare the house before surgery, and to take the prescribed medications.

Discussion

Interviews with TKA patients revealed a diverse range of experiences surrounding surgery and recovery. Participants discussed their expectations, fears/worries, difficulties experienced, coping strategies, and provided suggestions of relevant topics and components that should be included within psychological interventions.

Expectations

Overall, many participants had unrealistic expectations about their recovery period with many participants in the post-surgery group reporting that recovery had taken much longer than they had expected. Some participants expected to engage in vigorous activities within weeks of the surgery as evidenced by the participant who expected to be playing golf three weeks after surgery. Although there were participants with more realistic expectations, many participants thought that they would be back to 'normal' within the first few weeks after surgery. A recovery period of a few weeks is unrealistic given that improvements of the knee occur over a period of two years (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008). Similar findings of unrealistic expectations were highlighted in MacKichan, Wylde, and Gooberman-Hill (2015)'s qualitative study, in which it was identified that patients often expected to be free of pain in the recovery period after surgery.

The research literature currently does not provide a specific time-frame in which patients return to 'normality' following TKA, however it appears that it would take more than a few weeks to strengthen and increase range of motion to be comparable with healthy individuals. At six months post-surgery, TKA patients performed significantly worse than healthy adults on functionality tasks such as the stair-climbing test, timed up-and-go test, and the six-minute walk test (Bade, Kohrt, & Stevens-Lapsley, 2010). One study showed that significant improvements in range of motion and strength took between three months and one year after TKA (Yoshida, Zeni, & Snyder-Mackler, 2012), another study showed that most improvements in lower limb functionality occurred during the first 12 weeks following TKA, with notable improvements continuing up to 26 weeks (Kennedy, Stratford, Riddle, Hanna, & Gollish, 2008), and a further study showed that many patients achieved functional and pain improvements between three months and one year post TKA (Wylde, Penfold, Rose, & Blom, 2019). Interviews with TKA patients one year after surgery highlighted that many patients experienced obstacles during their recovery period, with some experiencing ongoing difficulties (Skogö Nyvang, Hedström, Iversen, & Andreassen Gleissman, 2019).

Participants' expectations of the length of the recovery periods were also in contrast to reported experiences. Therefore, it would be helpful for psychological interventions to address unrealistic expectations. Skogö Nyvang et al. (2019) found that patients with different sources of information about TKA (e.g. relatives, health care providers) felt well prepared for the surgery and were unsurprised by physical difficulties such as pain and restricted mobility. It would be important for patients to have realistic expectations so that they do not set themselves up for failure as evidenced by one participant who had expected to succeed at any activity she chose, whilst also discussing that she had felt discontented with

herself for a period of time following surgery because she was unable to be as active as she had wanted or expected.

Results indicated that TKA patients faced both physical and psychological challenges surrounding the surgery and recovery, however, when asked about expectations, participants tended to talk about physical outcomes, activities, and their expected recovery period. The results detailed demonstrated that pre-surgery participants did not refer to expectations about mood and psychological well-being although the post-surgery group reflected that they experienced a range of psychological difficulties following surgery, including depressed mood, anxiety, frustration, impatience, irritability, and dissatisfaction. Therefore, patients may benefit from being better prepared for psychological challenges that they are likely to face across the rehabilitation period.

Fears/worries

Participants highlighted many fears and worries related to the surgery and recovery period. The most notable worries were about 'the unknown', fears of falling, and developing medical complications. Many participants were uncomfortable when facing the uncertainty associated with their recovery, and in particular their capacity to cope with pain and with their life in general. Uncertainty of outcomes after TKA was described by many participants to be a main contributor to their anxiety. The cognitive-behavioural model established that emotions have unhelpful thoughts underlying them (Ellis, 1962) as evidenced by the participant who questioned her decision to undergo the surgery while waiting to be transported into the operating theatre and identified the thoughts underlying her anxiety. It may be helpful for psychological interventions to help patients understand and identify the thoughts contributing to their anxiety, and to address the beliefs giving rise to these thoughts.

Difficulties surrounding TKA

Participants described a range of physical and psychological difficulties surrounding their surgery and recovery period. The most notable physical difficulties experienced were managing pain, and difficulties completing activities of daily living, which are not unexpected as the surgery restricts mobility initially, and post-surgical pain is expected following the procedure. Our findings were consistent with Woolhead, Donovan, and Dieppe (2005)'s qualitative study, in which participants expressed ongoing difficulties with managing pain and restricted mobility six months after surgery. Thus, it would be important for future interventions to incorporate discussions and strategies to assist patients prepare for, and best manage their pain. Topics for discussion might include the normality and function of pain (Eccleston & Crombez, 1999), the fear-avoidance model of pain (Lethem, Slade, Troup, & Bentley, 1983; Turk, Meichenbaum, & Genest, 1983), the underlying thoughts and beliefs about pain, and behaviours surrounding pain.

Notable psychological difficulties included a lack of knowledge about the procedure and management of their recovery, mood difficulties such as depressed mood, anxiety, frustration, impatience, and irritability. Patients may benefit from exploring what information they perceived to be lacking with psychological interventions promoting active seeking of answers from their surgeons/hospital, and may provide answers to some frequently asked questions about the surgery and recovery from surgery. It would also be helpful for interventions to help participants understand the causes of mood difficulties and to provide strategies to improve mood. For example, it may have been helpful for the participant who felt depressed and was socially isolating herself to be provided with discussions that enabled her to link her physical symptoms to her psychological symptoms. Some mood difficulties

experienced by participants were related to unrealistic expectations and fears surrounding the surgery and recovery period and therefore, addressing unrealistic expectations may help to prevent frustration due to the mismatch between experiences and expectations and additionally may also reduce the experience of anxiety.

A majority of participants reported that the first few weeks after surgery were the most difficult period during their recovery, which suggests it is important for psychological interventions to be provided to patients within this time period which echoes the thoughts of participants who suggested that interventions should be implemented both before and after the surgery.

Suggestions for topics to include in psychological interventions

When asked about suggestions for topics to include in psychological interventions, some participants tended to give advice instead of specific topics. Given that participants felt keen to offer advice based on what they had learned from their experience, it may be beneficial to include a group session in which a post-surgery patient with a successful TKA outcome attends to discuss helpful practices in recovery from the surgery. Alternatively, a print-out with a summary of these points may be helpful if group sessions are not feasible. Common advice from participants included emphasizing the importance of doing pre-surgery and rehabilitation exercises, and the importance of listening to health professionals. Other topics of advice given by participants that may be useful to include are practical tips to manage physical difficulties such as receiving help from others, using cold-packs, doing hydrotherapy, and preparing their environment/home before surgery/activities.

The suggestions of topics to include in psychological interventions were relevant to the physical and psychological difficulties experienced by participants. Participants in both

the waitlist and post-surgery groups suggested similar topics with many participants from both groups wanting education about the procedure and recovery, and support/strategies to manage negative mood. However, proportionally more waitlist participants thought it would be important to include support for diminished motivation and perseverance to engage with rehabilitation exercises, while proportionally more post-surgery participants thought it would be important to include strategies to manage pain. Participants also suggested that interventions should address fears/worries, manage expectations, prepare for the surgery and recovery period, goal setting, pacing activities, include case studies of previous patients, and monitor progress over time. It was also reflected that goal-setting, pacing activities and monitoring progress may be helpful strategies for managing challenging activities and facilitating recovery in addition to setting difficult but achievable goals to enable the induvial to stay motivated and promote self-efficacy (Locke & Latham, 2006).

Previous interviews conducted by Kennedy et al. (2017) showed that there was a need for education about pain management after TKA, including information about the levels of expected pain, medication use, management of side-effects, and guidelines for weaning off medication. Kennedy et al. (2017) also noted that addressing frequently asked questions would be helpful in improving patients' overall experience of TKA and recovery. It is important to note that although participants perceived that education about the procedure and recovery were important elements of interventions, the interviews suggested that education alone would not be sufficient to meet their needs surrounding recovery from TKA. Participants have reported the need for support in managing both physical and psychological difficulties, such as pain and mood difficulties, in addition to education about the procedure and recovery. Thus, interventions should include more than just educational components. It is

also important to note that although patients have common difficulties, they also have a diverse range of experiences, and therefore interventions should be able to be adapted to meet individual needs.

Participants suggested that the interventions should commence before surgery which would allow opportunities to manage unrealistic expectations, address fears, prepare patients for the recovery period and provide education to patients prior to facing the challenges of TKA.

Limitations

Findings from this study may apply to those undergoing TKA, but not necessarily to other surgical procedures as difficulties experienced and timeline of recovery may be different for other surgical procedures. The majority of participants in this study were Caucasian with private health insurance, so they were more likely to be from higher socio-economic backgrounds these results may not be reflective of difficulties experienced by patients from lower socio-economic backgrounds. More females were interviewed than males, so it is possible that the difficulties reported in this study were more representative of those experienced by females, however, statistics show that more females undergo TKA than males worldwide (Koh, Kim, Chang, Cho, & In, 2013; Kurtz et al., 2011; Weinstein et al., 2013). Females have been shown to recover faster than males after TKA (Liebs, Herzberg, Roth-kroeger, & Ru, 2011), so it may be possible that males require support over a longer period of time than females.

Interviews with participants occurred at different time points in relation to their TKA, with post-surgery participants interviewed between two days and five years after surgery. Some waitlist participants had not yet received their surgery date, while others were

interviewed between two weeks and four months before their surgery, thus, conclusions drawn from this study may not be reflective of experiences at specific time points when undergoing TKA and recovery.

Conclusions

In summary, TKA patients have a diverse range of experiences with many participants holding unrealistic expectations about their recovery from TKA and were unaware of the psychological challenges of TKA and recovery. The participants identified struggling with both physical and psychological symptoms before and after TKA. The participants identified a lack of knowledge about the procedure and management of their recovery, experiencing the psychological challenges of mood difficulties, along with worries surrounding 'the unknown', falling, and developing medical complications. Specifically, post-surgery participants identified managing pain and completing activities of daily living as the most challenging physical difficulties whilst identifying a diverse range of coping strategies used to overcome these physical and psychological difficulties.

Overall, participants' experiences and suggestions implied the need for psychological interventions to manage unrealistic expectations, address fears, prepare for TKA and recovery, provide support and strategies for physical and psychological difficulties such as managing pain and mood difficulties, and educating about the procedure and recovery. Additionally, any supportive interventions should commence before surgery so that expectations, fears, and psychological and physical preparation for surgery could be discussed and addressed. Psychological support should also be continued for several weeks following surgery as this phase was identified as the most difficult period after TKA.

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Chapter Four:

Intervention Manual - Design and Rationale

The design of a therapist manual and patient booklet for a psychological intervention to facilitate recovery from TKA was informed by the findings from the first two studies of this thesis. This chapter outlines the intervention, and the rationale for inclusion of the components that comprise the therapist manual and patient booklet. A copy of the therapist manual and patient booklet are attached in *Appendix B* and *Appendix C* at the end of this thesis.

The intervention designed in this chapter was a complex intervention. Interventions are considered complex when they contain several interacting components, require those delivering and receiving the intervention to engage in multiple complex behaviours, have multiple groups that are targeted by the intervention, have multiple and variable outcomes, and/or have a degree of flexibility to tailor the intervention to individual needs (Craig et al., 2008). The intervention designed in this chapter contained many interacting components (e.g. concepts about physical and psychological wellbeing, and strategies to manage pain which can impact mood), required those delivering the intervention (e.g. exploring and managing anxiety) and those receiving the intervention (e.g. complete monitoring sheets and engage in coping strategies) to engage in multiple complex behaviours, has multiple outcomes (e.g. increasing knowledge about the procedure, managing unrealistic expectations, managing mood difficulties, managing pain), and allows for therapists to explore individuals' progress (e.g. during check-ins during sessions 2-6) and review materials according to individual patient needs.

Craig and colleagues (2008) outlined the Medical Research Council's (MRC) steps to developing a complex intervention: identify existing evidence (e.g. conduct a systematic review), identify and develop theory (e.g. rationale, expected outcomes, and how outcomes may be achieved), and modelling process and outcomes (e.g. conducting a feasibility or pilot study). The first step (i.e. identify existing evidence) was detailed in *Chapter two* (systematic review), the second step (i.e. identify and develop theory) is outlined in Chapter *three* and in this chapter, while the final step (i.e. modelling process and outcomes) is detailed in *Chapter five*.

Findings from the systematic review (*Chapter two*) suggested that psychoeducation alone was ineffective in improving patient reported outcomes after TKA and THA. Interviews (*Chapter three*) suggested that TKA patient needs extended beyond receiving education, and that an intervention designed to facilitate recovery from TKA should aim to help manage unrealistic expectations, address fears, provide education about the surgery and recovery, and provide support and strategies to manage the physical and psychological challenges of rehabilitation. Interviews also suggested that psychological interventions should begin before surgery in order to manage unrealistic expectations and address apprehensions, and should continue for several weeks following surgery as most patients found the period post-surgery to be the most challenging time. Table 1 shows how patient needs identified in Chapter *three* were incorporated into the intervention design. The literature has shown that preoperative anxiety and difficulties with mood are associated with poorer outcomes following surgery (Ip, Abrishami, Peng, Wong, & Chung, 2009; Munafò & Stevenson, 2001; Vaughn, Wichowski, & Bosworth, 2007). Therefore, it is possible that patients may have

better outcomes following surgery if anxiety and mood difficulties were addressed before surgery.

Table 1

Mapping patient needs identified in interviews (Chapter three) onto the intervention design

Topics identified from interviews	**Intervention Manual**
Intervention to occur both before and after surgery	6 Sessions: 2 before surgery, 4 after surgery
Addressing unrealistic expectations	Session 1: Managing expectations Session 1: Case examples of 'normal' recovery (examples of stories of participants' recovery from interviews, including some difficulties encountered)
Insufficient consideration of psychological variables and outcomes. outcomes	Session 1: Well-being (emphasizing importance and relationship between physical and psychological well-being)
Addressing anxiety/fears and mood difficulties	Session 1: Exploring anxiety and worries Session 2: Relationships between thoughts, behaviours, emotions (cognitive restructuring) Session 3: Keeping up with your social life Session 5: Catastrophizing (cognitive restructuring) Session 2-6: Check in (explore difficulties and manage appropriately) Session 6: Preparing for ongoing recovery

Topics identified from interviews	Intervention Manual
Pain management	Session 2: Psychoeducation about pain (definition, normality/function, cognitions/behaviours, neurobiology, cycle of avoidance) Session 2: Strategies to manage pain Session 2: Relationships between thoughts, behaviours, emotions, and pain (cognitive restructuring) Session 2: Body scan and mindfulness of breath exercises Session 3: More strategies to manage pain
Lack of knowledge about procedure/recovery, needing education	Session 1: Frequently Asked Questions Session 1: Activity for the week – write down questions that patient has for their surgeon Session 3: Medication chart (prompt patients to ask nurse/doctor to explain their medications)
Being unprepared after surgery	Session 1: Checklist: preparation for surgery
Worry about 'the unknown'	Session 4: Managing uncertainty Session 4: Mindfulness of thoughts exercise
Advice from patients	Session 1: Advice/tips from previous patients

Topics identified from interviews	Intervention Manual
Goal setting and monitoring progress	Session 4: Setting goals and rewards (short and long term goals) Sessions 5 & 6: Checking in on progress of goals Session 5: Values (engaging in valued activities) Sessions 2-5: Take home activity (Monitoring pain, mood, and activity)

It was decided that the psychological intervention would be a brief intervention to promote and increase the likelihood of patient participation, adherence and for practicality of administration of the intervention. However, this proposal needed to be balanced by the identified need for input prior to surgery and at key points in the recovery period. Thus, the intervention consisted of six sessions with two sessions prior to TKA and four sessions after TKA. The intervention commenced approximately two weeks before surgery and concluded approximately four weeks after surgery. The intervention was designed to be delivered by psychologists with experience delivering cognitive behaviour therapies.

The first two sessions aimed to build rapport, provide education about the surgery, coping strategies and pain, to address anxiety/fears and unrealistic expectations, and to discuss the relationships between thoughts, emotions and behaviours based on the Cognitive-Behaviour Therapy (CBT) model. The third session was conducted in hospital at the participants' bedsides, two days after surgery as consultation with nurses and doctors revealed that patients tended to be drowsy on day zero (i.e., day of surgery) and day one (i.e., day after surgery) due to the effects of medications and anaesthetics. The purpose of the third

session was to provide support, remind patients of discussion points and coping strategies from previous sessions and to help them manage anxiety surrounding their discharge from hospital in the following days. Subsequent sessions were scheduled weekly, from about two weeks after surgery, in order to allow the patient to settle into their routine post-discharge. The purpose of the fourth, fifth and sixth sessions were to discuss additional coping strategies, help with managing mood, pain and mobility restrictions, provide assistance with setting achievable goals, and assist participants in preparing for ongoing recovery. Table 2 summarises the six sessions of the psychological intervention.

Table 2
Summary of the psychological intervention

Session	When the session occurred	Goals/Topics covered
1	Two weeks prior to TKA	Anxiety, expectations (realistic/unrealistic), physical/psychological wellbeing, coping styles (helpful/unhelpful), preparation for surgery (environment, social support, activities), education and advice about TKA.
2	One week prior to TKA	Pain, pain related thoughts/behaviours, pain management, emotion regulation strategies, and beliefs about hospital stay.
3	Two days after TKA	Psychological support for difficulties encountered in early recovery period, review coping strategies, and plan for discharge from hospital.

Session	When the session occurred	Goals/Topics covered
4	Two weeks after TKA	Assess wellbeing, contrast experiences and expectations, managing uncertainty, and setting goals.
5	Three weeks after TKA	Assess wellbeing, review goals, explore values, catastrophizing, and cognitive restructuring.
6	Four weeks after TKA	Assess wellbeing, review goals, review progress, and prepare for ongoing recovery.

The intervention was titled "Psychological Coaching for Knee Replacements" based on the premise that the intervention was designed for a general population of patients who may or may not be experiencing psychological distress, with the term "psychological coaching" chosen over the terms "therapy" or "intervention" in order to reduce any stigma which may be associated with the latter terms. Despite the use of the term "coaching", the intervention was a CBT program (also known as "KneeBT") which focused on the relationships between thoughts, feelings and behaviours, targeted cognitive distortions such as catastrophizing, provided opportunity for problem solving, and discussed behavioural strategies to manage mood and physical difficulties. The intervention was designed to be delivered face-to-face. All sessions were conducted individually (i.e. not in a group).

All sessions, with the exceptions of sessions one and six, were designed to run for approximately one hour. Extra time was allocated in sessions one and six for completing questionnaires for baseline and outcome measures. TKA outcome measures collected included range of motion, pain, knee symptoms, functionality in activities of daily living,

knee-related quality of life, and awareness of the knee joint (please refer to *Chapter five* for more details about outcome measures).

There were 'homework' tasks for patients between sessions. For session one, patients were asked to read the information provided to them in their patient booklet, and to think about questions that they may have for their surgeon about TKA and recovery. For sessions two, three, four and five, patients were asked to record their pain, mood, and activities daily. Monitoring these variables weekly enabled participants and therapists to track recovery from surgery over time, as previous studies have shown that monitoring progress and providing patients with feedback of their progress over time enhanced outcomes of therapy (Lambert, Harmon, Slade, Whipple, & Hawkins, 2005; Lutz, 2003; Newnham, Hooke, & Page, 2010). Participants were also asked to complete activities related to content covered in the preceding session. For example, after session two, participants were asked to notice their thoughts relating to pain or challenges, and experiment with relaxation techniques and mindfulness exercises.

Participants completed a questionnaire during sessions one, two, four, five and six, measuring their average mood, pain, medication use, and coping strategy use. Additionally, therapists measured the participant's range of motion in their knee using a goniometer during sessions one, two, four, five and six. The questionnaire and measure of range of motion was not completed in session three as we wanted to reduce the demands on participants who may have been experiencing effects from anaesthetics during their hospital stay.

A therapist manual (*Appendix B*) and corresponding patient booklet (*Appendix C*) were designed for the intervention. The therapist manual provided information to guide therapists in conducting the intervention, was structured session by session and included all

worksheets and scripts needed to conduct sessions. The therapist manual included a section called “notes to therapists”, which outlined instructions on interpreting content in the manual, conducting sessions and record keeping. There was a checklist at the end of each session in the therapist manual, outlining the goals to fulfil during the session. The patient booklet contained information sheets and worksheets required for the intervention. Summaries of each session and rationale are outlined below. The Template for Intervention Description and Replication (TIDieR) Checklist (Hoffman et al., 2014) is attached in *Appendix D*; the TIDieR checklist outlines how the design of this intervention meets the criteria for completeness of reporting and replicability.

Summary: Session One

Session one was designed to be conducted approximately two weeks before TKA. Aside from building rapport, the goals of the session were to give participants an introduction to themes covered in the intervention, explore and normalise anxiety/worry, address unrealistic expectations, discuss relationships between physical and psychological wellbeing, discuss helpful and unhelpful coping styles, provide education about TKA (including answers to frequently asked questions), and to provide and discuss case examples (vignettes were derived from interviews in *Chapter three* and de-identified) and advice from patients who have undergone TKA. A checklist to aid with preparation of participant’s homes, social support networks and activities was provided.

Interviews (*Chapter three*) revealed that interventions needed to manage unrealistic expectations, address fears, prepare for TKA and recovery, provide support and strategies to manage physical and psychological difficulties, and provide education about TKA and recovery. Session one fulfilled most of these components. Therapists and participants

contrasted helpful and unhelpful styles of coping, including discussing examples of helpful and unhelpful coping strategies.

The information sheets and checklist for preparation for surgery were adapted from information booklets for TKA used by Hollywood Private Hospital (Ramsay Health Care, 2016) and Department of Health Western Australia (EIDO Healthcare Australia, 2015), which included information about pre- and post-surgery appointments, procedures, equipment, medical and social support. Additional information included was based on interviews (*Chapter three*) and discussions with nurses and an orthopaedic surgeon (Prof. M. Kuster; supervisor for this thesis). As some participants in interviews reported that they felt unprepared for the challenges of TKA post-discharge from hospital, the checklist was designed to ensure that participants' homes were prepared with the appropriate equipment, consideration was given to the social and professional support needed to aid with activities of daily living, and strategies were in place to manage anticipated physical and psychological difficulties.

Summary: Session Two

Session two was scheduled to be conducted a week following session one. The main goals of session two were to provide psychoeducation about pain, pain related thoughts, behaviours, emotions and avoidance, provide strategies to help manage pain (e.g., mindfulness, relaxation, mantras) and emotions (e.g., cognitive restructuring), and to explore beliefs about their upcoming hospital stay.

Post-surgical pain can increase stress responses that may lead to an increase in tissue breakdown, coagulation, and fluid retention, and can interfere with appetite and sleep, which are important for recovery (Good, 1996). During patient interviews, pain appeared to be one

of the most challenging difficulties faced by patients undergoing TKA. As the interviewees previously expressed that pain was an important topic, the purpose of pain, neurobiology of pain, common misconceptions about pain, and relationships between thoughts, behaviours, emotions and pain were discussed in some detail. Additionally, many interviewees reflected on negative mood following surgery because of their pain. Thus, it was decided that the intervention should include discussions about the relationships between thoughts, behaviours, emotions and pain, and fear avoidance in order to enable participants to become aware of their potential roles in perpetuating unhelpful coping styles and undesired outcomes. The fear avoidance model discussed in session two titled "cycle of avoidance" was adapted from chronic pain literature (Asmundson, Norton, & Vlaeyen, 2004), and deemed to be more relevant to acute pain rather than chronic pain. We discussed the emotional and behavioural consequences of avoidance behaviours as literature has shown that avoidance behaviours are associated with perpetuating anxiety and depression (Barlow, 2002; Chawla & Ostafin, 2007; Ferster, 1973).

The gate control theory of pain proposes that the brain plays a dynamic role in the perception of pain, such that experience of pain differs based on the pattern of activated fibres in the spinal cord and nerve impulses descending from the brain (Melzack & Wall, 1965). Pain perception is affected by factors such as pain catastrophizing (Sullivan, Bishop, & Pivik, 1995), anxiety and depression (Arntz & De Jong, 1993; Dickens, McGowan, & Dale, 2003; Racine et al., 2012), previous traumatic experiences (Fleischman, Bunevicius, Leserman, & Girdler, 2014), and self-efficacy (Ohlwein, Stevens, & Catanzaro, 1996). Given the complex relationship between pain and cognitive processes, and that participants reported (in *Chapter three*) that they needed support with managing pain and mood difficulties, it was important to

introduce and practice evidence based coping strategies such as cognitive restructuring, mindfulness exercises, relaxation exercises and helpful self-talk to enable and equip patients to deal with their post-operative pain.

The strategies incorporated in our intervention are commonly used in evidence-based therapies such as cognitive behaviour therapies (A-Tjak et al., 2015; Epp & Dobson, 2010; Hofmann, Sawyer, Witt, & Oh, 2010; Khoury et al., 2013), and included relaxation and mindfulness strategies. Relaxation strategies have been reported to improve post-surgical outcomes and assist pain management, but it is generally regarded as an ancillary rather than the primary treatment for managing acute pain (Broadbent et al., 2012; Carroll & Seers, 1998; Topcu & Findik, 2012).

Mindfulness is a process characterized by taking a non-judgemental stance of present moment experiences while encouraging openness, curiosity, and acceptance (Bishop et al., 2004; Kabat-zinn, 2003). Mindfulness has been found to moderate the relationship between stress and pain in knee osteoarthritis (Lee et al., 2017), and mindfulness-based therapies were found to be effective in improving chronic pain (Reiner, Tibi, & Lipsitz, 2013). Cognitive processes such as attention and emotional regulation play a role in pain perception with mindfulness targeting these cognitive processes, as patients focus their attention to the present moment in a non-striving way, which in turn enables the acceptance of experiences and an alteration of perceptions (Day, Jensen, Ehde, & Thorn, 2014). Given that mindfulness can influence mood and pain perception, participants were introduced to a body scan exercise, and a mindfulness of breath exercise through audio recordings in session two encompassing scripts which were written by the author of this thesis.

Summary: Session Three

The third session was conducted two days after surgery while the participant was in hospital. The main goals of session three were to provide support to participants in the immediate post-surgery period, review strategies from session two, and to discuss and plan for their discharge from hospital. It was decided that the third session would introduce relatively little new material, as it was believed that participants were dealing with a range of new experiences and challenges post-surgery and would benefit most from supportive counselling, and reinforcement of the coping strategies discussed in the first two sessions.

Most of session three was spent checking in on the participant's well-being, and providing validation and supportive counselling. Most patients have their nerve block (if applicable) and catheter removed on the second day after surgery and were adjusting to their restricted mobility. A chart on which to log medications was included in the patient booklet, as some interviewees (*Chapter three)* reported feeling confused about their medications after discharge, therefore this process was intended to prompt participants to ask hospital staff about their medication when completing this chart.

Discussions about anxiety related to their discharge from hospital were included, and therapists were instructed to conduct motivational interviewing if participants indicated over dependence on hospital staff and reluctance to go home. Motivational interviewing has been shown to be an effective technique to promote healthy behaviour change, particularly for highly anxious individuals (Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010).

Summary: Session Four

The fourth session was conducted approximately two weeks after surgery, in order to allow time for patients to be discharged from hospital (which was usually three to five days

after surgery), and to settle into their home environment before coming to their appointment. The main goals for session four were to assess the participant's wellbeing, contrast their actual experiences with their pre-surgery expectations, manage uncertainty associated with their recovery (i.e., 'the unknown' in *Chapter three*), set rehabilitation goals and introduce an additional mindfulness exercise.

Assessing participants' wellbeing weekly following surgery allowed opportunity for therapists to get an understanding of individual needs, in order to tailor sessions to the individual. For example, if a participant reported that they had been feeling anxious, the therapist could choose to allocate some time of the session to explore the anxiety and revisit content from previous sessions if needed.

Many participants from interviews (*Chapter three*) identified that they worried about 'the unknown', often referring to uncertainty about being able to cope with pain and with life in general, and uncertainty about achieving good physical outcomes after surgery. Thus, session four included discussions and worksheets about managing uncertainty with the worksheet used adapted from material developed for an anxiety management program (Saulsman et al., 2015).

Participants were asked to set both short-term goals (e.g., for tomorrow) and long-term goals (e.g., for six months' time). Goal setting has been shown to be an effective technique in achieving behaviour change (Epton, Currie, & Armitage, 2017). In order for goal setting to be effective, it is important that goals are well defined, relevant and motivating to the individual (Schut & Stam, 1994). Thus, each participant set their own goals according to the SMART criterion (specific, measurable, achievable, relevant, and time-based) in order to achieve personalised, well defined goals.

Participants were introduced to a mindfulness of thoughts exercise through an audio recording with the script adapted from Russ Harris' Leaves on a Stream (Harris, 2009). The exercise was included as an additional coping strategy to assist with managing uncertainty and anxiety, pain and other mood difficulties.

Summary: Session Five

Session five was conducted a week after session four. The main goals of session five were to assess the wellbeing of the participant, review goals, explore values, discuss the nature and impact of catastrophizing, and introduce the concepts of cognitive restructuring.

Short- and long-term goals set in session four were discussed and reviewed. In session four, participants were asked to set short-term goals, including a goal to achieve in a week's time (i.e., by session five). Discussing whether participants were able to achieve their short-term goals served multiple purposes. Firstly, to keep participants accountable to working toward their goals; secondly, to provide encouragement and positive reinforcement for participants' efforts and achievements; thirdly, to evaluate whether participants' goals were realistic; and fourthly, to discuss setting challenging but achievable goals. Long-term goals were also discussed and adjusted if needed. Participants were encouraged to reward themselves for achieving their goals, although many participants reported that the satisfaction from achieving the goal, in itself, served as an intrinsic reward.

Values-based action is a key principle of Acceptance and Commitment Therapy, with focus on aligning desired and personally meaningful outcomes with behaviours (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). In session five, participants' personal values were explored, in order to determine the degree to which participants were neglecting activities that brought them joy and satisfaction while they were recovering from their surgery. Given

the limited mobility and increased pain following surgery, it was thought likely that participants may become focused on the unpleasant experiences, and decrease the variety of activities that they engaged in. Participants were encouraged, where possible, to pursue activities in line with their values despite their discomfort from TKA, rather than putting these activities on hold until they were recovered. They were encouraged to brainstorm ways to complete activities given their mobility restrictions and pain.

Catastrophizing is a negative thinking style which has been shown to be associated with increased pain perception and poorer post-surgical outcomes (Pavlin, Sullivan, Freund, & Roesen, 2005; Sullivan, Rodgers, & Kirsch, 2001; Wright, Hoang, Sofine, Silva, & Schwarzkopf, 2017). Thus, it was an important topic to include in the intervention. Participants discussed their tendency to catastrophize and were taught cognitive restructuring, a technique used in CBT in which unhelpful thoughts and beliefs are identified, evaluated, and modified (Beck, 1996; Burns & Beck, 1978).

Summary: Session Six

Session six was the final session, conducted a week after session five. The main goals were to assess the participant's wellbeing, review goals, review the participant's progress since session two, and to prepare for ongoing recovery. Checking in on the participant's wellbeing and reviewing goals were included, for the reasons outlined above (please refer to session four and five for rationales).

Therapists reviewed the participant's progress with the aid of the activity logs and questionnaires completed by participants over the course of the intervention (completion of activity logs was set as 'homework' tasks from session two onwards). Activity logs allowed participants to compare their pain levels, mood, and mobility across weeks. Providing

feedback on participant's progress over time aimed to give positive reinforcement to participants who were engaging well with their rehabilitation regimen or motivate participants to engage more in their rehabilitation if their progress was lacking and to have a discussion about barriers to their recovery.

In order to prepare for ongoing recovery, participants discussed their anticipated challenges and any warning signs that indicate that they were not coping, potential beneficial coping strategies, support options, and important activities to continue doing. The discussion was aided using a worksheet in the patient booklet, which was adapted from a "Self-Management Plan" worksheet included in an anxiety management program (Nathan, Correia, & Lim, 2004). The aim of this discussion was to promote the ongoing engagement of participants in their rehabilitation regime, by encouraging engagement in activities that promote good health outcomes, monitoring and management of symptoms, problem solving, and using health care resources which were all important components of effective self-management programs (Sterling, von Esenwein, Tucker, Fricks, & Druss, 2010).

Summary

A six-session manualized CBT program, titled "Psychological Coaching for Knee Replacements" was developed to address the psychological challenges associated with TKA surgery and rehabilitation. The content and structure of the program was informed by the systematic review of similar psychological interventions and the difficulties and issues raised within the interviews reported in the previous chapter. The program aimed to manage unrealistic expectations, address fears, provide support and strategies to manage physical and psychological difficulties, and provide education about TKA and recovery. Strategies and components included in the intervention were evidence-based.

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Chapter Five:

Psychological intervention, and relationships between personality and TKA outcomes: A pilot study

TKA is a cost-effective surgery for relieving pain, restoring stability and motion to the knee, and improving quality of life for patients with end-stage osteoarthritis (Daigle, Weinstein, Katz, & Losina, 2012; Jüni, Reichenbach, & Dieppe, 2006; Losina et al., 2009; Shan, Shan, Suzuki, Nouh, & Saxena, 2015). However, 11% to 19% of patients reported dissatisfaction with their TKA (Anderson, Wixson, Tsai, Stulberg, & Chang, 1996; Baker, van der Meulen, Lewsey, & Gregg, 2007), with many complaining of poor outcomes despite no issues indicated by radiographs and other physical measurements (Brander, Stulberg, & Kirk, 2015).

Psychological factors have been found to account for a significant portion of variance in TKA outcomes (Giesinger, Kuster, Behrend, & Giesinger, 2013), and can influence perception of pain, participation in rehabilitation and other outcomes after TKA (Filardo et al., 2016). Studies have explored various psychosocial predictors of poor outcomes after TKA, including personality, depression, anxiety, stress, catastrophizing, fear of movement, and self-efficacy (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008; Gong & Dong, 2014; Lewis, Rice, McNair, & Kluger, 2015; Qi et al., 2016; Riddle, Wade, Jiranek, & Kong, 2010).

Pre-operative pain catastrophizing has been found to be associated with poor TKA outcomes (Burns et al., 2015; Forsythe et al., 2008; Masselin-Dubois et al., 2013). However, it has been argued that catastrophizing is not an independent construct, and is better viewed as part of mood constructs such as anxiety (Badura-Brzoza et al., 2009; McCracken & Gross,

1993) and depression (Turner, Jensen, & Romano, 2000), and is associated with the personality trait neuroticism (Badura-Brzoza et al., 2009; Goubert, Crombez, & Van Damme, 2004; Ramaesh et al., 2014).

Much of the research looking at the impact of psychological variables on TKA outcomes have focused on transient psychological states. The problem with these psychological variables is that it is difficult to disentangle whether transient psychological states are the cause or effect of the TKA outcomes. It can be argued that decreased levels of anxiety and/or depression after TKA may be attributed to the effectiveness of the surgery in alleviating knee symptoms (Blackburn, Qureshi, Amirfeyz, & Bannister, 2012; Drewett, Minns, & Sibly, 1992; Lopez-Olivo et al., 2011). Conversely, increased levels of anxiety or depression post-surgery may be mood states in response to poorer surgical outcomes. Therefore, investigating personality may obviate this cause effect dilemma as personality measures describe what are thought to be enduring traits which are less determined by life events (Allemand, Zimprich, & Hendriks, 2008). Personality is thought to influence how an individual negotiates and manages life events rather than being reactive to these life events. Hence, increasing our understanding of personality may be of value in attempting to better understand how an individual manages the challenges of major surgery and the associated challenges of rehabilitation.

Neuroticism, a personality trait, has been found to be correlated with poorer outcomes of TKA (Gong & Dong, 2014), and a predictor of knee-related functionality after TKA (Qi et al., 2016). In contrast, extraversion has been correlated with better TKA outcomes (Gong & Dong, 2014), and also appears to predict knee related functionality (Qi et al., 2016). While Qi and colleagues (2016), and Gong and Dong (2014) demonstrated evidence for personality

traits to be associated with TKA outcomes, the measure used by both studies, the Eysenck Personality Questionnaire, classified personality on just three dimensions, namely, extraversion, neuroticism, and psychoticism. It has been shown that a more extensive five-factor model explains more variance in personality than a three-factor model (Draycott & Kline, 1995). Therefore, given the complexity of personality functioning, it would seem potentially beneficial to employ a more extensive measure of personality.

It appears that psychological factors account for a significant portion of variance in TKA outcomes (Giesinger et al., 2013), yet little attention had been paid to systematic management of these psychological variables with few reports of comprehensive interventions designed to facilitate recovery from TKA (Bay, Kuster, McLean, Byrnes, & Kuster, 2018; Dennis, Wylde, Gooberman-Hill, Blom, & Beswick, 2020). The current study aimed to determine the feasibility of a study investigating the impact of a psychological intervention implemented pre- and post-surgery on patient outcomes after TKA. The design of the program was guided by findings from a systematic review (*Chapter two*) (Bay et al., 2018) and interviews with TKA patients (*Chapter three*). A secondary aim of this study was to explore the relationships of five dimensions of personality (i.e., neuroticism, extraversion, openness, agreeableness, and conscientiousness) with TKA outcomes. In addition, the impact of trait anxiety was also explored, as trait anxiety, like personality, is an enduring disposition rather than a transient psychological state. This study's objectives and research questions were:

1. To assess the feasibility of conducting a clinical trial investigating the impact of a psychological intervention on TKA outcomes.
    - Evaluate the recruitment rates via telephone.

- Determine if a random sample was achievable.
- Determine the completion rate of the intervention.
- Evaluate participants' perception of the designed intervention.
- Determine if treatment fidelity can be achieved by different therapists.
- Assess the retention rates with four week and six month follow ups via mail.

2. Which domains of the five-factor personality model and trait anxiety are related to TKA outcomes at six months post-surgery?

Method

Study design

A pilot study with two parallel groups was conducted and reported according to the CONSORT guidelines (Eldridge et al., 2016) for pilot/feasibility trials (see *Appendix H*). Participants were randomised (1:1) into either the control group or intervention group using computer generated random numbers in blocks of 10. There were three time points for data collection: before TKA (baseline; time 1), four weeks after TKA (time 2), and six months after TKA (time 3). The control group received treatment as usual and questionnaires in the mail at all time points. The intervention group completed a six-session psychological program between time 1 and time 2, in addition to treatment as usual (i.e. usual pre-surgery education delivered by the hospital, in-patient physiotherapy, in-patient nurse care, and follow ups with surgeons). In public hospitals in Western Australia, TKA patients have a minimum length of stay in hospital of three days, and rehabilitation planning is coordinated by the multidisciplinary team and initiated during pre-admission clinic (Western Australia

Department of Health, 2010). Rehabilitation plans may include physiotherapy visits in patients' homes (Western Australia Department of Health, 2010).

The intervention group completed their baseline measures at the end of the first session (i.e., two weeks before surgery), and their time 2 measures at the end of the final session (i.e., four weeks after surgery). The intervention group completed follow up (time 3) questionnaires in the mail six months after surgery. In order to reduce demand effects, participants in the intervention group completed time 1 and 2 questionnaires without the therapists in the room, and time 3 follow up questionnaires were completed via mail. Participants were contacted if their questionnaires were not received in the mail within two weeks of the date specified in a letter.

Information sheets were mailed to patients on the waitlist for TKA at a large public hospital with participants then recruited over the phone. Information sheets were also distributed by secretaries at a private orthopaedic clinic, and those who indicated that they were interested in participating were then contacted over the phone to discuss the study. Patients were contacted in the order that appeared on the waitlists (i.e., those with surgeries sooner were contacted first). Patients were told that they had equal chances of being allocated to either group, and needed to be willing to be part of the intervention group in order to participate. Participants were only told which group they were allocated to once they verbally consented to participate. The author of this thesis generated the random allocation sequence, enrolled the participants, and assigned the participants to the intervention. This study attempted to recruit as many participants as possible over a period of twelve months.

In March 2019, it was noted that three control group participants had withdrawn from the study and eight participants had not returned baseline questionnaires despite reminders

from researchers. Due to the high attrition rate in the control group (n = 11), participants were recruited into the study in a non-randomized fashion (i.e., participants were allocated to the control group in a row) to balance the numbers in each group in March and April 2019 and recruitment then continued in a randomized fashion following this (i.e., according to the computer generated numbers).

Participants

Patients who were on a waitlist to undergo TKA were invited to participate. Participants needed to be over the age of 18 years, and undergoing primary TKA (i.e., the knee joint is replaced with an implant; including unilateral TKA, staged bilateral TKA and simultaneous bilateral TKA). Patients were invited to participate regardless of whether they had undergone TKA previously. Patients were excluded if they were non-English speakers, and/or had an illness or disorder that would have impeded their ability to participate in the program (e.g., dementia).

Intervention design

Participants in the intervention group completed the Psychological Coaching for Knee Replacement program, which was a six-session manualised cognitive behaviour therapy program for TKA conducted by 12 provisional psychologists at the University of Western Australia. The provisional psychologists worked under the supervision of Clinical Psychologists with more than 15 years' experience in the field of clinical psychology. Please refer to *Appendix B* for a copy of the therapist manual for the intervention.

Participants attended sessions with psychologists individually. Sessions commenced approximately two weeks prior to TKA and concluded approximately four weeks after TKA. Sessions were conducted either at the University of Western Australia, Perth Orthopaedic and

Sports Medicine Clinic, Hollywood Private Hospital, Sir Charles Gairdner Hospital, or in participants' homes. After commencement of the intervention, we recognized that many participants identified transport as a barrier to participation in the intervention, therefore home-visits were offered. However, this was not offered as a standard practice; participants were encouraged to seek help with transport from friends and family, and home visits were only offered when there were no alternatives.

Measures

Participants' demographic details were collected from a self-report questionnaire. Information collected included age, gender, operated leg (right/left), highest education level, and number of comorbidities (excluding osteoarthritis in other joints).

At baseline (time 1), personality traits were measured using the NEO Five-Factor Inventory-3 (NEO-FFI-3), and trait anxiety was measured using the State-Trait Anxiety Inventory (STAI) form Y-1 (Spielberger, 1983). Personality tends to be relatively stable and enduring over time (Allemand et al., 2008) with the NEO-FFI-3 shown to have robust test-retest reliability over 30 months (Murray, Rawlings, Allen, & Trinder, 2003), and trait anxiety from the STAI has been shown to be relatively stable over 24 months (Usala & Hertzog, 1991).

Knee-related measures included pain, knee symptoms, functionality in activities of daily living (ADL) and quality of life (QOL); subscales of the Knee Osteoarthritis Outcome Score (KOOS) (Roos, Roos, Lohmander, Ekdahl, & Beynnon, 1998), awareness of the knee, measured using the Forgotten Joint Score (FJS-12) (Behrend, Giesinger, Giesinger, & Kuster, 2012); and range of motion (ROM), measured using photographs at maximum flexion and universal goniometry. ROM was defined by the angle (in degrees) between the tibia and

femur at maximum flexion of the leg. ROM was measured three times with a goniometer for each photograph, and the average was used in the data analysis. An average ROM taken from left and right legs was calculated for participants undergoing bilateral TKA at each time point. The KOOS, FJS-12 and ROM measures were administered at all time points. Table 1 summarises the administration of measures over the three time points.

NEO-FFI-3. The 60-item measure classifies personality on five dimensions: neuroticism, extraversion, openness, agreeableness and conscientiousness (McCrae & Costa, 2010). Neuroticism was defined as the general tendency to experience negative affect and psychological distress (McCrae & Costa, 2010). Extraversion was defined as being sociable, liking the company of large groups of people, being assertive, active, and talkative (McCrae & Costa, 2010). Openness was defined as willingness to experience new things and it involves an active imagination, aesthetic sensitivity, attentiveness to feelings, preference for variety, intellectual curiosity and independence of judgement (McCrae & Costa, 2010). agreeableness was defined as the interpersonal tendency to be altruistic, sympathetic, and eager to help others (McCrae & Costa, 2010). Conscientiousness was defined as being careful and diligent, and involves orderliness and industriousness (McCrae & Costa, 2010). The NEO-FFI-3 has been shown to be a reliable and valid measure of personality; Cronbach alphas for neuroticism = .87, extraversion = .80, openness = .77, agreeableness = .75, and conscientiousness = .85 (Murray et al., 2003). T-scores were used in this study in order to pool data between genders, as there were separate norms for males and females (McCrae & Costa, 2010).

STAI. The STAI has 40 items, 20 of which measure anxiety as a trait (i.e., how anxious someone generally is), and 20 of which measure anxiety as a state (i.e., how anxious

someone was feeling in that moment) (Spielberger, Gorsuch, & Lushene, 1970). It has been shown to be valid and reliable (Barnes, Harp, & Jung, 2002), with an ability to discriminate between low and high stress situations (Metzger, 1976). As would be expected, test-retest reliability was much stronger for trait anxiety (r = .97) than for state anxiety (r = .45) (Metzger, 1976). Only data from the trait anxiety scale was analysed in this study. Raw scores were analysed as there were no appropriate norms for TKA patients in the STAI manual (i.e., norms for general medical and surgical patients were only available for males). Raw scores range between 20 and 80 for each subscale.

KOOS. The KOOS is a 42-item measure of physical and functional symptoms of knees, using five subscales: Pain, Symptoms, Functionality in ADL, Sport/Recreation, and Knee-related QOL (Roos et al., 1998). Each item is rated on a five-point Likert scale. Scores from each subscale are transformed to obtain a score out of 100. Higher transformed scores indicate better outcomes. The KOOS was validated for the use with patients undergoing TKA, demonstrating good internal consistency; Intraclass Correlation Coefficients: Pain = .97, Symptoms = .94, ADL = .93, Sport/Recreation = .78, QOL = .88 (Roos & Toksvig-Larsen, 2003). As most participants reported not engaging in sport before or after TKA, therefore scores on the Sport/Recreation subscale were not interpreted in this study.

FJS-12. The FJS-12 is a 12-item measure of patients' unintended awareness of a joint (e.g., knee) during activities of everyday life (Behrend et al., 2012). Each item is rated on a five-point Likert scale. The FJS-12 does not have subscales; a composite score of items are calculated and are subsequently transformed to obtain a score out of 100. Higher final scores (transformed) indicate better outcomes (i.e., less awareness). The FJS-12 was found to have high internal consistency Cronbach's alpha = .95 (Behrend et al., 2012). The FJS-12 reflects

an individual's awareness of knee symptoms and functioning in activities of daily living, thus is a good overall measure of TKA outcome (Behrend et al., 2012). As patients with healthy joints usually have little to no awareness of their joints while performing activities of daily living, an ideal outcome following TKA would be for patients to "forget" about having an artificial joint while performing everyday activities (Behrend et al., 2012).

Participants in the intervention group were asked to complete the Robin Winkler Clinic Client Evaluation of Service Questionnaire at the end of session six (final session of the intervention). The evaluation questionnaire asked about participants' satisfaction with the service received, whether their needs were met, improvement of symptoms, willingness to use strategies learned, and confidence in recommending the service to others. Items were rated on four, five and ten point Likert scales. Participants were also given the opportunity to leave comments. A copy of the questionnaire is displayed in *Appendix E* at the end of this thesis.

Table 1

Time points at which measures were administered

Time point	Questionnaire/Tool
Baseline (Pre-TKA; time 1)	Demographics, NEO-FFI-3, STAI, KOOS, FJS-12, photograph of maximum ROM
Four weeks post TKA (time 2)	KOOS, FJS-12, photograph of maximum ROM
Six months post TKA (time 3)	KOOS, FJS-12, photograph of maximum ROM

Notes: NEO-FFI-3 = Five factor personality inventory, STAI = State Trait Anxiety Inventory, KOOS = Knee Osteoarthritis Outcome Score, FJS-12 = Forgotten Joint Score, ROM = Range of motion

Treatment Fidelity

All sessions were video or audio recorded, and one recording from each therapist (n = 12) was randomly selected for fidelity check using computer generated random numbers. Recordings were reviewed to ensure that goals were achieved for each session using the checklist in the therapist manual. Please refer to *Chapter four* and *Appendix B* for a more detailed outline of the intervention and goals for each session. Additionally, therapists attended weekly supervision with experienced Clinical Psychologists while conducting sessions to summarise each session conducted, and to discuss difficulties that arose.

Data Analysis

All data analyses were completed using SPSS version 26. Intention to treat principles (Montori & Guyatt, 2001) were followed in this study. Little's Missing Completely At Random (MCAR) test was conducted to explore whether data was missing at random, and the multiple imputation using estimation maximisation method was used to impute missing data in order to have a complete set of data to explore correlations between personality dispositions and TKA outcomes at six months.

Pearson correlations were conducted to examine the relationships between personality dispositions (i.e., NEO-FFI-3 subscales and trait anxiety) and TKA outcomes (i.e. ROM, pain, knee symptoms, ADL, QOL and awareness of the knee) at the six month follow up. Data from both groups were pooled for the correlational analyses.

Descriptive data about participant demographics, personality scores and TKA outcomes at the six month follow up were obtained for each group.

Ethics Approvals and Registration

Ethics approvals were obtained from the Sir Charles Gairdner Human Research Ethics Committee, Hollywood Private Hospital Research Ethics Committee, and the University of Western Australia Human Research Ethics Office. This study was registered on the Australian New Zealand Clinical Trials Registry (Reference no. ACTRN12618000702213).

Results

Participants

Recruitment for the study occurred between July 2018 and June 2019. A total of 171 TKA patients were contacted to participate in the study. Overall, 67 (39.18%) patients agreed to participate in the study. Thirty-seven participants were allocated to the control group, but 15 (40.54%) control group participants were excluded due to withdrawal from the study (n = 4; 10.81%) or failing to return questionnaires (n = 11; 29.73%). Thirty participants were allocated to the intervention group, but eight (26.67%) intervention group participants were excluded from the study. Six (20.00%) intervention group participants withdrew from the study prior to participation despite initially verbally consenting to enrol in the study over the phone, while two (6.67%) intervention group participants withdrew from the study after commencing the intervention program. One participant from the intervention group withdrew from the study after completing the first session (time 1) due to having to travel a long distance without a car, so data collected from this participant was excluded. One participant in the intervention group withdrew from the study due to family reasons after completing the fourth session and data collected from this participant was excluded.

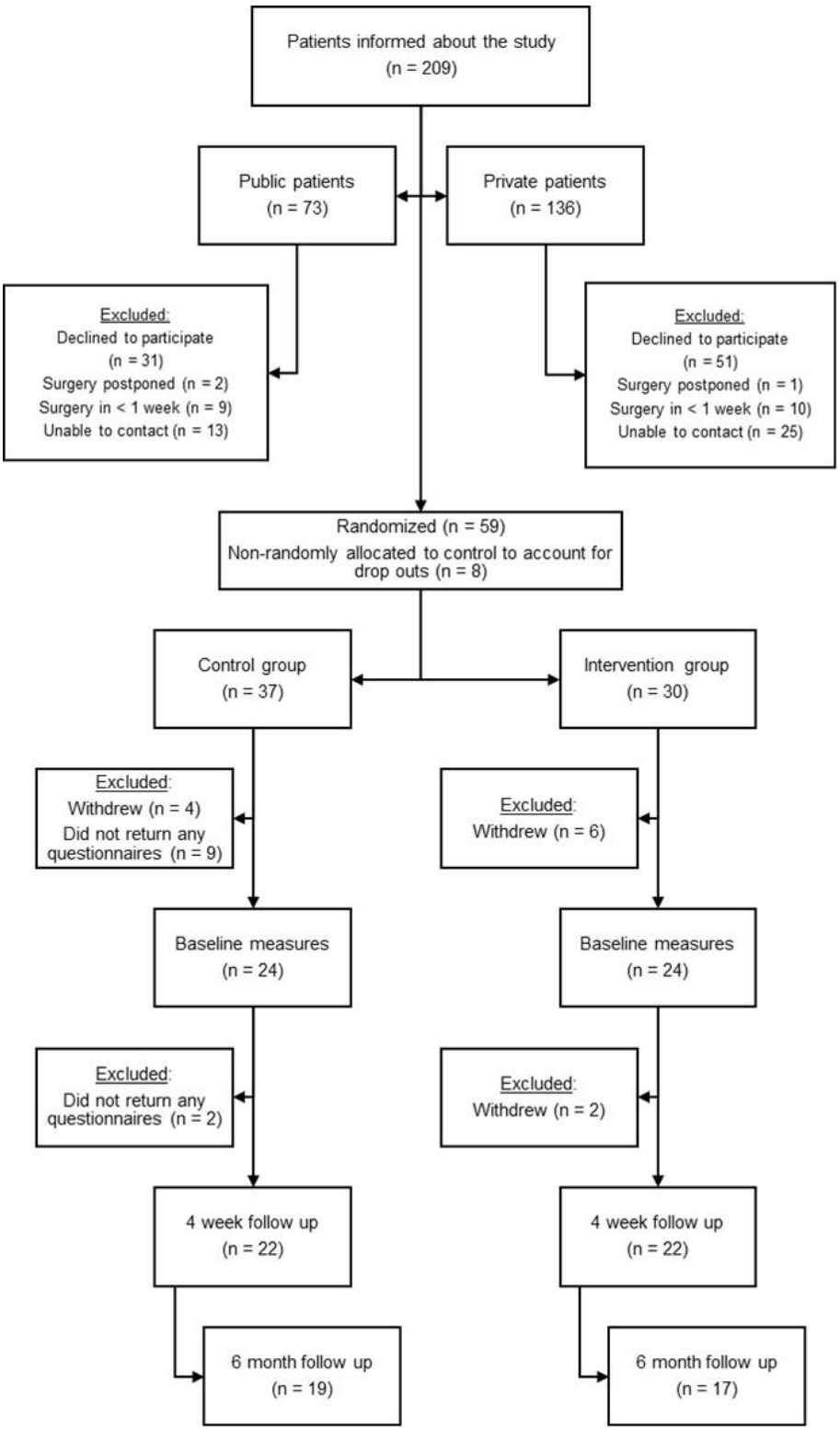
In the end, 44 participants (65.67%) were included in the analyses for this study, 22 were in the intervention group and 22 were in the control group; 24 were females and 20

were males, with a mean age of 66.39 years (SD = 7.30 years). Figure 1 summarizes the process of participant recruitment, allocation, and data collection points. Means and standard deviations of ROM, KOOS and FJS-12 for each group are shown in *Appendix G*.

Five participants, four from the intervention group and one from the control group reported medical/surgical complications during the first six months. Two participants required further knee surgery (e.g., debridement, wash outs, tendon reconstruction), one patient injured their hip, one required ankle surgery, and one participant was diagnosed with cancer (unrelated to the knee). Four of these participants continued their participation in the study despite their complications, while one participant did not return follow up questionnaires for time 3. Data collected from all five participants were included in the analysis where possible.

Figure 1

Summary of patient recruitment, allocation and data collection



Missing data

Table 2 summarises the missing data. Little's MCAR test suggested that data were missing completely at random, χ^2 (223) = 201.84, p = .842. Missing data was imputed using multiple imputation expectation maximization, with five imputations. ROM at time 3 had the most missing data, with 27.27% missing. As data was missing completely at random and less than 50% of data was missing, it was therefore acceptable to impute all missing values (Scheffer, 2002).

Table 2

Missing data summary

Measure	Number of data points missing	Group data was missing from	Percentage (%) missing
NEO-FFI-3	0	-	0
STAI	1	Intervention = 1	2.27
KOOS (time 1)	3	Control = 3	6.82
KOOS (time 2)	1	Intervention = 1	2.27
KOOS (time 3)	5	Intervention = 3 Control = 2	11.36
FJS-12 (time 1)	3	Control = 3	6.82
FJS-12 (time 2)	0	-	0
FJS-12 (time 3)	5	Intervention = 3 Control = 2	18.18
Range of motion (time 1)	4	Control = 4	9.09
Range of motion (time 2)	6	Control = 6	13.64
Range of motion (time 3)	12	Intervention = 7 Control = 5	27.27

Descriptive statistics

Descriptive statistics for participant demographics are displayed in *Appendix G*. The means, standard deviations and ranges of the NEO-FFI-3 subscales and STAI (trait anxiety) for each group are also displayed in *Appendix G*.

Personality

Overall, participants tended to score in the low range (i.e. T-scores 35 to 44; McCrae & Costa, 2010) for neuroticism (mean = 41.55, median = 42.00), average ranges (i.e. T-scores 45 to 55; McCrae & Costa, 2010) for extraversion (mean = 53.26, median = 55.00), openness (mean = 53.69, median = 54.00), and agreeableness (mean = 53.26, median = 54.00). Participants tended to score in the elevated range (high, T-scores 56 to 65; McCrae & Costa, 2010) for conscientiousness (mean = 57.10, median = 56.00). On the STAI, participants' scored in the low average range (mean = 29.61, T-score = 37.00) for trait anxiety.

Treatment fidelity

Working from a checklist of goals to be met for the respective sessions (please refer to *Appendix B* for checklists), a review of 12 randomly selected recordings indicated that topics to be covered in each session were adequately and appropriately addressed.

Of the 22 participants in the intervention group, 21 participants (95.45%) attended all six sessions. One participant attended only four sessions due to time limitations (i.e., planned holidays) but all session goals were achieved for this participant over the four sessions, as content from two sessions were delivered during extended sessions (i.e., sessions one and two combined, sessions four and five combined). Home visits were conducted for seven participants (31.82%) following TKA due to their lack of access to transport.

Evaluation of the intervention program

Twenty-one participants from the intervention group completed the Robin Winkler Clinic Client Evaluation of Service Questionnaire, however two participants did not complete all items on the questionnaire, therefore, data from these participants were included where possible. Overall, responses on items were positive, as many participants indicated high levels of satisfaction with the program and improved ability to cope.

Twenty of the twenty-one participants (95.00%) rated the quality of service provided to be "excellent", and one (5.00%) rated it to be "good". Twenty of the twenty-one participants (95.00%) were "very satisfied" with the amount of help they received, and one (5.00%) was "mostly satisfied". Twenty of twenty participants (100.00%) indicated that the program met their expectations; one participant noted that they had not known what to expect and thus did not choose a response. Twelve of the twenty-one participants (57.10%) indicated that "almost all needs were met" (highest rating possible), eight (38.10%) indicated that "most needs were met", while one (4.80%) indicated that "only a few of my needs were met". Eight of nineteen participants (42.10%) indicated that their ability to cope with symptoms had become "very much better" (highest possible rating), seven (36.80%) indicated "much better", and four (21.10%) indicated "better"; data for two participants were missing. Twelve of nineteen participants (63.20%) indicated that they were "extremely willing" to use strategies taught, six (31.60%) were "very willing", one (5.30%) was "willing"; data for two participants were missing. Nineteen participants indicated that they were confident in recommending the service to friends, confidence levels ranged between 60-100% confidence; 13 (65.00%) indicated "100%", one (5.00%) indicated "90%", four (20.00%) indicated "80%", and one (5.00%) indicated "60%"; data were missing for two participants. Seventeen

of nineteen participants (89.50%) participants rated their general satisfaction of the service as "very satisfied" (highest rating), and two (10.50%) rated their general satisfaction as "mostly satisfied"; data for two participants were missing. Responses on the items about symptom improvement (items 5 and 7) were not interpreted, as symptoms experienced by participants during the majority of the program were surgically related.

Eleven participants wrote comments about the program, all indicating that the program was helpful for them. Some examples included: "A very helpful clinic, some very good ideas offered for recovery after surgery. Thank you for a most helpful service."; "A very useful experience in management of physical and emotional side of knee replacement surgery."; "At the beginning of the course, I was very anxious about the operation. Doing the first exercises helped me with my nerves and anxiety. Listening to the tapes of mindfulness was very calming."; "I have found the program excellent and tell all my friends about it. Should be available to everyone!"; "I had no expectations leading into this service. I have found it insightful and helpful in my recovery journey."

Correlations: Personality dispositions and TKA outcomes

To explore the relationships between personality dispositions and TKA outcomes, correlations between neuroticism, extraversion, openness, agreeableness, conscientiousness, and trait anxiety, and TKA outcomes (i.e., ROM, KOOS subscales, and FJS-12) at four weeks and six months post-surgery were conducted. Correlations between personality traits and TKA outcomes at six months post TKA are depicted in Table 3.

Table 3

Correlations between personality dispositions and TKA outcomes at six months post-surgery

		Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness	Trait Anxiety
ROM	r	.01	-.17	.05	-.25	-.16	-.26
(time 3)	*p*	.956	.266	.766	.107	.289	.082
Pain	r	-.22	.29	.41**	.33*	.17	-.40**
(time 3)	*p*	.161	.060	.006	.031	.263	.007
Symptoms	r	-.30*	.30	.27	.50**	.10	-.35*
(time 3)	*p*	.048	.051	.079	.001	.528	.021
ADL	r	-.15	.38*	.14	.31*	.12	-.21
(time 3)	*p*	.345	.011	.360	.042	.444	.161
QOL	r	-.24	.47**	.06	.26	.19	-.19
(time 3)	*p*	.121	.001	.692	.087	.213	.223
FJS-12	r	-.32*	.51**	.22	.29	.25	-.31*
(time 3)	*p*	.037	.000	.149	.059	.101	.037

*Note: * indicated p < .05; ** indicated p <.01*

All TKA outcomes except ROM were significantly associated with at least one personality trait at six months post-surgery. Neuroticism was correlated negatively with KOOS symptoms scores (r = -.30, $p < .05$) and FJS-12 scores (r = -.32, $p < .05$) at six months post-surgery, indicating that higher levels of neuroticism were associated with poorer reported outcomes (higher scores on KOOS and FJS-12 scales indicate more positive outcomes). Extraversion was correlated positively with KOOS ADL scores (r = .38, $p < .05$), QOL scores (r = .47, $p < .01$), and FJS-12 scores (r = .51, $p < .01$) at six months post-surgery, indicating that higher levels of extraversion were associated with better knee function, QOL and less awareness of the knee during daily activities. Openness was positively correlated with KOOS pain scores at six months post-surgery, r = .41, $p < .01$, indicating that higher

levels of openness was associated with less pain. Agreeableness was positively correlated with KOOS pain scores (r = .33, $p < .05$), symptoms scores (r = .50, $p < .01$) and ADL scores (r = .31, $p < .05$) at six months post-surgery, indicating that higher levels of agreeableness was associated with less pain, symptom complaints, and better knee function. Trait anxiety (STAI) was negatively correlated with KOOS pain scores (r = -.40, $p < .01$), symptoms scores (r = -.35, $p < .05$) and FJS-12 scores (r = -.31, $p < .05$) at six months post-surgery, indicating that higher levels of trait anxiety was associated with more pain, symptom complaints, and awareness of the knee in daily activities. Conscientiousness was the only personality disposition that was not significantly correlated with any TKA outcomes.

Discussion

Previous studies have found various psychological factors to be associated with outcomes of TKA (Filardo et al., 2016; Giesinger et al., 2013; Lewis et al., 2015). However, there has been a lack of comprehensive psychological interventions designed to facilitate recovery from TKA (Bay et al., 2018; Dennis et al., 2020). Most of the studies of psychological variables have tended to focus on mood symptoms (e.g., depression, anxiety) as predictors of TKA outcomes. However, mood symptoms could either influence or be influenced by TKA outcomes (Blackburn et al., 2012; Drewett et al., 1992; Lopez-Olivo et al., 2011), so the cause effect relationships are difficult to disentangle. Investigating personality would largely obviate the cause-effect dilemma, as personality traits are more enduring and less likely to be reactive to life events (Allemand et al., 2008). This study aimed to explore the following objectives and questions:

1. To assess the feasibility of conducting a clinical trial investigating the impact of a psychological intervention on TKA outcomes.

- Evaluate the recruitment rates via telephone.
- Determine if recruiting a random sample was achievable.
- Determine the completion rate of the intervention.
- Evaluate participants' perception of the designed intervention.
- Determine if treatment fidelity can be achieved by different therapists.
- Assess the retention rates with four week and six month follow ups via mail.

2. Which domains of the five-factor personality model and trait anxiety are related to TKA outcomes at six months post-surgery?

Recruitment rate

We were able to recruit about one-third of TKA patients who were informed of the study. Many patients indicated that they had declined to participate due to the time commitment involved (i.e. to attend six sessions of the intervention, and to complete follow up questionnaires), some simply identified that they were not interested in participating in an intervention study of this nature, and others identified practical difficulties such as a lack of transport to the university clinic or hospital as a barrier to participating. The feedback given by patients suggest that future randomized control trials may wish to consider other modes of delivery (e.g. online, via telephone) in order to increase recruitment rates. The number of follow-ups should also be considered in future trials, as patients indicated that time commitment was a barrier to participation. Recruitment rates may also be improved if studies were incorporated to usual care procedures of a hospital; for example, having nurses/surgeons explain the rationale of the study after the patient consents to undergo TKA, and have enrolments and allocation to control and intervention groups occur at the surgeon's clinic,

rather than receiving a phone call from researchers perceived to be external to their usual hospital/surgical care after receiving information about the study via information sheets.

Interviews with TKA patients in *Chapter three* (*study two*) suggested that patients valued the idea of having psychological interventions to aid recovery from TKA. However, it is possible that not all TKA patients need to receive a full psychological intervention, and may explain why many declined to participate in our study. In order to increase recruitment rates, there may be a need for a tiered approach to the psychological intervention (i.e. having different programs with different target populations, ranging from brief interventions to more comprehensive interventions). For example, patients with psychological vulnerabilities such as high levels of anxiety, depression or neuroticism may be offered more comprehensive interventions, while those with low psychological vulnerabilities may be offered more brief interventions.

Randomization

A random sample was unable to be obtained in this study. The retention rate of participants in the control group at baseline was poorer than in the intervention group (i.e. drop outs after being enrolled in the study). The attrition rate of the control group was unsurprising as the control group did not benefit from participation as they still received treatment as usual from the hospitals. Results show that future studies will need to consider ways to keep the control group engaged in the study. For example, studies may consider having control group participants complete questionnaires at all time points (times 1, 2 and 3) while waiting to see their surgeons in surgical clinics (e.g. in hospital or in their private clinics).

Completion of the intervention

Results showed an excellent completion rate of the intervention program. Apart from the two participants that dropped out of the study, and one participant who attended four sessions (although all six session goals were achieved), all other participants in the intervention group completed all six sessions. The high completion rate of the intervention program indicates good feasibility for conducting comprehensive psychological interventions that begin prior to TKA and continue for the first few weeks after TKA.

We recognized that a lack of transport to complete face-to-face sessions was a barrier to participation in the study, therefore home visits were offered to participants who were unable to attend the university clinic or hospital. Future studies implementing face-to-face sessions may consider home visits during the first few weeks post-surgery as an effective strategy to reduce barriers to participation, however other modes of delivery may also be considered (e.g. online or telephone).

Participants' perceptions of the intervention

Feedback received from the intervention group in this study was very positive, as the majority of participants rated the intervention to be "excellent", and that they were "very satisfied" with the help received. Many participants commented that they had found the program "very helpful" in their recovery from TKA. Given that the intervention was well received by participants, further investigation of the effectiveness of the intervention in a randomized controlled trial would be warranted as the feasibility of conducting such interventions was supported by this study; however, future studies will need to navigate the challenges of recruitment of participants.

Treatment fidelity

Fidelity checks showed that twelve provisional psychologists were able to attain session goals. Results suggest that future studies can use multiple post-graduate trained therapists, as those in our study were able to deliver the intervention as specified by the intervention manual, and regular supervision sessions with experienced clinical psychologists were adequate to attain treatment fidelity. Results also suggest that the intervention manual was adequately detailed to achieve treatment fidelity and supported the use of the manual in conducting the intervention. Overall, this study showed that it was feasible to conduct a psychological intervention using the designed manual in *Chapter four*.

Retention at follow ups

The retention rate of participants over a period of six months of follow up was more than 85%. Results indicated that data was missing at random, indicating that there were no systematic factors associated with the missing data. Results indicated that it is feasible for future studies to complete follow up questionnaires via mail, with researchers contacting participants if questionnaires were not received in the mail within two weeks of the date specified in a letter. Future studies may also consider administering questionnaires online to reduce the need for participants to go to a post-box/office to return questionnaires (i.e. reducing barriers to participation).

However, it was noted that relying on participants to send a photograph of their knee at maximum flexion for ROM measurements was an unreliable method of data collection, as there were more missing data for ROM measures than questionnaires at all time points (i.e. participants were not sending their photographs despite completing questionnaires). This unreliability was highlighted by participants in the intervention group; there were no missing

data at time 2 (i.e. four weeks post-surgery) for ROM measures as they were collected by therapists during the final session of the intervention program. At time 3, about a third of intervention group participants had not returned ROM measures. Future studies need to consider other ways of collecting ROM measurements, for example, having ROM measurements collected when patients attend follow up appointments at the hospital.

Conclusions: Feasibility

This study showed that it is feasible to conduct a clinical trial to evaluate the effectiveness of the designed intervention. The completion rate of the intervention, and treatment fidelity, and retention rates at follow ups were adequate. Participants indicated that they had positive experiences with the intervention program. However, recruitment rates and retention of participants in the control group at baseline were poor, and our attempts to balance participant numbers in each group resulted in a non-random sample. Future studies need to consider reducing the barriers to participation, for example by considering other modes of delivery (e.g. online, telephone) and offering home visits. It is not feasible to attain ROM measurements by relying on participants to send a photograph of their knee at maximum flexion. Future research may consider having ROM measurements collected when patients attend follow up appointments at the hospital.

Which domains of the five-factor personality model and trait anxiety are related to TKA outcomes at six months post-surgery?

Results indicated that higher levels of extraversion, openness, agreeableness, and lower levels of neuroticism and trait anxiety were associated with better TKA outcomes at six months post-surgery. However, conscientiousness was not significantly correlated to any TKA outcomes at six months post-surgery.

Trait Anxiety

Trait anxiety is defined as the general tendency to experience symptoms of anxiety; it differs from transient or state anxiety which may fluctuate in context of life experiences (Spielberger & Rickman, 1990). This study showed that higher levels of trait anxiety were associated with higher pain ratings. This study supported previous findings about the relationships between trait anxiety (Ayers, Franklin, Trief, Ploutz-Snyder, & Freund, 2004; Bierke & Petersen, 2017; Brander, Gondek, Martin, & Stulberg, 2007) and TKA outcomes.

Anxiety is an emotion associated with perceived threat to one's well-being and one's ability to exercise control over these perceived threats (Bandura, 1988). Research has shown a multidimensional interaction between anxiety, stress, and coping (Endler & Kocovski, 2001). One study reported that higher levels of trait anxiety was associated with passive coping styles (i.e., using maladaptive strategies such as denial and mental disengagement), while lower levels of trait anxiety were associated with active coping styles (i.e., use of problem-solving) (Villada, Hidalgo, Almela, & Salvador, 2016). It is possible that TKA patients with lower levels of trait anxiety have better TKA outcomes than those who have higher levels of trait anxiety due to these associated coping styles; future research should measure coping styles to better understand the relationships between trait anxiety and TKA

outcomes. Future studies should investigate trait anxiety rather than state anxiety in order to obviate the cause effect dilemma between mood states and TKA outcomes.

Neuroticism

Neuroticism can be defined as the general tendency to experience negative affect and psychological distress (McCrae & Costa, 2010). Results showed that higher levels of neuroticism were associated with more knee symptoms and awareness of the knee. This study supported previous findings about the relationships between neuroticism (Gong & Dong, 2014; Qi et al., 2016) and TKA outcomes, and is in line with the findings of a recently published study that investigated a five-factor model of personality and found neuroticism to be a predictor of patient reported knee stiffness and function one year after surgery (Belford et al., 2020).

Higher levels of neuroticism have been found to be associated with passive coping strategies such as wishful thinking, withdrawal, and emotion-focused coping (Connor-Smith & Flachsbart, 2007). Individuals with high levels of neuroticism have been found to make higher threat appraisals during stressful events than those with lower levels of neuroticism (Schneider, Rench, Lyons, & Riffle, 2012), which was in keeping with our finding that higher levels of neuroticism were associated with more reported knee symptoms and awareness of the knee six months post-surgery. It is likely that individuals with high levels of neuroticism appraise their knee symptoms as more threatening than those with low levels of neuroticism, and therefore pay more attention to their knee. Future studies should explore the relationships between threat appraisals of knee symptoms after TKA and neuroticism, as findings will provide evidence for whether cognitive restructuring and attention training components should be included in psychological interventions.

Extraversion

Extraversion can be defined as being sociable, liking the company of large groups of people, being assertive, active, and talkative (McCrae & Costa, 2010). This study showed that higher levels of extraversion were associated with better functioning in ADL, QOL and associated with less awareness of the knee.

Extraverted individuals are more likely than introverted individuals to engage socially. This more social external focus may serve to distract from physical symptoms or limitations, resulting in better QOL and less focus on, and awareness of the knee. High scorers on extraversion are more likely to seek social interaction and in turn derive enjoyment from this social engagement, which could explain their higher QOL scores. On the other hand, introverted individuals are less likely to engage in social activities even if their body has recovered from the surgery and may be more inclined to focus on their physical symptoms and difficulties.

A study showed that extraverted individuals were more likely than introverted individuals to use social supports as an emotion regulation strategy (Kokkonen & Pulkkinen, 2001). Another study showed that extraverted individuals were more likely to follow through on intent to exercise than introverted individuals (Rhodes, Courneya, & Jones, 2003). Given Rhodes and colleagues' (2003) finding, it is possible that extraverted TKA patients were more likely to adhere to the rehabilitation exercises than introverted TKA patients; future studies may need to measure adherence to rehabilitation and social engagement in order to better understand the relationships between extraversion and TKA outcomes.

Openness

This thesis showed that higher levels of openness were associated with less pain six months after TKA. An unpublished doctoral thesis also reported that higher levels of openness was associated with better TKA outcomes (Gibson, 2007).

Openness can be defined as an individual's willingness to experience new things; it involves an active imagination, aesthetic sensitivity, attentiveness to feelings, preference for variety, intellectual curiosity and independence of judgement (McCrae & Costa, 2010). It is possible that individuals with higher levels of openness tend to have better outcomes as they are attentive to their internal states and are more likely to try/use a variety of coping strategies. On the other hand, those with low levels of openness are less likely to pay attention to their internal states and therefore be unable to identify their needs and less willing to try unfamiliar coping strategies. One study showed that individuals with higher levels of openness tended to take direct action and engage in problem solving in order to overcome difficulties (Bouchard, 2003).

Surgery is associated with physiological and psychological stress (Salmon & Hall, 1997). A study by Williams, Rau, Cribbet and Gunn (2009) showed that higher levels of openness were associated with resilience to stressful events. They also found that openness moderated the relationship between stress and sleep, where individuals with lower levels of openness experienced poorer quality sleep when experiencing stressful life events (Williams et al., 2009). Sleep plays an important part in regulating biological and physiological functions, and can impact skeletal muscle metabolism (Dattilo et al., 2011). It is possible that individuals with higher levels of openness have better TKA outcomes than those with lower levels of openness due to their ability to recover faster as they have better quality sleep during

the first few weeks of recovery, which had been identified as a challenging period by participants in interviews (*Chapter three*). Further studies are needed to explore the relationship between openness and TKA outcomes, and if there is a significant relationship it would be useful to better understand the mechanisms that underpin this relationship in order to incorporate helpful strategies into interventions.

Agreeableness

This study showed that higher levels of agreeableness were associated with less knee symptoms six months post-surgery. Findings in this thesis were in keeping with a recent study that showed agreeableness to have an inverse relationship with knee stiffness one year following TKA (Belford et al., 2020).

Agreeableness can be defined as the interpersonal tendency to be altruistic, sympathetic, and eager to help others (McCrae & Costa, 2010). In contrast, disagreeable individuals tend to be egocentric, uncooperative, and sceptical (McCrae & Costa, 2010). A study by Boyce & Wood (2011) showed that agreeableness was related to how well patients adjusted to disability, where more agreeable patients had higher life satisfaction than less agreeable patients. It has been hypothesized that agreeable patients were more likely to follow advice of health professionals and uphold social conventions, which resulted in more healthy behaviours (Ingledew & Brunning, 1999). It is possible that for a range of reasons, agreeable individuals were better able to adapt to difficulties.

The presence of significant relationships in self-report measures and the lack of significant relationships with an objective outcome (i.e., ROM) may highlight the possibility that demand effects were at play with subjective reports. It is possible that the relationship between agreeableness and TKA outcomes in our study could be attributed to a demand

effect, as agreeable individuals tend to be eager to please others, and all but one of the outcome variables in the current thesis relied on self-report (Costa, McCrae, & Dye, 1991; Crowe, Lynam, & Miller, 2018; McCrae & Costa, 2010). Future studies may choose to focus on objective measures of TKA outcomes when investigating agreeableness, to account for demand and social desirability effects.

Conscientiousness

Conscientiousness was not found to be significantly correlated to TKA outcomes at six months post-surgery, however it was noted that the sample of patients had elevated levels of conscientiousness. Previous studies have found that higher levels of conscientiousness were associated with better health outcomes, such as longevity (Fry & Debats, 2009, Kern & Friedman, 2008) and healthier behaviours (Bogg & Roberts, 2004). Given that our small sample of participants tended to have high levels of conscientiousness, further studies are needed to explore the relationships between conscientiousness and TKA outcomes.

Conclusions: Personality

Personality traits may influence the way patients cope in the longer term, after the body has had time to recover from the acute effects of the surgery. It is likely that personality traits have moderating effects on other personality traits. For example, extraversion has been found to be associated with increased frequency, intensity and duration of positive emotions, while neuroticism has been found to be associated with increased frequency of negative emotions (Verduyn & Brans, 2012). As discussed above, Extraverted individuals tend to have increased social engagement (Kokkonen & Pulkkinen, 2001) and may be more likely to follow through with their intent to exercise (Rhodes et al., 2003); therefore, although individuals with high levels of neuroticism may experience more negative emotions,

extraversion may be a moderating factor in how well individuals cope with the challenges of TKA recovery and engage in rehabilitation. Future studies may explore the relationships between personality traits in influencing TKA outcomes and rehabilitation engagement.

Overall, this study found that four of the five domains of the five-factor personality model were associated with self-reported TKA outcomes, and trait anxiety was associated with self-reported TKA outcomes six months post-surgery. Given that findings were based on a small sample of TKA patients, results should be interpreted with caution. Our findings support the need for further studies exploring the relationships between the five-factor model of personality and TKA outcomes, as it explains more variance in personality than the three-factor model (Draycott & Kline, 1995) used in previous studies. Future studies exploring the underlying mechanisms of the relationships between personality traits and TKA outcomes would be useful to inform designs of psychological interventions (e.g. identifying the relationships between trait anxiety and coping styles after TKA would provide support for psychological interventions to include components about coping).

Limitations

This study had a small sample, and participants were predominantly operated on in a private hospital, indicating that participants had private health insurance and were thus likely to be of higher social economic status compared to the patients in the public system. Future studies should consider recruiting equal numbers of participants from both private and public systems in order to generalize findings to the broader population of TKA patients.

Some participants were allocated non-randomly into the control group due to many participants failing to return questionnaires or dropping out of the study despite verbally consenting to participate, thus compromising the rigorous randomization process. Future

studies may improve rigorous randomization by reducing the randomization block sizes (i.e. less than blocks of 10).

Although patient reported questionnaires are useful to measure outcomes that cannot be observed, for examples pain and mood states, self-reports are subjective and can be influenced by demand effects. In the current study, ROM was the only TKA outcome that was not reliant on subjective patient report. However, ROM measurements may not have been reliable in this study, given that measurements were taken from photographs sent by participants. Although instructions were provided (please refer to *Appendix F* for instructions for taking a photo), it was not possible for all participants to take photographs from a standardized angle (they were instructed to take the photograph from the same level as their legs). Additionally, the surfaces on which patients sat to take the photograph differed, with some sitting on the floor, while others sat on softer surfaces such as a bed or sofa, which may have affected their ROM measurement.

Future studies may wish to take ROM measurements in-person, using a standardized procedure and equipment (e.g., bed or chair) to increase the reliability in ROM measurements. Future studies may also consider using more than one standardized, objective measures of TKA outcomes so that measurements are not just reliant on patient reports. Examples of objective measures of knee function include the six minute walk test (i.e., distance walked in six minutes) (Enright, 2003), the Timed Up and Go test (i.e., time it takes to get out of a chair, walk three metres, turn around and return to a seated position) (Podsiadlo & Richardson, 1991), or the Five-Times-Sit-to-Stand test (i.e., time it takes to stand five times from seating position) (Whitney et al., 2005).

Conclusions

This study showed that it is feasible to conduct clinical trials to evaluate the effectiveness of the designed intervention. However, improvements need to be made in order to increase recruitment rates, retention of participants in the control group at baseline, and collection of ROM data. Overall, participants provided positive feedback about the intervention program. Correlational analyses showed that four of the five domains of the five-factor model of personality were associated with TKA outcomes. Trait anxiety was also associated with TKA outcomes. Future research is needed to continue exploring the relationships between personality and TKA outcomes, and future randomised control trials are needed to evaluate the effectiveness of the designed intervention.

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Chapter Six:

Summary and General Discussion

TKA is an effective procedure to relieve pain and provide stability in the knee (Felson et al., 2000; Laupacis et al., 1994; Räsänen et al., 2007), and it is often undergone due to chronic pain caused by osteoarthritis (Robertsson et al., 2010; Wylde, Dieppe, Hewlett, & Learmonth, 2007). Despite the consensus that TKA is a successful procedure in treating osteoarthritis, some patients still report dissatisfaction and difficulties with their knees (Baker, van der Meulen, Lewsey, & Gregg, 2007; Wylde et al., 2007). For example, Brander, Stulberg, and Kirk (2015) reported that one in eight patients reported experiencing moderate to severe levels of pain one year after surgery despite having normal clinical and radiographic findings.

The literature suggested that discrepancies between clinical/radiographic findings and patient reported outcomes may be, at least in part, explained by psychological and demographical factors. Demographic and psychological variables explained 38% of variance on the FJS-12, and 68% of the variance of WOMAC scores in TKA and THA (Giesinger, Kuster, Behrend, & Giesinger, 2013). It has been suggested that personality traits, psychological factors and processes such as anxiety, depression and catastrophizing, are associated with TKA outcomes (e.g., Blackburn, Qureshi, Amirfeyz, & Bannister, 2012; Duivenvoorden et al., 2013; Edwards, Haythornthwaite, Smith, Klick, & Katz, 2009; Giesinger et al., 2013; Gong & Dong, 2014; Qi et al., 2016; Riddle, Wade, Jiranek, & Kong, 2010). Much of the research looking at the impact of psychological variables on TKA outcomes has focused on transient psychological states such as anxiety and depression, but the cause effect relationship has been difficult to establish (Blackburn et al., 2012; Drewett,

Minns, & Sibly, 1992; Lopez-Olivo et al., 2011). Exploring more stable psychological factors such as personality traits largely obviates the cause-effect dilemma between psychological factors and TKA outcomes, as personality is more stable over time than mood states (Allemand, Zimprich, & Hendriks, 2008). Previous research has explored personality traits using a three factor model (Gong & Dong, 2014; Qi et al., 2016), whereas a five factor model has been shown to explain more variance in personality than the three-factor model (Draycott & Kline, 1995).

Given that psychological factors have significant associations with TKA outcomes, it would seem logical that rehabilitation would be facilitated if these factors were appropriately addressed and managed. Previous systematic reviews exploring the effects of psychological interventions on outcomes after surgery have found some psychological interventions to improve outcomes (Devine, 1992; Johnston & Vögele, 1993; Nelson et al., 2013). However, most reviews included a wide range of surgical procedures, and results were difficult to apply specifically to TKA, as arthroplasty is an elective surgery and is often undergone by healthy individuals with relatively low rates of comorbidities (Singh & Lewallen, 2014).

This thesis had two broad aims. The first aim was to explore TKA patient needs and psychological interventions targeted at improving TKA outcomes. Secondly, the thesis explored relationships between personality and TKA outcomes. This thesis aimed to answer the following questions:

1. What patient needs should psychological interventions target?
2. Can psychological interventions improve patient outcomes after TKA?
3. Are personality traits related to TKA outcomes?

Summary of main findings of thesis

What patient needs should psychological interventions target?

Interviews

One of the aims of this thesis was to determine the needs of TKA patients, in order to design a psychological intervention to address those needs. Thus, in *Chapter three (study two),* 22 patients were interviewed about their experiences surrounding TKA. Fourteen participants had undergone TKA, and eight participants were on a waitlist to undergo TKA. Information about expectations, fears, difficulties experienced, coping strategies, and relevant suggestions were extracted from interview transcripts.

The majority of participants reported that the first few weeks after surgery were the most difficult period of their recovery, highlighting the need for support during this period. Many participants who had undergone TKA had held unrealistic expectations about their recovery, with many noting in the interviews that their recovery period had been much longer than expected. Similar unrealistic expectations were highlighted in another qualitative study, which identified that patients often expected to be free of pain in the recovery period after surgery (MacKichan, Wylde, & Gooberman-Hill, 2015). In reality, it has been documented that recovery occurs over many months rather than a few weeks, and can take up to two years for full recovery (Forsythe, Dunbar, Hennigar, Sullivan, & Gross, 2008). Although the literature does not provide a specific timeframe in which patients return to 'normality' following TKA, it has been shown that at six months post-surgery, TKA patients still performed significantly worse than healthy adults on various functionality tasks (Bade, Kohrt, & Stevens-Lapsley, 2010). Additionally, when discussing expectations of TKA, most participants tended to focus on physical outcomes and did not consider the impact of the

surgery on their psychological wellbeing, with few participants anticipating mood or psychological difficulties. Thus, psychological interventions should address unrealistic expectations and facilitate consideration of the psychological challenges associated with the surgery.

Interviews showed that TKA patients needed help with managing post-surgical pain, and mood related difficulties such as symptoms of depression, anxiety and irritability. Some participants identified the impact of their inability to manage post-surgical pain on their mood and social engagement. TKA patients may benefit from psychological interventions that explore relationships between pain and mood, and from help to develop coping strategies for managing pain and mood symptoms. A common fear/concern associated with elevated levels of anxiety was identified as 'the unknown', which included uncertainty about being able to cope with pain and with life in general, and uncertainty about the outcomes of the surgery. It may be beneficial for psychological interventions to incorporate discussions about tolerating uncertainty in order to reduce anxiety. Additionally, education about the TKA procedure and recovery period may aid in alleviating anxiety.

A notable finding from the *Chapters two* (systematic review) and *three* (interviews) was that the needs of TKA patients extended to more than just education about the surgical procedure and recovery. Results from studies in the systematic review suggested that psychoeducation alone was ineffective in improving patient reported outcomes. In the interviews, participants expressed the need to have opportunities to manage unrealistic expectations, address fears, and to prepare for TKA and recovery. In addition, they sought support and strategies to manage physical challenges such as pain and limited mobility, and difficulties with moods such as depression, anxiety, and irritability.

Intervention Manual

In *Chapter four*, a manualised psychological intervention titled "Psychological Coaching Program for TKA" was designed to meet the patient needs identified in *Chapter three.* Therapist and patient manuals (*Appendices B* and *C)* were designed to aid the delivery of the program. The intervention was designed to provide support to participants during the most difficult time of their recovery period, by continuing sessions up to four weeks after surgery. Commencing the program two weeks prior to surgery allowed opportunities to prepare participants for TKA and the recovery period, and to provide education about the procedure and recovery.

Conclusion

From the information drawn from the patient interviews, it was concluded that in addition to providing psychoeducation about TKA and recovery, psychological interventions for TKA should provide opportunities to manage unrealistic expectations, address fears/worries, aid in preparations for undergoing TKA, and provide support and strategies to manage physical and psychological difficulties. Psychological intervention sessions should also occur during the first few weeks after TKA, to satisfy the need for support during the most difficult time of recovery and commence prior to surgery in order to allow opportunities to address fears, unrealistic expectations and provide psychoeducation. A manualised program was designed to meet TKA patient needs (*Chapter four).*

Can psychological interventions improve patient outcomes after TKA?

Systematic Review

In order to answer the second question (can psychological interventions improve patient outcomes after TKA?), *study one (Chapter two)* reviewed the elective arthroplasty

literature, examining the effects of previous psychological interventions on TKA and THA outcomes. PRISMA guidelines were followed, and seven randomised control trials were reviewed. Interventions used by studies were psychoeducation (n = 2), motivational interviewing (n = 1), guided imagery (n = 3), and a combination of cognitive behaviour therapy (CBT) and relaxation therapy (n = 1). The combination of CBT and relaxation therapy was found to be significantly associated with improved hip function at the 12 month follow-up (Berge, Dolin, Williams, & Harman, 2004), and guided imagery was significantly associated with decreased knee pain three weeks after TKA (Jacobson et al., 2016). Other studies exploring guided imagery, psychoeducation, and motivational interviewing were ineffective in improving patient outcomes after TKA and THA (Doering et al., 2000; Forward & Greuter, 2015; Frost, 2003; Grossman, 2016; McGregor, Rylands, Owen, Doré, & Hughes, 2004).

Overall, the arthroplasty literature did not offer conclusive evidence that psychological interventions improved outcomes after TKA and THA. However, the literature was limited in many ways. Firstly, there was only a small number of randomized controlled trials that investigated the effectiveness of psychological interventions in knee and hip arthroplasty, with only seven studies reviewed. Secondly, there were a lack of high-quality studies as all studies reviewed had moderate and high risk of biases. Thirdly, there was a lack of long term follow ups, as most studies focused on early postoperative outcomes which often extended to just the first few days after surgery. Improvements in TKA outcomes can occur up to two years post-surgery (Forsythe et al., 2008), so the first few days after surgery are considered to be in the very early stages of recovery. A recent systematic review was also unable to draw definitive conclusions of the effectiveness of psychological interventions for

TKA (Whale et al., 2019). Another recent review of the broader elective orthopaedic literature noted similar limitations to those identified in our systematic review indicating that the studies were of low quality due to risk of bias, and there was a lack of long-term follow up with most studies only investigating outcomes during the first few days after surgery (Tong, Dannaway, Enke, & Eslick, 2020).

Manual design and pilot intervention study

Given the lack of high-quality randomized control trials that investigated outcomes past the first few days of surgery, a comprehensive psychological intervention was designed (*Chapter four; Appendices B* and *C*) and piloted in *study three* (*Chapter five*) to assess the feasibility of conducting future randomized control trials to evaluate the effectiveness of the designed intervention. Findings from interviews in *study two (Chapter three)* informed the design of the psychological intervention used in *study three*.

The intervention was a six-session CBT program, commencing approximately two weeks prior to surgery and concluding approximately four weeks after surgery. Personality dispositions were measured using the NEO-FFI-3 which measured personality traits on a five factor model, and the STAI was used to measure trait anxiety. TKA outcomes measured included range of motion (ROM), pain, knee symptoms, functioning in activities of daily living (ADL), knee-related quality of life (QOL), and awareness of the knee during daily activities. Measures used were self-report questionnaires (i.e., NEO-FFI-3, STAI, KOOS, and FJS-12) and universal goniometry (for ROM). The pilot study evaluated the recruitment rates, determined if a random sample could be obtained, determined the completion rate of the intervention, evaluated participants' perception of the designed intervention, determined if treatment fidelity could be achieved by different therapists, and assessed the retention rates

with four week and six month follow ups. Relationships between the domains of the five-factor model of personality, trait anxiety and TKA outcomes were also explored.

A total of 44 TKA patients were included in the study; 22 were in the control group and 22 were in the intervention group. Data were collected at three time points: baseline (prior to surgery), four weeks, and six months after surgery. Feedback received from patients undergoing the Psychological Coaching for Knee Replacements program (i.e., intervention group) was positive. Majority of patients (95.00%) rated the level of service provided to be "excellent" and were "very satisfied" with the amount of help received. Qualitative feedback (i.e., handwritten comments) indicated that many participants found the program to be helpful in their recovery from TKA. The pilot study showed that it is feasible to conduct a randomised control trial to evaluate the effectiveness of the designed intervention. The completion rate of the intervention, treatment fidelity, and retention rates at follow ups were adequate. However, recruitment rates, retention rates of control group participants at baseline, and methods for collection of ROM data were poor. We were unable to attain a random sample due to attrition of control group participants at baseline. We suggested that future studies need to consider reducing the barriers to participation, and include other ways of measuring objective TKA outcomes (i.e. not patient reported). Future randomized control trials are needed to assess the effectiveness of the designed intervention in this thesis.

More recent studies (Cai et al., 2018; Sun et al., 2020; Tong et al., 2020) have been published since the systematic review (*Chapter two*) was conducted, showing promising results for CBT interventions in improving TKA outcomes. A randomised control trial showed promising results that a six-session CBT program was effective in reducing pain in the first three months following TKA (Sun et al., 2020), and another study showed that a four

session CBT program was effective in reducing pain and improving knee functionality six months post TKA (Cai et al., 2018). A recent meta-analysis of psychological interventions in elective orthopaedic surgery found that psychological interventions decreased anxiety during the acute post-surgical period, and improved quality of life in the longer term (Tong et al., 2020).

Conclusion

Study one (systematic review) did not offer conclusive evidence that psychological interventions improved patient outcomes after TKA. Therefore, a comprehensive psychological intervention was designed (*Chapter four*) and piloted in *study three* (*Chapter five*). Further investigations of the effectiveness of the manualised program in a randomised control trial are feasible, although changes to the protocol are needed.

Are personality traits related to TKA outcomes?

Another aim of this thesis was to explore the relationships between personality traits and TKA outcomes. Correlational analyses were conducted (*Chapter five)* to explore the relationship between personality dispositions and TKA outcomes. Personality dispositions were measured on the NEO-FFI-3 and STAI (trait anxiety). TKA outcomes measured were pain, knee symptoms, functioning in ADL, QOL, ROM and awareness of the knee.

Correlations between personality and TKA outcomes

This thesis aimed to provide insight into the relationships between personality and TKA outcomes using a more comprehensive measure of personality (i.e. five-factor model) than those predominantly used in previous research (i.e. three-factor model). Findings from this thesis provided evidence that personality dispositions were related to TKA outcomes. Neuroticism, extraversion, openness, agreeableness and trait anxiety were significantly

correlated to TKA outcomes at six months post-surgery. Conscientiousness was not significantly correlated with any TKA outcomes. Higher levels of extraversion, openness, and agreeableness were moderately associated with better TKA outcomes at six months post-surgery, while higher levels of neuroticism and trait anxiety were moderately associated with worse TKA outcomes at six months post-surgery.

Higher levels of neuroticism were associated with worse knee symptoms and more awareness of the knee at six months post-surgery. Higher levels of extraversion were associated with better functioning in ADL and QOL, and less awareness of the knee at six months post-surgery. Higher levels of openness were associated with less knee pain at six months post-surgery. Higher levels of agreeableness were associated with less knee pain and symptoms, and better functioning in ADL at six months post-surgery. Higher levels of trait anxiety were associated with more knee pain, symptoms and awareness of the knee at six months post-surgery. Conscientiousness was not found to be significantly correlated with TKA outcomes at six months post-surgery. However, given the small sample, presence of elevated levels of conscientiousness, and low levels of neuroticism in the sample in this thesis, these relationships should be interpreted with caution.

Conclusion

Overall, this thesis showed evidence that personality traits were associated with TKA outcomes. Higher levels of extraversion, openness, and agreeableness were associated with better TKA outcomes, while higher levels of neuroticism and trait anxiety were associated with poorer TKA outcomes. This thesis showed that four of the five domains of the five-factor model of personality were related to TKA outcomes. Further investigations of relationships between the five-factor model of personality and TKA outcomes are needed, as

it is more informative than the three-factor model of personality, and exploring the mechanisms underlying the relationships between personality traits may be useful in informing the design of psychological interventions.

Implications, limitations and future research

Design of psychological interventions

To our knowledge, this thesis was the first to design a psychological intervention for TKA based on input from patients. Through interviews with patients, *study two (Chapter three)* explored experiences and suggestions of TKA patients and identified topics and components that they considered to be important to include in psychological interventions for TKA. There were two groups of participants; one group who had experienced a TKA and the second group who were about to undergo TKA. Interviews with these participants indicated that psychological interventions should be designed to help develop realistic expectations of TKA, to address fears, to provide education about the surgery and the rehabilitation, and provide support and strategies for managing challenges such as post-operative pain and negative affective states. In order to meet the needs of TKA patients, future interventions should include these topics and components.

This thesis outlined suggestions for the timing of delivery of psychological interventions for TKA. Interviews in *Chapter two* suggested that interventions should commence prior to surgery in order to provide education, and aid in preparations for the procedure and recovery, and should continue through the first few weeks after TKA, to provide support during what was commonly reported as the most difficult time of recovery. Sun and colleagues (2020) followed a similar session schedule to that used in this thesis and showed that CBT commencing two weeks prior to TKA and concluding two weeks after

surgery was effective in improving pain outcomes up to three months post-surgery in a general population of patients (i.e., not screened for psychological distress/vulnerability).

Study three (*Chapter five*) showed that personality dispositions were related to TKA outcomes at six months post-surgery. Although personality traits tend to be relatively stable (Allemand et al., 2008), moderation of personality traits is possible through therapy (Roberts et al., 2017). A systematic review by Roberts and colleagues (2017) found that emotional stability (i.e., neuroticism) and extraversion were traits that showed changes as a result of therapy. However, it may not be necessary to change personality traits in order to achieve better TKA outcomes; it may be sufficient to address the factors associated with these traits that appear to influence outcome. It is possible that extraverted individuals have better TKA outcomes due to their increased social engagement and tendency to follow through on intentions to do rehabilitation exercises, and open individuals have better outcomes due to their ability to pay attention to their internal states, identify their needs and use a variety of coping strategies. Therefore, TKA patients may benefit from psychological interventions that encourage social engagement, aid patients to set and achieve rehabilitation goals, facilitate greater attention to internal states and personal needs, and teach a variety of coping strategies.

Psychological interventions for TKA

This thesis showed limited support for the proposal that psychological interventions may be beneficial for patients in their recovery from TKA, however there was a lack of high quality trials identified by the systematic review (*Chapter two*). Other studies in the recent arthroplasty literature found cognitive behaviour therapy to be effective in improving TKA outcomes (e.g., Cai et al., 2018; Sun et al., 2020). Feedback from the intervention group reported in *Chapter five* indicated that the intervention designed in this thesis had been

helpful in their recovery from TKA, and the pilot study (*study three*) found that it is feasible to conduct future clinical trials to investigate the effectiveness of the intervention.

Study three identified poor recruitment rates, and some TKA patients identified that they were not interested in participating in an intervention study. It is possible that recruiting groups of patients with high psychological distress or vulnerability would increase interest and recruitment rates in psychological interventions for TKA. For example, Cai and colleagues (2018) were able to recruit a sample of 100 TKA patients (n = 50 in each group), and found a four session CBT program that commenced after surgery to be effective in reducing knee pain and improving knee function six months after TKA, in a population of patients with high levels of Kinesophobia. Kinesophobia can be defined an excessive and irrational fear of physical movement, resulting in avoidance of physical activity due to fear of pain (Doury-Panchout, Metivier, & Fouquet, 2015). Psychological interventions may be beneficial for those with high levels of neuroticism and low levels of extraversion, or patients with high psychological distress (e.g., depression, and anxiety), as these psychological factors have been found to be associated with poorer outcomes in other studies (Browne, Sandberg, D'Apuzzo, & Novicoff, 2014; Duivenvoorden et al., 2013; Edwards et al., 2009; Gong & Dong, 2014; Qi et al., 2016).

Personality

Due to difficulties disentangling the cause-effect relationships between mood symptoms (e.g., depression and anxiety) and TKA outcomes, this thesis explored the relationships between personality dispositions and TKA outcomes, given that personality dispositions are more stable over time than mood states (Allemand et al., 2008). Prior to the commencement of our study, the literature lacked studies exploring personality using a five-

factor model. Findings from this thesis provided evidence that four personality dispositions from the five-factor model were associated with TKA outcomes. In particular, this thesis showed that higher levels of extraversion, agreeableness and openness were correlated with better TKA outcomes, while higher levels of neuroticism was correlated with poorer TKA outcomes. Higher trait anxiety was also correlated with poorer TKA outcomes.

Previous studies investigating personality on the three-factor model (i.e. domains included neuroticism, extraversion, and psychoticism) found that neuroticism and extraversion were associated with TKA outcomes (Gong & Dong, 2014; Qi et al., 2016). This thesis showed that more than two personality domains were associated with TKA outcomes; in addition to neuroticism and extraversion, openness and agreeableness were also found to be associated with TKA outcomes. Therefore, this thesis supported the value of exploring personality on a more comprehensive scale, as openness and agreeableness are not constructs that are accounted for by the three-factor model of personality.

A recently published study measured personality using the Big Five Inventory (i.e. five-factor model of personality), and showed that higher levels of neuroticism were correlated with worse pain and stiffness at one year post TKA, higher levels of extraversion were correlated with better knee function, pain and stiffness at one year post TKA, higher levels of conscientiousness were correlated with better knee function and pain at one year post TKA, and higher levels of agreeableness were correlated with less stiffness at one year post TKA (Belford et al., 2020). They also found that neuroticism was a significant predictor of stiffness and physical functioning (Belford et al., 2020).

Earlier literature showed interactions between personality traits, coping styles, tendency to follow through with intentions, social engagement, emotional experiences, and

physiological responses (Bouchard, 2003; Dattilo et al., 2011; Endler & Kocovski, 2001; Rhodes, Courneya, & Jones ., 2003; Salmon & Hall, 1997; Verduyn & Brans, 2012; Villada et al., 2016; Williams, Rau, Cribbet, & Gunn., 2009). Personality traits appear to influence the way patients cope with the challenges, therefore tailoring interventions and rehabilitation programs with an awareness of the influences of these personality traits may be beneficial in improving TKA outcomes.

Currently, there appears to be a lack of studies exploring relationships between awareness of the knee (measured using the FJS-12) and personality traits. To our knowledge, apart from *study three* in this thesis and a study by Giesinger and colleagues (2013), there are no studies investigating the relationships between psychological factors and awareness of the knee. The FJS-12 has been shown to be a good measure of patient-reported outcomes for TKA and has been shown to have less of a ceiling effect than the more widely used patient-reported outcome measure WOMAC (Behrend, Giesinger, Giesinger, & Kuster, 2012). It is a good measure of overall outcome because the FJS-12 measures the ability of the patient to forget the fact that they have an artificial joint, rather than measuring specific symptoms (e.g., pain and stiffness) (Behrend et al., 2012). The ability to forget the artificial joint has been associated with patient satisfaction (Behrend et al., 2012). Future studies with larger samples exploring the relationships between personality and awareness of the knee are needed to replicate our findings, and to explore relationships between other psychological factors such as mood symptoms and awareness of the knee.

Limitations

When considering implications of this thesis, some limitations need to be kept in mind. Firstly, patients participating in studies *two* and *three* were mainly of Caucasian race,

and recruited from the private sector (71.93%), indicating that patients were predominantly of higher social economic status. Patients in the private sector have private health insurance and are usually willing to pay out of pocket gaps for their surgery. Individuals with private health insurance tend to have more access to resources such as professional help (e.g., private physiotherapists and psychologists) and facilities (e.g., rehabilitation centres). Patients in the public sector do not pay any fees, as their surgery and hospital stay are covered by Medicare. However, public hospital waitlist times are generally significantly longer than those in the private sector. Giesinger and colleagues (2013) found that demographic factors, as well as psychological factors, played important roles in influencing TKA outcomes. Another study showed that patients of higher social economic status had better TKA outcomes than those of lower social economic status (Feldman, Dong, Katz, Donnell-Fink, & Losina, 2015).

Individuals of lower social economic status tend to have more conflict in their environments (e.g., neighbourhood, family, interpersonal relationships), biological predispositions to certain diseases, and more conflicting demands in their day-to-day lives, which can be associated with more negative emotional and cognitive states (Chen & Miller, 2013). The differences in presence of life stressors (e.g., environmental conflicts, physical and psychological well-being), differences in access to resources, and literacy/language barriers may influence how TKA patients cope and recover from surgery (Feldman et al., 2015). Therefore, findings from this thesis cannot be generalized to the wider population and may only be applicable to TKA patients of higher social economic status. Pilot studies exploring whether the intervention designed in this study would be feasible to conduct with TKA patients with lower social economic status are needed. Future studies are also needed to

explore the needs of lower social economic status TKA patients, and relationships between personality dispositions and TKA outcomes in this population.

Secondly, sample limitations needed to be considered; the sample was small (n = 44), with up to 27.27% of missing data in *study three* (*Chapter five*). Type II errors (i.e., incorrectly accepting the null hypothesis) are more likely to occur in studies with small sample sizes (Columb & Atkinson, 2016), so given the small sample it is possible that there may have been undetected relationships between personality and TKA outcomes in this thesis. The small sample size arose from difficulties in recruitment, as many patients declined to participate in a study requiring longitudinal follow up, and comprehensive but time-consuming serial assessments. Many patients commented during recruitment that they did not have the time or were not interested in participating in research due to the time commitment needed. In order to gain larger sample sizes, future research may need to use a different approach to recruit participants, or to recruit over a longer period of time, or to use a different mode of delivery (e.g., online intervention and questionnaires). It may also be that a more targeted recruitment strategy may yield higher response rates as participants with greater psychological needs may be more disposed towards a psychological intervention.

Thirdly, conclusions drawn about the feasibility of conducting clinical trials, and relationships between personality and TKA outcomes were limited to six months post-surgery. Recovery from TKA can take up to two years (Forsythe et al., 2008), and findings from this thesis cannot be generalized to the longer term. Future studies with longer term follow ups (e.g. two years) are needed to explore the effectiveness of psychological interventions, and relationships between psychological factors and TKA outcomes.

Finally, although the intervention in this study was designed based on suggestions from TKA patients in *study two*, TKA patients were not consulted following the construction of the intervention manual and prior to implementing the intervention study (*study three*). Patient and public involvement may have identified barriers and solutions to some problems encountered in the feasibility study in this thesis. For example, patient and public involvement may have identified transport difficulties as a barrier to participation prior to the commencement of recruitment, and a different mode of delivery of the intervention may have been considered in the design of the intervention, which may have made improvement to recruitment and retention rates. Future studies should consider patient and public involvement when designing and implementing intervention studies.

Conclusions

This thesis reviewed the effectiveness of previous psychological interventions in improving TKA and THA outcomes, explored TKA patient needs through interviews, designed a comprehensive psychological intervention manual to meet the needs of TKA patients, investigated the feasibility of conducting clinical trials exploring the effectiveness of the designed intervention, and examined the relationships between personality dispositions and TKA outcomes.

Study one showed that there is a paucity of comprehensive psychological interventions for TKA and THA. Most studies were of low quality and lacked long-term follow up. Results from *study one* also suggested that psychoeducation alone was not effective in improving outcomes after TKA.

Study two showed that TKA patients faced both psychological and physical challenges. Psychological interventions for TKA should provide opportunities to manage

unrealistic expectations, address anxiety/fears, educate about TKA and recovery, aid in physical and psychological preparations for undergoing TKA, and provide support and strategies to manage physical and psychological difficulties. Ideally, interventions would commence prior to surgery to facilitate awareness and coping, and continue for the first few weeks after TKA as this period immediately post-surgery was identified as the most challenging time period. A comprehensive psychological intervention was designed to meet these needs (*Chapter four).*

Study three showed that it was feasible to conduct clinical trials to evaluate the effectiveness of the intervention designed in this thesis. However, improvements need to be made to the protocol in order to increase recruitment rates, retention of control group participants at baseline, and reliability of objective measures of TKA outcomes (e.g. range of motion). Further research may consider recruiting more psychologically vulnerable or distressed patients, and/or patients of lower social economic status to explore the effectiveness of the designed psychological intervention.

Study three also showed that all personality dispositions except for conscientiousness (i.e., neuroticism, extraversion, openness, agreeableness and trait anxiety) were correlated to at least one TKA outcome at six months post-surgery. However, it was noted that the sample in this thesis was small and had elevated levels of conscientiousness and low levels of neuroticism, therefore future research with a more diverse range of personality profiles are needed to further explore the relationships between the five-factor personality model and TKA outcomes.

In summary, TKA patients identified that interventions needed to address unrealistic expectations and anxiety/fears and provide education about TKA and recovery. They also

identified the need for assistance in physical and psychological preparation for undergoing TKA, and guidance and support to manage physical and psychological difficulties post-surgery. It was noted that commencing the intervention prior to surgery, and continuing sessions during the first few weeks post-surgery was an important feature of intervention designs. The current literature about the effectiveness of psychological interventions in improving TKA outcomes is still in its infancy, and therefore further high quality randomized control trials are warranted. A manualised complex intervention was designed in this thesis, and a pilot study showed that it was feasible to conduct future clinical trials to assess its effectiveness, though changes to the protocol are needed to increase recruitment rates, retention rates of control group participants at baseline, and reliability of objective measures of TKA outcomes. Personality dispositions were found to be associated to TKA outcomes in this thesis; personality tends to be associated with the way patients cope with the challenges of TKA, and hence interventions and rehabilitation programs should be designed with an awareness of the influence of personality dispositions on rehabilitation and coping in order to improve TKA outcomes Four of five of the domains of the NEO-FFI-3 (i.e., neuroticism, extraversion, openness, and agreeableness) and trait anxiety were found to be associated with TKA outcomes. More research about the relationships between the five-factor model of personality and TKA outcomes are needed.

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Appendix A: Published copy of the systematic review, and PRISMA Checklist

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RESEARCH ARTICLE Open Access

A systematic review of psychological interventions in total hip and knee arthroplasty

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Abstract

Background: The current practice in elective orthopaedics does not routinely include psychological interventions despite evidence that psychological factors such as personality, anxiety, depression and negative thinking styles can influence outcomes and recovery from surgery. The objective of this paper was to review the effectiveness of psychological interventions used in conjunction with total hip (THA) and knee arthroplasty (TKA), in improving patient reported joint outcomes.

Methods: An extensive literature search was conducted according to Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines. Search terms included psychology, interventions, and orthopaedics. Articles were included if they were randomised controlled trials (RCTs) of psychological interventions involving active patient participation measured with patient reported joint outcomes in patients undergoing hip or knee arthroplasty.

Results: A total of 19,489 titles were screened. Seven studies met the inclusion criteria and were included. Five of seven studies did not show improvements in patient reported outcomes after surgery. Specifically, psycho-education alone was not effective at improving patient reported joint outcomes in two out of two studies.

Conclusion: The current literature does not support routine psychological interventions for TKA and THA. However, it should be noted that the literature for psychological interventions in conjunction with TKA and THA is still in its infancy. This gap in the literature is surprising, considering the importance of the role of psychological factors in recovery. Further RCTs with long term follow ups, multidisciplinary involvement, and more comprehensive and focused interventions that go beyond educating patients are needed. Future studies should account for the demand effect, include measures of psychological variables to determine whether psychological interventions are more beneficial for some patients compared to others, and compare the different modes of delivery and timing of interventions to determine the optimal nature and duration of psychological interventions for TKA and THA.

Keywords: Arthroplasty, Knee, Hip, Psychology, Intervention

Background

The current practice in elective orthopaedics does not involve routine psychological interventions, despite evidence that psychological factors influence outcome and recovery from surgery [1–3]. One in eight patients experience moderate to severe levels of pain one year after total knee arthroplasty (TKA) despite having normal clinical and radiographic findings [4]. Many studies have suggested that psychological factors such as personality, anxiety, depression and negative thinking styles influence outcomes and recovery from surgery [1–3, 5, 6]. Giesinger et al. documented that psychological and demographic factors accounted for more variance in patient reported outcomes after hip and knee arthroplasty, than surgical factors [1]. Therefore, it would seem logical that inclusion of psychological interventions to facilitate recovery from arthroplasty may enhance patient satisfaction and outcomes, as psychological factors can influence

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perception of pain, participation in rehabilitation and other outcomes after surgery [7].

Previous meta-analyses and systematic reviews [8–10] of psychological interventions found some to be effective in improving physical and psychological outcomes after surgeries. For example, in the most recent review, Nelson et al. investigated 20 studies with patients undergoing abdominal, cardiac, and orthopaedic surgery, and documented that there was some evidence for relaxation therapy in improving psychological well-being, such as reducing tension, anger, anxiety and pain, and evidence that guided imagery reduced post-surgical pain levels, and reducing analgesic intake [9].

Most reviews include a wide range of surgical procedures, which makes it difficult to draw conclusions and frame recommendations specific to TKA and total hip arthroplasty (THA). Arthroplasty is an elective surgery and is often undergone by healthy individuals with relatively low rates of comorbidities [11], and is thus very different from other surgeries, for example, coronary artery bypass grafting where patients require surgery in order to prolong life.

This systematic review aimed to bring more clarity with respect to the effectiveness of psychological interventions in improving joint outcomes following hip and knee arthroplasty. The following questions were addressed: Are psychological interventions beneficial in improving recovery and joint outcomes after TKA and THA? If so, are all types of psychological interventions equally effective?

Descriptions of psychological interventions in reviewed articles:

Cognitive behaviour therapy, psycho-education, motivational interviewing, relaxation therapy and guided imagery are some examples of well-established evidence-based psychological therapies in the literature.

Cognitive behaviour therapy

Cognitive behaviour therapy seeks to reduce symptoms by modifying maladaptive thought patterns and behaviours [12, 13]. It is based on the works of Beck [14] and Ellis [15]. Ellis proposed the ABC model of irrational beliefs, which cognitive behaviour therapy is based upon [16]. In the ABC model, an activating event (A), such as pain after surgery, in combination with a negative/irrational Belief (B), thinking that surgery is only successful if there is no pain at all, leads to a maladaptive behavioural or cognitive consequence (C), thinking that the pain will last forever and that the procedure had failed [16]. Cognitive behaviour therapy aims to help the patient understand and alter beliefs and thought processes, in order to positively influence consequences [15, 17, 18]. The therapist guides the patient to actively recognise maladaptive beliefs and thoughts, and to effect changes in emotional and behavioural consequences [18].

Psycho-education

Psycho-education is the systematic education of patients about their condition, along with discussion of coping strategies that might be used to manage and cope with current and future problems [19–21]. Psycho-education is often part of cognitive behaviour therapy [22, 23], but unlike cognitive behaviour therapy, Psycho-education does not aim to change emotional and behavioural consequences by exploring and changing a patient's belief, but rather gives the patient information about their condition and offers suggestions of behaviour changes that they can implement when faced with problems.

Motivational interviewing

Motivational interviewing is a counselling style that is targeted at eliciting behaviour changes [24]. Unlike persuasion, which generally increases resistance from the patient, motivational interviewing aims to explore and resolve the patient's ambiguity to change [24]. The counsellor uses empathy and acknowledges resistance, to guide the patient to create a discrepancy between reasons for and against change [25]. It is paramount that the patient reaches the conclusion on their own accord, with guidance from the counsellor [25].

Relaxation therapy

Relaxation therapy encompasses a range of techniques designed to reduce muscle tension and autonomic arousal [26]. This is achieved by using skills that focus on the internal state of the individual such as controlled breathing, focused muscle relaxation and postural awareness and management. [26]. Techniques typically focus on the redirection of attention of the patient from their thoughts and emotions [27].

Guided imagery

Guided imagery is a type of relaxation therapy in which patients deliberately form mental representations of positive images to promote relaxation and body awareness [28, 29]. While many relaxation therapies focus on physical components such as breathing and muscle tension, guided imagery most commonly focuses on sensory information such as sound, smell, touch, vision and taste [29, 30].

Methods

Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines were applied. There was no published protocol for this review.

Search strategy

The search included empirical articles published in peer-reviewed journals, conference abstracts, and unpublished articles between January 1980 and mid-May 2017. An extensive literature search was conducted by

searching electronic databases (Keyword and MeSH explode) for published articles and conference abstracts (MEDLINE, PsycInfo, EBSCO, PubMed, CINAHL, Web of Science, Scopus), grey literature (PsycExtra, Cochrane Library), and dissertations and theses (ProQuest Dissertations and Theses). Hand-searching was also conducted by reviewing the references cited in previous systematic reviews, and articles included in this study.

Unpublished dissertations, theses and grey literature were included in the search in order to avoid publication bias. Authors of conference abstracts, who reported collecting data on patient reported outcomes in elective orthopaedic surgery after psychological interventions were contacted by email for further information about their studies. The date of the last search was 17 May 2017. The search methodology is detailed in Fig. 1.

The following search terms were used: (psychological OR cognitive OR behavioural) AND (intervention OR therapy OR treatment OR program OR education OR information OR teaching OR skill OR learning) AND (orthopaedic OR orthopedic OR knee surgery OR hip surgery OR shoulder surgery OR spine surgery). Boolean truncations were used to allow for a more expansive search (see in Appendix for an example).

The terms chosen covered were broad in focus to allow inclusion of all studies that investigated the role of

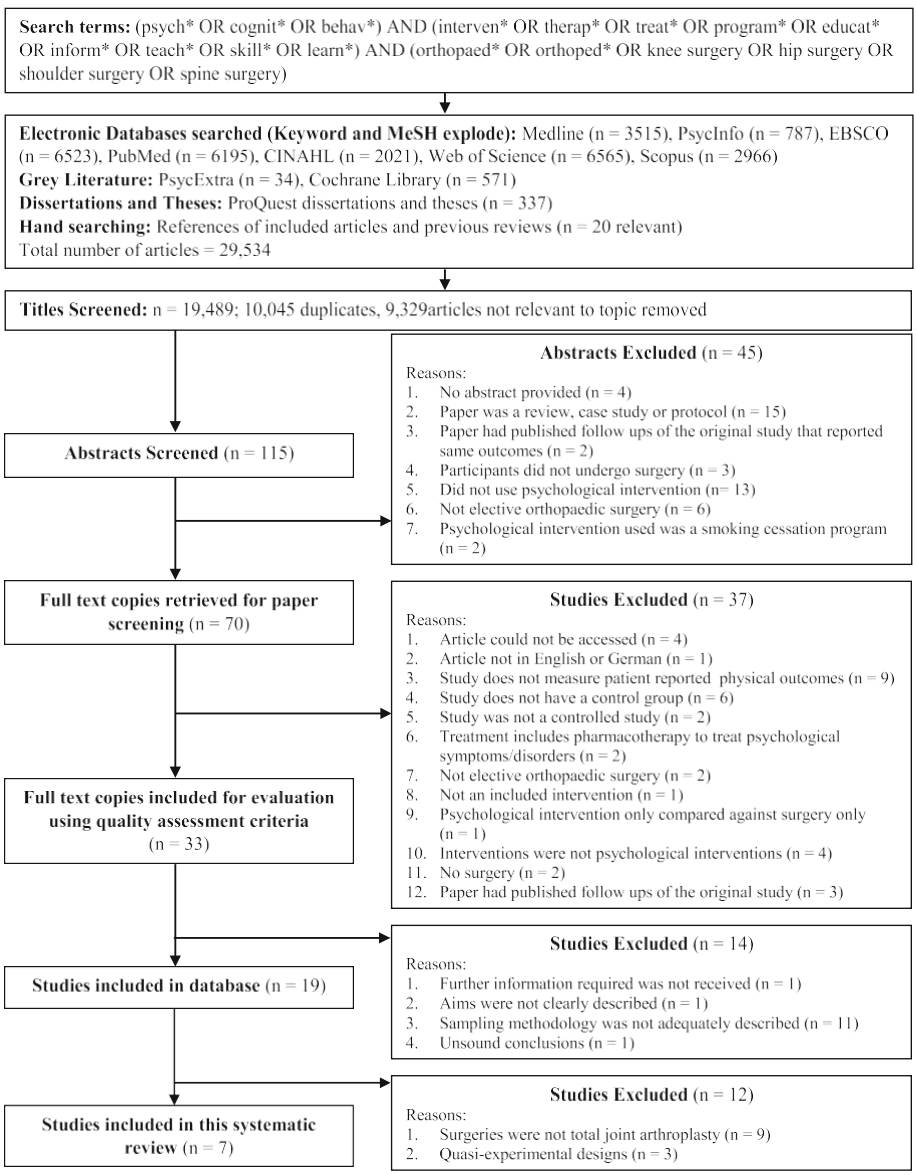

Fig. 1 Flow chart of search, retrieval and inclusion process

psychological intervention in elective orthopaedic surgery. However, in order to understand the more specific effects of psychological interventions on patients undergoing hip and knee arthroplasty, articles included in this review were further restricted.

Selection criteria

Studies included in this review satisfied the PICOS criteria:

Participants: elective orthopaedic patients undergoing knee or hip arthroplasty;

Interventions: psychological interventions involving active patient participation;

Comparisons: control groups including placebos, sham treatments, treatment as usual, education only or physical exercise only;

Outcome: Patient reported joint outcomes including pain, and/or functionality, and/or disability;

Study designs: Randomised controlled trials (RCTs).

Studies were excluded if participants did not undergo surgery, and/or if psychological intervention was compared to surgery. Studies were also excluded if they did not include a control group, and if a patient reported joint outcome was not measured. Articles that were in languages other than English and German were excluded. Only randomised control trials were reviewed.

Quality assessment

Only articles that fulfilled the requirements of the quality assessment were included in the review. In order to be considered good quality, an article must: 1) clearly describe the aims of the study; 2) adequately describe the methods undertaken in the study such that it may be replicated, which required clear descriptions of the recruitment of participants, timeline of interventions and data collection; and 3) have logical and sound conclusions drawn from results of the study.

Two authors (SB and LK) conducted the systematic searches and reviewed articles independently, according to the selection criteria. When there were disagreements regarding whether an article should be included, the issue was discussed with a third author (MSK), and a decision was made when all authors came to an agreement.

Data extraction

Data on participants, type of surgery, type of intervention, intervention timeline, sample size, follow ups, drop outs, outcome measures, professional backgrounds of therapists, power calculations, and major findings regarding patient reported joint outcomes were documented on predesigned spreadsheets. Interventions were classified as effective if at least one outcome related to the arthroplasty was significantly improved for the treatment group compared to control group, after surgery. Data was extracted by the first author and checked by the second author.

Risk of Bias assessment

All included papers were reviewed for risk of bias, by assessing seven criteria adapted from the Cochrane Risk of Bias Tool [31]: 1) adequate randomization (selection bias); 2) dropout rate was not a threat to power (attrition bias); 3) demand effect - assessor of outcomes should not be the therapist/clinician (detection bias); 4) complete reporting of outcome data in results section; 5) significant and non-significant findings reported appropriately in the discussion section (reporting bias); 6) monitored intervention integrity; and 7) appropriate use of statistical analyses. Advice from a statistician about the appropriateness of statistical analyses was obtained.

There were two stages in defining risk of bias. Firstly, the articles were assessed according to the seven criteria, and rated with a risk score of “high” or “low” for each criterion. If there was inadequate information in articles to determine whether a criterion was satisfied, then a risk score of “high” was given. Secondly, a pre-defined classification of overall risk of bias assessment was agreed upon by the authors. Each article was rated to have either low, moderate or high overall levels of risk of bias, according to the following classification: low risk
(A) where the article satisfies all 7 criteria in stage one; moderate risk (B) where 1–3 criterion were not satisfied in stage one; and high risk (C) where more than 3 criterion were not satisfied in stage one.

Results

Study selection

A total of 19,489 titles of studies were screened. Seven studies met criteria, and were included in this review (Fig. 1).

Study characteristics

Characteristics of the included studies are presented in Table 1.

Participants

The 7 reviewed studies consisted of 7 randomized controlled trials [32–38]. A total of 573 participants were involved, where 280 participants underwent a total knee arthroplasty (TKA), while 293 underwent a total hip arthroplasty (THA).

Analysis of studies

The data extracted from studies were categorised according to effectiveness in improving patient reported outcomes, and are presented in Table 2. Table 2 also

Table 1 Summary of reviewed studies

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in bold)	Main findings about patient reported joint outcomes
Berge, Dolin, Williams & Harman (2004) [32]	Total *N* = 44 Mean age = 71.6 (PMP), 71.0 (controls) Age range = NS	THA	*N* = 21 TAU	Pain Management Training: education, cognitive behaviour therapy, relaxation (CBT + RT)	Total = 21.5 h; Occurred over 6 weeks; 1 to 2 mornings a week (In-person)	Pre; at least 6 months before surgery	Total = 3; Pre intervention, 3 and 12 months after PMP	Pain (numerical rating scales), Analgesic drug use, function (Arthritis Impact Measurement Scale), metres walked in 4 min	Treatment group had sig. Better function than controls at 12 month follow up. No sig. Difference in pain was found between groups at 12 month follow up.
Doering et al. (2000) [33]	Total *N* = 100 Mean age = 58.7 (treatment), 60.4 (control) Age range = NS	THA	*N* = 54 TAU	Educational video + discussion (PE)	Total = 1 × 12 min video watched with psychologist/psychiatrist (Video recording)	Pre: afternoon of the pre-operative day	Total = 8; 5 consecutive days starting on pre-operation day, 3 months post-surgery	Anxiety (STAI), Depression (Von Zerssen Depression Scale), Pain (VAS), Blood pressure, Heart rate, Stress hormones (Urine samples), intake of analgesics and sedatives	No sig. Difference in pain was found between groups at all time points.
Forward et al. (2015) [38]	Total N = 224 TKA = 154 THA = 70 Mean age = NS Age range = NS	THA + TKA	*N* = 75 TAU TKA = NS THA = NS	Guided Imagery: Guided Meditation for Procedures or Surgery (GI)	Total = 4 × 18-20 min sessions: pre-surgery day, post-surgery day 0, 1 and 2 (Audio recording)	Pre and Post: began after admission	Total = 8; pre and post intervention on pre-surgery day, post-surgery day 0, 1 and 2	Pain (Numeric Rating Scale), Anxiety (Numeric Visual Anxiety Scale, Hamilton Anxiety Scale)	No sig. Differences in pain between GI and controls during overall hospital stay.
Frost (2003) [34]	Total *N* = 24 Mean age = 66.2 (treatment), 65.9 (control) Age range = 57–75	THA	*N* = 11 Telephone contact only	Motivational Interviewing (MI)	Total = 3 sessions; 1 × 1 h in person, 2 x bi-monthly 15-30 min telephone session (In-person and over the telephone)	Post: began 3 months post-surgery	Total = 2; Pre intervention, 5 months post-surgery	Exercise (diary), Physical activity (Modifiable Activity Questionnaire), Mobility (Gait Speed), Muscle force/balance (Timed Chair Rise), Pain/ Stiffness/physical function (WOMAC), physical health and mental health (SF-36), Self-efficacy (Self Efficacy for Exercise Questionnaire), Depression (CESD-10)	No sig. Differences found between groups for all measures at 5 months post-surgery.
Grossman (2016) [37]	Total *N* = 60 TKA = 44 THA = 16 Mean age = 66.1 Age range = NS	THA + TKA	*N* = 15 Education only TKA = 10 THA = 5	Guided Imagery (GI)	Total = not standardised: 6 min recording pre-surgery twice a day for 1–2 weeks (At least once on day of surgery), encouraged to listen to recording post-surgery but no specific instruction. (Audio recording)	Pre: before admission and before surgery	Total = 3; pre intervention, post intervention (during hospital admission), post-surgery (before discharge)	Anxiety (STAI-S), Stress (Perceived Stress Scale), Coping Strategies (CSQ), Pain (VAS), compliance (Training survey), medication use, length of hospital admission	No sig. Differences between groups for pain overall.

Table 1 Summary of reviewed studies *(Continued)*

Author (Year)	Participants	Type of surgery	Control group	Psychological intervention (Type)	Frequency of sessions + (Mode of delivery)	Pre or Post surgery	Data collection points	Outcome measures (Note: Patient reported joint outcomes in bold)	Main findings about patient reported joint outcomes
Jacobson et al. (2016) [36]	Total *N* = 82 Mean age = 65.0 Age range = 41–81	TKA	*N* = 40 Placebo audio recordings	Guided Imagery (GI)	Total = 35 self-directed sessions; Every day for 2 weeks before, and 3 weeks after surgery; 19-21 min each session for treatment, 17-21 min each session for control (Audio recording)	Pre and post: began 2 weeks pre- surgery	Total = 4; 2-3 weeks before surgery (pre-intervention), day of surgery, 3 weeks after surgery (post-intervention), 6 months after surgery	Gait velocity (Timed 10-Meter Walk), functional status (SF-36), Pain/ stiffness/function (WOMAC), imaging ability (Imaging Ability Questionnaire), optimism/pessimism (TKR Outcome Expectancy), daily pain (VAS), self-efficacy (Self-Efficacy for Rehabilitation Scale), pain catastrophizing (PCS), fear of movement (Tampa Kinesophobia Scale), CD use questionnaire, Physiological variables (Lymphocytes, macrophages and cytokines)	Treatment group had sig. Reduced pain levels compared to baseline 3 weeks after surgery than control group. No sig. Differences between groups in improvements of knee function at 6 months post-surgery.
McGregor et al. (2004) [35]	Total *N* = 39 Mean age = 71.9 Age range = 51–92	THA	*N* = 20 TAU	Education + discussion (PE)	Total = 1 x advise class (In-person)	Pre surgery: 2-4 weeks before surgery	Total = 4; Pre-intervention, at admission, at discharge, 3 months post-surgery	Function (WOMAC, Harris Hip Score, Berthel Activities of Daily Living Index), Pain (VAS), Mood states (Positive Affect Negative Affect Scale), helplessness (subscale of Rheumatology Attitudes Index), Fatigue (VAS), expectations of pain/ function/satisfaction (VAS), Life satisfaction (Cantril Life Satisfaction Ladder)	No sig. Difference was found between groups for pain and function 3 months post-surgery. No results were reported for differences between groups in fatigue.

Note. "*NS*" *indicates information not specified by papers. The word* "*significant*" *was abbreviated with* "*sig.*"*. CBT = Cognitive Behaviour Therapy, MI = Motivational Interviewing, GI = Guided Imagery, PE = Psycho-education, RT = Relaxation Therapy, TAU = Treatment as usual, PMP = Pain management program, STAI = State-Trait Anxiety Inventory, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, PCS = Pain Catastrophizing Scale, CESD-10 = The Centre for Epidemiologic Studies Depression scale 10*

Table 2 Effectiveness of interventions in improving patient reported outcomes after surgery

Not effective					Effective					
Study	*Psychological intervention (Surgery)*	*Mode of delivery*	*Timing of Intervention*	*Joint outcomes measured*	Study	Psychological intervention (Surgery)	Mode of delivery	Timing of intervention	Joint outcome improved	Joint outcomes measured but not sig.
Doering et al. *(2000)* [33]	*Psycho-education (THA)*	*Video*	*Pre-surgery*	*Pain*	Berge et al. (2004) [32]	CBT + Relaxation (THA)	In-person	Pre-surgery	Function	*Pain*
Grossman (2016) [37]	*Guided Imagery (THA + TKA)*	*Audio*	*Pre-surgery*	*Pain*	Jacobson et al. (2016) [36]	Guided Imagery (TKA)	Audio	Pre- and Post-surgery	Pain	*Function, Stiffness*
Frost (2003) [34]	*Motivational Interviewing (THA)*	*In-Person + Telephone*	*Post-surgery*	*Pain, Stiffness, Function, Physical Health*						
Forward et al. *(2015)* [38]	*Guided Imagery (THA + TKA)*	*Audio*	*Pre- and post-surgery*	*Pain*						
McGregor et al. *(2004)* [35]	*Psycho-education (THA)*	*In-person*	*Pre-surgery*	*Function, Pain*						

Note. The word "significant" was abbreviated with "sig."

summarises the joint outcomes that were found to be improved by interventions, and joint outcomes that were not found to be improved by interventions.

Types of psychological interventions

Two studies used psycho-education [33, 35], one used motivational interviewing [34], and three used guided imagery [36–38]. One study used a combination of cognitive behaviour therapy and relaxation therapy [32].

Effectiveness of interventions

Patient reported outcomes included pain, physical health status, physical function, stiffness and fatigue. The most common parameter was pain, either measured on a numerical rating scale, visual analogue rating scale (VAS), or as part of the Western Ontario and McMaster Universities Arthritis Index (WOMAC).

Overall, two out of seven studies (total n = 126, 65 treated) found psychological interventions to be effective in improving at least one patient reported joint outcome [32, 36]. Of these two studies, one study (total n = 44, 23 treated) used a combination of cognitive behaviour therapy and relaxation therapy and was found to signifi- cantly improve hip function at the 12 month follow-up [32], and one study (total n = 82, 42 treated) used guided imagery and was found to significantly decrease knee pain 3 weeks after surgery [36]. Psycho-education, guided imagery, and motivational interviewing were amongst the types of interventions that were found to be ineffective in improving patient outcomes after TKA and THA.

The number of sessions of interventions varied widely, ranging from 1 to 35 sessions. Interventions that were effective in improving patient reported joint outcomes ranged from 6 to 35 sessions [32, 36]. All interventions with less than six sessions were not effective in improv- ing patient reported outcomes [33–35, 38], and one intervention with more than 14 sessions was found to be ineffective [37]. However one intervention with 6 to 12 sessions [32] and another intervention with 35 self-directed sessions [36] were found to improve patient reported outcomes.

Mode of delivery

Mode of delivery varied across the studies with interventions delivered face to face, by video, by audio and by a mix of telephone and face to face contact. Effective interventions were delivered face to face [32], and by audio recording [36]. However, not all interventions delivered face to face and by audio re- cording were effective. Of two studies that delivered psychological interventions in-person (i.e. face to face) [32, 35], one [32] was effective (total n = 44, 23 treated). One study delivered interventions partially over the telephone and partially in-person [34], and was found to be ineffective. One study used video re- cordings [33], and was found to be ineffective. Three studies used audio recordings to deliver psychological interventions [36–38], and one [36] was effective (total n = 82, 42 treated).

Timing of interventions

Interventions were delivered either pre-surgery, post-surgery, or both pre and post-surgery, and varied considerably in terms of the number of sessions conducted. Four studies delivered psychological intervention

sessions pre-surgery [32, 33, 35, 37], while one study delivered sessions post-surgery [34]. The number of sessions in pre-surgery interventions ranged from 1 to 28 sessions [32, 33, 35, 37], while the post-surgery intervention had 3 sessions [34]. Two studies [36, 38] delivered psychological intervention sessions both pre-surgery and post-surgery. The number of pre-surgery sessions ranged from 1 to 14 sessions, and post-surgery sessions ranged from 3 to 21 sessions [36, 38].

There was no clear trend as to the effectiveness of interventions according to the timing in which interventions were delivered. One intervention that was effective in improving at least one patient-reported outcome after surgery [36] was delivered both pre- and post-surgery (total n = 82, 42 treated), while the other intervention that was effective (total n = 44, 23 treated) was delivered pre-surgery [32]. The intervention delivered post-surgery only was not found to be effective [34], the other intervention delivered both pre and post-surgery was found to be ineffective [38], and the other three interventions delivered pre-surgery only were found to be ineffective [33, 35, 37].

Length of follow up

The timing of follow up measurements was variable and ranged between 1 day and 12 months post-surgery. One study conducted a follow up 12 months post-surgery [32], one study at 6 months post-surgery [36], one study at 5 months post-surgery [34], two studies at 3 months post-surgery [33, 35], and two studies conducted follow ups less than 1 week post-surgery [37, 38].

Risk of bias across studies

Of 7 studies, 5 had moderate risk of bias [32–34, 36, 38] and 2 had high risk of bias [35, 37].

The most adhered to criteria were adequate randomization and complete reporting of findings in the discussion section. The least adhered to criterion was having an independent researcher (i.e. not therapist or clinician) to collect outcome measures, which increased detection bias. As expected, none of the studies blinded participants or clinicians providing the interventions, as it is not possible due to the nature of psychological interventions. A summary of the risk of bias assessment is displayed in Table 3.

Discussion

Five out of seven RCTs did not show a benefit for psychological interventions in TKA and THA, questioning whether psychological interventions should be part of routine arthroplasty surgery. However, it should be noted that the literature for psychological interventions in conjunction with TKA and THA is still in its infancy, considering that 10 data-bases were searched, and only 7 RCTs met criteria to be reviewed. Many studies had small sample sizes and moderate levels of risk of bias despite being RCTs. The sub-optimal quality of articles exploring the effects of psychological interventions on patient reported joint outcomes is concerning, and the gap in the literature is surprising, considering the im- portance of the role of psychological factors in recovery.

Across the 7 studies, many different types of interventions were applied, and the timing and mode of delivery was variable, making comparisons difficult. Despite this, some interesting conclusions and directions for future research can be drawn.

Firstly, psycho-education was found to be ineffective in improving patient reported joint outcomes. Both RCTs applying psycho-education only found no sig- nificant differences between treatment and control groups [33, 35]. Imparting information alone to pa- tients, while necessary, seems insufficient to change behaviour and therefore does not improve outcomes. This is in keeping with previous findings [39, 40]. Many studies have shown that psychological factors such as personality, anxiety, depression, and negative thinking styles influence the outcomes after surgeries [1–3, 5, 6]. Given that psycho-education alone is not effective in improving patient-reported joint related outcomes after surgery, these psychological factors need to be addressed using more comprehensive

Table 3 *Risk of bias assessment*

Authors	Risk of bias	Selection bias	Attrition bias	Detection bias	Complete outcome data (results)	Reporting bias	Compromised Intervention integrity?	Appropriate use ofstatistics?
Berge et al. (2004) [32]	B	Low risk	High risk	High risk	Yes	Low risk	High risk	Yes
Doering et al. (2000) [33]	B	Low risk	Low risk	High risk	No	Low risk	Low risk	Yes
Forward et al. (2015) [38]	B	Low risk	Low risk	High risk	No	High risk	Low risk	Yes
Frost (2003) [34]	B	Low risk	High risk	Low risk	Yes	Low risk	Low risk	Yes
Grossman (2016) [37]	C	Low risk	High risk	High risk	Yes	Low risk	High risk	No
Jacobson et al. (2016) [36]	B	Low risk	High risk	Low risk	Yes	Low risk	Low risk	No
McGregor et al. (2004) [35]	C	High risk	Low risk	High risk	No	Low risk	High risk	Yes

Note. Overall risk of bias: low risk (A), moderate risk (B) and high risk (C). Highlighted cells indicate unsatisfied criterion. No = high risk

interventions that go beyond educating patients. In other words, changing patients' thinking styles and providing strategies for managing physiological states are important in achieving improved patient reported outcomes after TKA and THA.

Secondly, interventions with less than six sessions were found to be ineffective, but beyond this, there was no clear relationship between the number of sessions and effectiveness of interventions. There was also no clear indication for the effectiveness of the different modes of delivery, or timing of interventions (i.e. pre/ post-surgery). Further research is needed to define the optimal nature and duration of psychological interven- tion for TKA and THA.

There was promising evidence from two RCTs which integrated some form of relaxation therapy in their interventions, that psychological interventions improved outcomes post-surgery [32, 36]. Both studies showed a lasting effect beyond the allocated therapy period. One study that delivered cognitive behaviour therapy and relaxation therapy with a clinical psychologist found improvements in patient-reported functionality 12 months after surgery [32], and the other study found that guided imagery improved patient-reported pain 3 weeks after surgery [36].

Limitations

This systematic review identified a growing body of literature that explored the use of psychological interventions in TKA and THA. The quality of studies was sub-optimal with various sources of bias identified. Most studies did not account for a demand effect, where therapists or clinicians that administered interventions also collected outcome data. The demand effect is related to response-biases, where patients respond to questions in order to maintain socially desirable appearances [41]. It is possible that patients report improvements in order not to disappoint their therapist, or to maintain an image of being a "good patient". Future studies can ac- count for the demand effect by having an independent researcher administer the questionnaires to patients and by including objective measures of outcomes, for ex- ample, measuring the range of motion to assess func- tionality of the knee or hip.

One of the main limitations of the current literature is the lack of long-term follow ups. Many studies focused on early postoperative outcomes, often only exploring outcomes during hospitalisation. It has been found that majority of patients experience low to mild levels of pain immediately after TKA [42], which mostly declines to half the intensity after 3 months [4]. Subjective perception of pain and functionality of the knee improves over a period of two years, and reaches a plateau after this period [43]. Thus, it would be important for studies to monitor patient outcomes over a longer period, as the rate of recovery varies over months [4, 42, 43].

Only one study in this review conducted a follow up at 12 months post-surgery [32] and one study conducted a follow up at 6 months post-surgery [36]. Thus, a conclusion as to whether psychological inter- ventions have a lasting influence on patient outcomes cannot be drawn.

Most studies in the literature did not have specific intervention programs targeting different groups of patients in recovery from TKA and THA, rather, they were implemented as general concepts to every pa- tient. Many patients will do well after TKA and THA, and psychological interventions may be more beneficial for patients with higher levels of cata- strophic thinking styles, depression or anxiety as pa- tients with these traits tend to have worse outcomes after surgery [1–3, 5, 6]. Future studies may wish to include measures of these psychological variables, to gauge whether psychological interventions are more beneficial for some patients compared to others. Add- itionally, most studies lacked a multi-disciplinary ap- proach, where there was a lack of input from both mental health practitioners (e.g. psychologist or psychiatrist) and a surgical team member (e.g. sur- geon). Future studies may wish to explore whether psychological interventions targeting recovery from TKA and THA specifically, with involvement of a multi-disciplinary team are effective.

Conclusions

The current literature does not support the effective- ness of psychological interventions in improving pa- tient reported joint outcomes after TKA and THA as most interventions explored by studies were found to be ineffective. Specifically, psycho-education alone was shown to be ineffective. It should be noted that the literature for psychological interventions in conjunc- tion with TKA and THA is still in its infancy. This gap in the literature is surprising, considering the im- portance of the role of psychological factors in recov- ery. Further RCTs with long term follow ups (e.g. at least 1 year), with more comprehensive and focused interventions that go beyond educating patients are needed. Future studies should account for the de- mand effect by involving an independent researcher and including objective measures of joint outcomes, include measures of psychological variables to deter- mine whether psychological interventions are more beneficial for some patients compared to others, in- volve a multidisciplinary team, and compare the dif- ferent modes of delivery and timing of interventions to determine the optimal nature and duration of psy- chological interventions for TKA and THA.

Appendix

Table 4 Example of search terms

Search terms in MEDLINE	
All fields Limit to yr. = "1980–2017"	(Psychiatry/ or psych*.mp. OR exp. Cognition/ or exp. Cognitive Processes/ or cognit*.mp. OR behav*.mp. or exp. Behavior/) AND (interven*.mp. OR exp. Psychotherapy/ OR therap*.mp. OR exp. Treatment/ or treat*.mp. OR program*.mp. OR educat*.mp. OR exp. Information/ or inform*.mp. OR exp. Teaching/ or teach*.mp. OR exp. Skill learning/ or skill*.mp. OR exp. Learning/ or learn*.mp.) AND (Orthopedics/ or Orthopedic Procedures/ OR exp. Knee/ or knee arthroplasty.mp. OR exp. Hips/ or hip arthroplasty.mp. OR shoulder surgery.mp. OR Spinal Fusion/ or spine surgery.mp. or Spine/)

Abbreviations

CBT: Cognitive Behaviour Therapy;; CESD-10: the Centre for Epidemiologic Studies Depression scale-10.; GI: Guided Imagery;; MI: Motivational Interviewing;; PCS: Pain Catastrophizing Scale;; PE: Psycho-education;; PMP: Pain management program;; PRISMA: Preferred Reporting Items for Systematic reviews and Meta-Analyses; RCTs: Randomised Control Trials; RT: Relaxation Therapy;; Sig. : Significant;; STAI: State-Trait Anxiety Inventory;; TAU: Treatment as usual;; THA: Total Hip Arthroplasty;; TKA: Total Knee Arthroplasty;; VAS: Visual analogue scale;; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index;

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Availability of data and materials

All data points relevant to this review and reasons for exclusion of studies are already presented in this review in the results section. Please contact corresponding author (SB) at samantha.bay@research.uwa.edu.au for more comprehensive reasons for exclusions and details of risk of bias assessments.

Authors' contributions

SB was the primary author, who conducted the comprehensive search of terms, data collection, analysis and writing of each section. LK was the secondary author who did an independent search of the literature to match SB's search terms, checked SB's data and contributed to the writing of each section. NM, MB, and MK are SB's PhD supervisors, whom SB consulted with while writing the review. NM and MB also contributed ideas in the development of this systematic review, and edited manuscript drafts. The idea of this systematic review originated from MK, who was consulted by SB and LK while writing the review, resolved SB and LK's disagreements about data, contributed major ideas to the discussion section and edited manuscript drafts. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Competing interests

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Publisher's Note

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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	47
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	204
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	47-49
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	48
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	50
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	51, 53
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	51
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	51
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	53
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	54
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	54
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	54-55
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	54

Section/topic	#	Checklist item	Reported on page #
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	54-55
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	55
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	56-59
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	64-65
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	55-59
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	64-65
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	65-66
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	67-68
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	68-69
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	213

Appendix B: Therapist's Manual

Psychological Coaching for Knee Replacements:

Therapist's Manual

Authors:
Samantha Bay, Neil McLean, Dr Michelle Byrnes, Prof Markus Kuster

Notes to therapists

- Paraphrase statements that are in *italics.* This is a manualised intervention, but you should still respond on an individual level. (Use the manual to guide your responses)
- Instructions to therapists are between asterisks *…*
- Give each participant a patient booklet.
- You may review content from previous sessions if they did not grasp the concepts.
    - Session 5 will provide the most time for review, further clarification and discussion with the patient.
    - Session 2 will be the most content heavy session – just before they go into hospital.
- Video record your sessions. (Audio record session 3)
    - Video name: Participant ID, Initials, Session no. (Eg. PC001, BR, Session1).
- You may use the online SMS system, send them emails using your research account, give the clinic reception/student room number, but please don't give out your personal mobile number!
    - Put your phone on 'No Caller ID' if you are calling from your mobile phone.
- You do not need to conduct a risk assessment, but use your clinical judgement – if you have good reason to suspect risk of harm, then conduct a risk assessment and discuss it in supervision.
    - Most of these patients are not distressed and are normal functioning people who are just here to contribute to research. We do not want to scare them.
    - Participants should sign the form that outlines consent for research, video recording and confidentiality – you do not need to go through the limits of confidentiality with them as it is specified there. Again, we do not want to scare them by mentioning neglect and harm.
- Treat record keeping for participants as you would with individual clinic clients.
    - Open a file with allocated client ID with reception, but also indicate participant ID on the front of the file. Participant ID should be "PCxxx" (x = number)
    - Write progress notes for each correspondence
    - Write progress notes for each session using the templates
    - Write intake and termination reports
    - Score and file tests in appropriate sections
    - Administer the weekly questionnaire instead of DI-5 & WHO-5
    - Close the file according to clinic guidelines
- Photocopy the checklist for each session and tick off the components that you completed during the session, the file in 'Misc.' section of your file.
- See clients/patients during clinic hours Mon-Wed 8.30am-8pm, Thu-Fri 8.30am-5pm. Session 3 may be an exception, when you visit them in hospital.
- If there are any questions that you are unable to answer, direct them to Sam's email, which participants should have on their information sheets.
- If your patient is already doing all the strategies or does not identify with negative thinking styles, then tailor the sessions to reinforce how their positive outcomes are related to their actions. Contrast that what they are doing is helpful, versus what some other people may be prone to be doing.

Session 1

(2 Weeks Pre-surgery)

- Introduction and overview of program
- Find out what their worries/anxieties are
- Expectations
- Wellbeing: Recovery is not just physical – importance of biopsychosocial approach
- Education/Psychoeducation
- Preparing home for post-surgery: Meals, support, aids
- Pre-surgical questionnaires

Materials:

- Manual & Checklist
- Consent forms: Participation for this study, video (RWC form)
- Weekly questionnaire (See attached at the end of this manual)
- Goniometer
- Camera: for taking photo of knee range of motion
- Questionnaires

Introduction

Introduce yourself – Your name, your title (psychologist/provisional psychologist), course you are doing (if applicable: clinical psychology/neuropsychology).

What this program is about: *This program aims to help patients through their knee replacement surgery, to prepare for it, to manage difficulties and speed up recovery from their surgery. Psychology is a big part of recovery from damage to the body, whether that be physical injuries or surgery. Some people, including professional sports athletes/sports people have psychological support to supplement their physical rehabilitation program throughout their recovery, as recovery challenges both physical and psychological aspects. You could probably think of yourself going through a similar recovery to athletes who had an injury (in your case, your injury is osteoarthritis), and needed surgery to fix it (your knee replacement). The aim of your recovery is to get you back on the field to play again (in your case, to get back to your life activities).*

This is a 6 session program – do you have any questions so far?

Answer questions, then get participants to fill out consent forms (study form and video form) and then the weekly questionnaire.

Tell them that they will be filling the weekly questionnaire at the start of every session so we can track how they are going throughout the program

Today's session should take no longer than 2 hours, which will include filling out questionnaires at the end. Every other session should take 1 hour, except for the last session, which might take 1.5hours to allow time to fill out questionnaires again.
Session 2 = Next week
Session 3 = While in hospital (You will visit them in hospital)
Session 4 = 2 weeks post-surgery
Session 5 = 3 weeks post-surgery
Session 6 = 4 weeks post-surgery, final session.

Map out the dates with them in their diary – would be good if you can do the same day of the week each time to make the appointment a bit easier to remember

This program will involve:

- *Educational components*
- *Pen and paper activities*
- *Discussions about expectations, concerns, progress and recovery*
- *Learning skills to cope with discomfort, surgery and recovery*
- *Things to do in-between sessions, such as keeping records of your discomfort and movement from day to day*

*Discuss with patients: *We only have 2 sessions before you go for surgery, and we want to cover a range of topics. However, we can also tailor the sessions to any particular needs that you may have. Please feel free to raise questions at any time, and please let me know if you are unclear on anything that we discuss..**

Expectations:

- *We think that it is important that there is continuity in the program, so we hope that you will be able to attend all the scheduled sessions. If you can't make it, please call the clinic on 6488 2644, and you can reschedule (+/- 5 days).* The clinic is open on Mon-Wed 8.30am-8pm, Thu-Fri 8.30am-5pm.
- *Bring your booklet with you every time.*
- *We will be asking you to fill out various questionnaires as we go through the program and we ask that you fill these out as requested as honestly as possible, as this will allow us to assess the effectiveness of our program, and more specifically how you are progressing in your recovery.*
- *We want to make sure that this program is working for you so if there is any aspect of a session that you believe might have been better please let us know so we can attempt to make the appropriate modifications.*

Measure degrees of bend in knee that is going to be operated on

Say: *The first thing we are going to do is measure the maximum amount of bend you can get in your knee, then we will take a photo of your knee. Your face will not be in this photo. Is that ok? We will be measuring the maximum amount of bend that you can get in your knee every week, but we will only take a photo today and once more at the end of the program. Both methods (measuring using the goniometer and photographs) will be used as range of motion measures. Every one taking part in this study will have photos of their knees taken at these 2 time points, however only the people receiving the psychological coaching program will have their knees measured every week, so that we can track your progress over the program.*

- *Use the goniometer to measure the degrees of bend they get with their knee. This is their range of motion measurement, and should be recorded on Question 5 on their weekly questionnaire. They are welcome to have a copy of the weekly questionnaire for their records – ask if they want this, if so, photocopy it each week.*
- **Take a photo of their leg at their maximum flexion**
  No face should be in this photo!

See instructions for taking the photo at the end of this section
Email photo to Sam with their Participant ID and date that the photo was taken

Today's session and expectations of program

Today's session will involve about finding out about your experiences with your knee, giving you some information about your knee replacement, giving you some information that past patients wished they had been told, and completing some questionnaires.

Before we go on, I would just like to ask; what you were hoping to get out of this program?

*Take note of this, and if expectations are unrealistic, explain what we are actually going to be doing. (i.e., teaching them some things about the relationships between thoughts, emotions, and pain, wellbeing, thinking styles, strategies to manage difficulties and supporting them in their recovery from surgery).

How did you feel about coming here today?

Reassure if they were feeling anxious, and explain the nature of the sessions.

Anxiety and worries

Ask the patient how they are feeling about their surgery. *Take note of the following*

- *How are you feeling about going into surgery?*
- *What are you most worried about?*
- *What do you think will be the hardest aspects of the surgery and recovery?*

If they are anxious, then reassure: *Going into surgery can be anxiety provoking, it is a major operation, so it is normal that one might feel anxious in the weeks coming up to surgery.*

Check their understanding of the procedure

Check their understanding about their procedure by asking the following questions:

- *How much do you know about your surgery procedure?*
    - *What's going to happen before hospital admission?*
    - *What's going to happen during hospital admission?*
    - *What's going to happen after hospital admission?*
- *Has your surgeon explained your surgery clearly to you?*
    - *Have you got any outstanding questions for him/her?*
        - If yes, *what are they?* Encourage them to write them down, and contact their surgeon.
        - Maybe some of their questions will be answered after going through the information sheets today.
- *Have you gone to pre-admission clinic?*
    - **If yes** – *how was it?* Useful?
    - **If no** – *why not?* (If they are going to attend, ask them what they would like to find out from attending the clinic).
        - Encourage them to go if they say they don't want to – it will give them a chance to meet the team that will be caring for them, and give them a chance to learn about their surgery.
        - It is important for their recovery that they understand what is going to happen, risks that are involved and things they can do to make the process easier for them.
        - *Avoidance of thinking about the problem does not mean that the problem is not there.*

Managing Expectations

- *What are you expecting from having your surgery, in the long run?*
- *What are you expecting your hospital stay to be like?*
- *What activities are you expecting to be able to do straight after surgery?* (First few days)
- *What activities are you expecting to be able to do when you go home?* (First week)

Are these expectations realistic? If not, ask them if they think they are, present reason why it is not realistic, and re-evaluate/come up with a more realistic expectation.

Get them to write down their expectations so they can refer to them after surgery

Well-being

What do you think of when you hear the words 'well-being'?
Therapists: Refer to Misc. Notes at the end of the manual for a note about well-being

Well-being can refer to physical well-being, and/or psychological well-being. Many people think that 'well-being' refers to physical aspects only, like how fit you are, how healthy you eat, and living comfortably. However, they ignore psychological factors like having positive relationships, satisfaction, personal growth and sense of accomplishment.

Both psychological well-being and physical well-being are related to each other and can influence each other. For example, low mood, worries and stress can affect activities of daily living. In the same way, being physically ill can also affect our mood and satisfaction with life. So it is important to consider both psychological factors as well as physical factors, when we try to improve our well-being as they are related to each other.

*Ask: *Can you think of an example of when a psychological factor can affect your physical well-being?*
If they can't come up with something, then give them an example (e.g., When we are stressed, some people tend not to eat well, and may feel that they have less energy… etc. - therefore stress has an indirect effect on the person's physical health)*

We will be exploring psychological and physical aspects of your well-being throughout this program, and will be teaching you skills to manage the relationships between psychological factors and physical factors, to help you get back out in the field of normal life after surgery.

Unhelpful vs Helpful Coping Styles

What do you think of when you hear the words 'coping'?

People do different things in response to life's challenges (pain can be a life challenge). Every person's style of coping is a reflection of their personality, in the way that they handle life experiences.

What are the main differences between helpful and unhelpful coping strategies?

Helpful strategies tend to involve you do something to change the situation and approach the problem, while unhelpful strategies happens when you avoid or surrender to the situation.

Can you think of some examples of each type of coping style? *Get them to write this down*

Examples: Unhelpful – avoiding situations, ignoring pain/situations, feeling helpless and hopeless
Helpful – taking medications, seeking help from a doctor/professional, engaging with rehabilitation programs

Which one do you think achieves better outcomes? Which one would you like to try to engage in?

We will be discussing some helpful coping strategies in session 2 and 3 to help you manage in your recovery. During the week, see if you can identify your helpful and unhelpful coping actions to events that come up.

Information sheets

These information sheets are based on feedback of other patients in the past, who have found this information helpful. Unfortunately we do not have time to go through all of them today, so please read them at home and we can discuss them if you have any questions next week. We will be discussing the Checklist: preparation for surgery sheet today.

It's probably an information overload, so encourage them to have a look at it when they get home and come back with any queries they have next week.

a. **Frequently asked questions**
b. **Recovery from surgery**
c. **Advice from previous patients**
d. **Checklist: preparation for surgery**

Below are some therapist notes for each information sheet. The sheets that patients have in their booklets are at the end of this section
Using the sheets, discuss with them:

a. **Frequently asked questions**

Here are some frequently asked questions that previous patients have asked, for you to reference to.

You do not need to discuss these with them, as you won't have much time. Encourage them to read it at home.

b. Recovery from surgery

This sheet includes some case examples of ordinary recoveries (real names are not used) *and a list of symptoms that you should seek medical attention for.*

You do not need to read it through with them, as you won't have much time. Summarise that it is normal to experience difficulties and still end up with good outcomes, however, there are some symptoms that need immediate medical attention. Encourage them to read it at home.

c. Advice from previous patients

You do not need to discuss this one in detail – simply inform them that these are from real patients that have gone through the surgery themselves, and these were collected in interviews with them. Encourage them to read it when they get home.

d. Checklist: preparation for surgery

*Ask: *Who do you live with?* – (many older people live alone)*

Go through the list with them and see if they have considered each point. If they haven't, then it will be their job to think about each point and to make the appropriate arrangements (could be arrangements with Silver Chain, or having a discussion with friends/family to establish their support person).

You might need to do motivational interviewing with the patient if they refuse to have a support person, as they are fiercely independent. For example, what are the pros and cons for not having a support person, versus the pros and cons for having a support person.

Here are the check list items and elaboration on each item:

- **Set up the house so it is easy to get around (Remove trip hazards):** This could include pet beds, furniture, carpets/rugs etc. Get them to think about whether they have any trip hazards, or any furniture that will make it difficult getting around with crutches.

- **Home aids/equipment:** The important (essential) ones are a **Comfortable seat with armrests** (this is probably where they will spend a lot of their time, and will need the arm rests to help them get up), **Toilet seat with handles** (handles aid with standing up)**, Shower chair,** and **Crutches.**
  Some patients may want to have other aids: **long handled brushes/sponges** for showering**, a pick-up reacher** tool (device that has a clip on the end so they can pick stuff up from the ground without bending down), **soap bag/on a string/in pantyhose** (so they can retrieve soap in the shower if they drop it), **shoe horns**, **dressing sticks**, etc. List these off to them to see if they would like to list it under the 'Others' section.

- **Meals for when they come home (Frozen meals?):** Encourage them to think about what they're going to do for meals when they get home from hospital. If they live alone and don't have a partner to cook for them, frozen/pre-cooked meals are a great idea.

- **Who will be their support person:** This would be their allocated support person. It could be a partner, family member or friend. This person should check in on the patient regularly whether it's in person or over the telephone, and someone they can

talk to when they are having a difficult time. They don't necessarily need to live with them for the period of time. Encourage them to have a conversation with the person about what they would like, e.g., phone call every day to see how they are doing, or a visit once a week, etc. Get them to discuss what they would like with you and write it down. Remind them that their support person is merely there to guide, encourage and to be an assistant, and **NOT to take over** for them.

- **Who they can go to for medical support:** This could be their surgeon or GP.
- **Who they can go to for physiotherapy:** Their appointed service/professional – some patients may not need to go to one, but it's always good to have someone in mind if they decide they need to go. If they don't know if the hospital is providing one (Hollywood doesn't do outpatient physiotherapy, but SCGH might), get them to find out.
- **Who will do the cleaning of the house:** This could be a partner, family member, friend, or professional service like Silver Chain.
- **Who will do grocery shopping:** This could be a partner, family member, friend, or they could do online shopping and have the groceries delivered.
- **How they will get to appointments:** They could be driven by a partner, family member, friend, or they could take a taxi/Uber etc. Patients are generally not allowed to drive for about 6 weeks after their surgery, unless cleared by their doctor.
- **Activities you can do to fill your day:** Patients will tend to have a lot of free time on their hands after surgery, as they will either be on leave from work (if not retired), and will have restricted mobility so they can't go out and play sports straight away. They are likely to stay at home a lot of the time, so they need activities they can pass their day with. It would be best if they can brainstorm at least 5 meaningful activities that they can do with restricted mobility. Some examples: Puzzles, books, drawing, painting, writing, movies/series, knitting/crochet, learning a new language, playing an instrument, video games, board games with friends/family/partner, etc.

If they have a dog, ask them who is going to take the dog out for a walk.

Discuss their between-session activities for the week.
(Don't call them homework or tasks! It will make it sound like a chore.)

Activities for this week

- Read the information sheets
- Write down any questions that they may have for their surgeon.

Frequently Asked Questions

What are common complaints after knee replacement surgery?
There are 5 common complaints after surgery, which are all normal: 1) numbness along the scar and leg; 2) clicking of the prosthesis when walking; 3) stiffness/tightness in the knee compared to the natural knee; 4) discomfort when kneeling; 5) being unable to fully flex the knee. The average knee replacement bends about 110 degrees, and most people are unable to fully flex the knee after a total knee replacement.

How much pain will I be in after surgery?
The amount of pain people experience varies from person to person. The first few days tend to be the most painful, and the pain should ease off over the weeks/months following surgery. You may also experience a bruised feeling, soreness in your thigh, and aching at the back of your knee as a result of realignment of your knee which should settle down after a few days. You will be given pain medications to take the edge off your pain, but you may still experience pain when you move/walk on it.

Why is it important to move even though I am in pain?
Movement (such as walking and swimming) promotes flow of oxygen throughout your body and maintains your normal breathing function. Moving around also improves blood flow, speeds up wound healing, and strengthens your muscles. Gastrointestinal and urinary tract functions can be improved by moving around, as these body systems are slowed down after surgery.

What should I keep in mind when I go home?
Be wary of things that you can trip or slip on, including slippery floors, rugs, furniture and pets. Use your crutches/supports in the first few weeks, even if you are feeling strong, as your knee may not be healed enough to catch yourself if you slip/trip in the first few weeks.

What is the general recovery period?
The recovery period ranges from person to person. Most patients say that they are not fully recovered until a year after their surgery, as it takes time for the swelling and pain to disappear, and to re-gain their full mobility and strength. Generally, you can expect to be back in your day-to-day activities within 6-12 weeks after surgery if you are diligent with your rehabilitation exercises.

Recovery from surgery

There is no set path to normal recovery, and your recovery will look different to another person's recovery. Most recoveries are not without some pain and difficulties.

Here are some cases of NORMAL recovery (based on real experiences):

1) Jane was 58 years old when she received her new knee. She was ready to go home on the 3rd day after surgery, however there was liquid seeping out of her wound and the hospital kept her for an extra day, just in case she had an infection. Jane found her hospital stay to be untroublesome, and said that the most difficult thing was adjusting to pain and restrictions in movement after she went home. She said that the most challenging thing about her recovery was pushing through the pain while doing exercises for rehabilitation. She said that it took about 9 weeks for the pain to subside, but she was able to return to work 6 weeks after surgery and took Panadol for pain relief at work. She reported that her pain had completely disappeared about 12 months after surgery. She rated her satisfaction with her new knee to be 10/10. Jane is able to kneel, but puts a cushion under her knees to make it more comfortable. She is also able to play 18 holes of golf.

2) Eric was 72 years old when he received his new knee. He started walking with crutches the next day, however he had numbness in his leg after surgery which he found very annoying as it made it difficult to walk. The numbness resolved after 3 days. He spent most of his time in bed for the first 10 days, but got up and wandered around often. Eric said that on the 5th day after surgery, he had more pain than usual because he didn't take his medication at the right time. Eric found that the first 3 weeks of recovery was the most difficult time period after surgery. 12 months after his surgery, Eric said that he had just spent a whole day cycling around Rottnest Island and felt stiffness in his knee afterwards, but was happy that he was able to cycle all day. Eric rated his satisfaction with his new knee to be 9/10, and said that the best part of having his surgery was that he is now able to stand for long periods of time.

3) Peter was 63 years old when he received his new knee. He experienced some adverse side effects from the opioid medications during his hospital stay, but had this sorted out by the doctors and nurses on the ward. His blood pressure was abnormally high while in hospital, but it settled down after he went home and managed it with his GP. He found that the hardest part of his recovery was motivating himself to do the rehabilitation exercises every day. Peter said that he found it more difficult to straighten his leg than to bend it. About 3 weeks after surgery, Peter reported feeling very gloomy, and felt that he did not want to do anything, or see any of his friends or family members. Peter had an episode of Deep Vein Thrombosis (DVT) 10 days after he went home, after he had dozed off for 2.5 hours with his legs elevated. Peter had his DVT treated immediately by his doctor and continued his recovery and rehabilitation exercises. Although Peter experienced a number of difficulties as he recovered, he reports that he is happy with the outcomes of his new knee. He said that he is now able to hop, jump, walk and swim, and he rates his satisfaction with his new knee to be 8/10. He thinks that the best part about getting his new knee is the long-term reduction of pain and swelling in his knee as compared to before his surgery.

Note: Ensure that you seek immediate medical attention if you suspect that you have Deep Vein Thrombosis.

Here are some symptoms that you should seek medical attention for:

- Discolored/foul smelling discharge from your wound/excessive bleeding
- Feeling out of breath, chest pain or difficulty breathing (Not after physical exertion)
- Hot streaking down the leg from your incision
- Sharp pain in the back of your surgical leg calf
- Body temperature of 38 degrees or greater (Fever)
- Muscle cramps that cause involuntary contractions and jerking of your operated leg
- Rash around the surgical site
- Grinding of the knee when you move

Note: If you experience any of these symptoms, please seek medical attention immediately.

Advice from previous patients

Here are some tips/advice given by patients with knee replacements:

- Read all the information given to you, if you don't understand or are missing information, ask questions.
- Take your pain medications 20 minutes before you do your exercises/physiotherapy – it will help to take the edge off the pain.
- Be prepared for some pain and discomfort even though you have medications, it's not a walk in the park, it's a major surgery.
- Do your exercises every day! Don't skip them even if you're in pain, it gets better over the days and weeks. Your recovery depends on what you put in.
- Listen to your body. You will know when you've done too much.
- Follow the instructions given by the professionals (Doctors, Nurses, Physiotherapists, etc.), as they are trying to help you to get the best results.
- Don't stop taking your medications in the first few weeks!
- It's not weakness or cowardly to ask for help.
- Don't stop your exercises even if you have achieved your goals, if you stop, you will lose the progress you have made.
- Use cold packs on your knee every day, as often as you can, to help bring down the swelling. Have a few in your freezer so you can rotate through them.
- Do some physical exercise to get yourself fitter before your surgery, it will make it easier to bounce back after your surgery. You could walk, cycle or swim.
- At times, you might get to a point where you think the pain and restrictions are not going to get better – but you need to persevere, push through and keep doing what you're meant to, because it will get better and you will get your functionality and independence back.
- Prepare yourself before activities. For example, lay out your clothes and towels before your shower, so you don't have to hobble around afterwards.
- Remember to take care of your new knee, it's not magic.

Checklist: preparation for surgery

Before going into surgery, check that you have considered/arranged the following:

- Set up the house so it is easy to get around (Remove trip hazards)
- Home aids/equipment (Tick when arranged):
    - Comfortable seats with armrests
    - Toilet seat with handles
    - Shower chair
    - Crutches
    - Others: _____
- Meals for when you come home (Frozen meals?)
- Who will be your support person: _____
  (This person should check in on you regularly whether it's in person or over the telephone, and someone you can talk to when you're having a difficult time)
- Who you can go to for medical support: _____
- Who you can go to for physiotherapy: _____
- Who will do the cleaning of the house: _____
- Who will do grocery shopping: _____
- How you will get to appointments:

  _____
- Activities you can do to fill your day:

  _____

  _____

  _____
    - Have you got all the materials you need for activities after surgery? (e.g., Books, puzzles, etc.)

Questionnaires

Offer to make them a cup of coffee/tea while they fill out the questionnaires.

Say: *Here are some questionnaires and a form asking about your background information, please complete all of them so that we can assess the effectiveness of our program and explore the relationships between psychological and physical factors in recovering from knee replacements. Some questions may seem a little bit strange, however please answer them as honestly as you can, so that we can get a general sense of your life and functioning. Please feel free to ask me any questions that you may have about them, I will just be here doing some reading while you complete them.*

Fill in their participant ID on demographics form

Point to the **NEO-FFI-3**: *This questionnaire is about your personal style and how you approach things. Please answer the questions based on your life in general.*

Point to the **STAI**: *This questionnaire asks about how you are feeling right now and how you feel most of the time.*
*Point out and **underline** the words "at this moment" on page 1, and "generally feel" on page 2 of the questionnaire*

Point to the **KOOS**: *This questionnaire is about your knee and how well you can perform daily activities. Please answer the questions based on your experiences in the last week. There may be some activities in this questionnaire that you may not do, for example, jumping or squatting, so please write N/A next to the activity if you do not do them.*

Point to the **FJS-12**: *This questionnaire is about how aware you are of your knee while you do certain activities. Please answer the questions based on your experiences in general.*

Administer the questionnaires and demographic form
When they have completed them, collect them, score them and put them in their client file under "tests". See Misc. Notes for how we will use the questionnaires in the study.

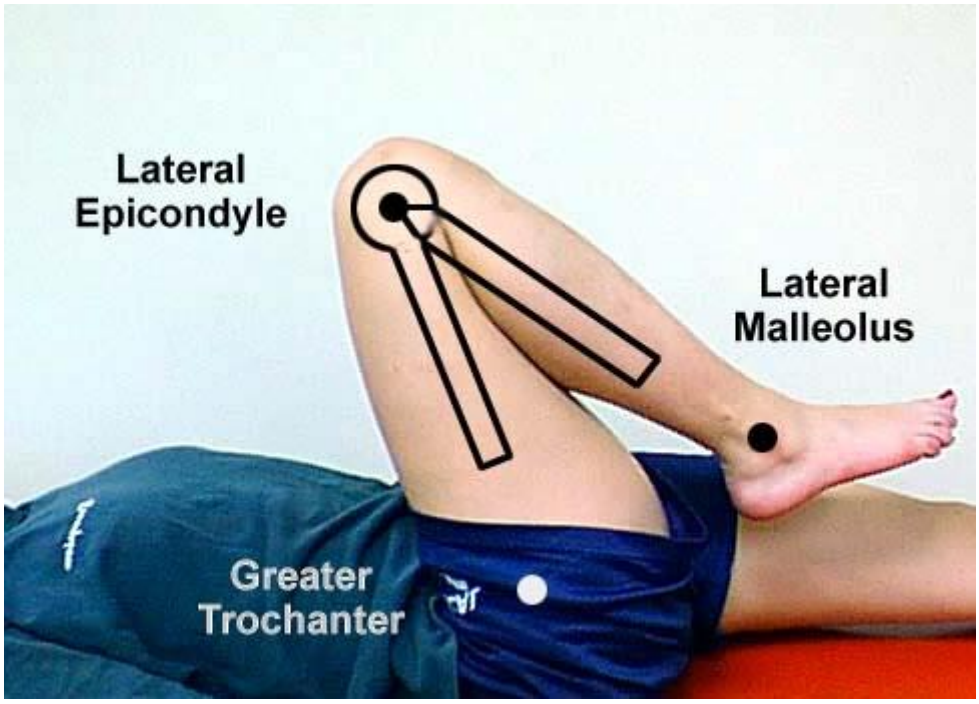
Thank them for completing the questionnaires.

Ensure that you have arranged your next appointment before you leave the room.

End of Session 1

Instructions for using goniometer to measure range of motion

1. Get the patient to sit in a chair, and put another chair in front of them so they can put their foot up on it.
2. Get the patient to bend their knee back as much as they can (without using their hands to pull it back), and rest their foot on the surface of the other chair.
   (If they can bend it back all the way, they may even rest their foot on the chair they are sitting on.)
3. Place the middle point of the circular part of the goniometer at their Lateral Epicondyle (middle of their knee joint – see picture below).
4. Ensure that the middle line on the goniometer arm that runs along their Tibia points towards their Lateral Malleolus (Bone bump on their ankle – see picture below).
5. Ensure that the middle line on the goniometer arm that runs along their Femur points towards their Greater Trochanter (Near the end of the thighbone – see picture below).
6. Read the number of degrees of flexion on the goniometer, and record.



Picture from http://www.scranton.edu/faculty/kosmahl/courses/gonio/lower/pages/knee-flexion.shtml

Instructions for taking a photo of the knee

Photos will be used to measure range of motion of the knee.

1. Tell the patient to bend their knee as much as they can and rest it on the chair's surface (**without** pulling their leg back with their hands or shifting their position).
2. Ensure that the photo is taken from the same level that their legs are at.
3. Ensure that you can see the ankle and hip as well (if possible – it's not a big problem if chair handles are obstructing the hip).
4. Take the photo from the side-view and send it to Sam with the date and participant ID.
   See example photos below.

Example photos:

Checklist: Session 1

☐ Introduce the program and its structure.

☐ Explain expectations of the program.

☐ Complete consent forms and weekly questionnaire.

☐ Measure range of motion with goniometer.

☐ Take photo of their knee according to instructions provided.

☐ Find out patient's worries, anxiety level, and reassure.

☐ Check their understanding of the procedure.

☐ Explore and manage expectations of surgery/recovery.

☐ Explore concept of 'Well-being'.

☐ Explore Unhelpful and Helpful Coping Styles.

☐ Encourage patient to read the information sheets.

☐ Explore Checklist: Preparation for surgery, and identify items needing attention.

☐ Administer demographic form and questionnaires.

☐ Arrange appointment for session 2.

☐ Send photo of knee to Sam, with Participant ID and date.

Session 2

(1 Week Pre-surgery)

- Psychoeducation about pain
- Strategies to manage pain
- Motivational Interviewing: Hospital stay
- Introduce monitoring worksheets

Materials:

- Manual
- Weekly questionnaire
- Goniometer
- Mindfulness audios – Breath and body scan
- Whiteboard marker & whiteboard

Patients are to fill out weekly questionnaire.

In today's session, we are going to discuss:

- *Pain*
- *Coping strategies*
- *Hospital Stay*
- *Monitoring physical and psychological factors*

There is a lot of content in this session. These are the 4 core discussion points:
1) Cognitive aspect of pain
2) Cycle of avoidance
3) Strategies to help manage pain
4) Hospital stay

Check in

- *Do you have any questions about the previous session?*
- *Did you notice the different ways you coped with events during the week?*
- *How are you going with preparation for surgery?*
- *Have you got everything that you need?*

Measure their range of motion using the goniometer and record on their weekly questionnaire.

In today's session, we will be exploring pain and how the experience of pain can affect you more broadly. Then we will cover some strategies to help you get through your recovery period and hospital stay. There is a lot of information, so please feel free to stop me and ask questions along the way.

Pain

If they haven't already told you *Tell me about your experience with pain.*
(Most of them would have experienced pain, that's why they are getting their surgery)*

Pain after your knee replacement surgery will probably be different from other types of pain. It will disrupt your daily routines, and will stop you doing the things that you are used to doing now.

What is pain?

What is the definition of pain? –
Ask patient if they can define it without using the word 'pain'. Ask them to describe pain to someone who doesn't know what pain feels like.

(Pain is an unpleasant **sensory and emotional** experience associated with actual or potential tissue damage) – Definition from the International Associate for the Study of Pain (Merskey & Bogduk, 1994)
*Pain can be defined by 3 components: **sensory**, **emotional** and **cognitive** components (thoughts).*

Get them to write the definition in their booklet

Pain is NORMAL and HELPFUL, it helps our survival – it's not all bad. Pain is the signal that the body is sending to tell you that something needs your attention.

For example: *When you touch a hot oven – what do you feel?* (Pain)
What message do you get from this pain? (It's dangerous, don't touch)

What message is pain trying to send after surgery?
(You just had major surgery which involves opening of the knee, be gentle so I can heal).

What would happen to you if you NEVER experienced pain?
(You could get seriously hurt and not notice it, or even be killed by it – *imagine if you got a huge cut and didn't feel pain, you might lose a lot of blood and not notice.*)

*When we talk about experiencing pain, we should consider all 3 aspects (**sensory**, **emotional** and **cognitive)**.*

For example: You stubbed your toe on a step.
***Sensory** component of pain = the pain you feel in your toe.*
***Emotional** component of pain = annoyance/frustration at the step/yourself*
***Cognitive** component of pain = the thought "stupid step" or "I'm so silly" or "that hurts"*

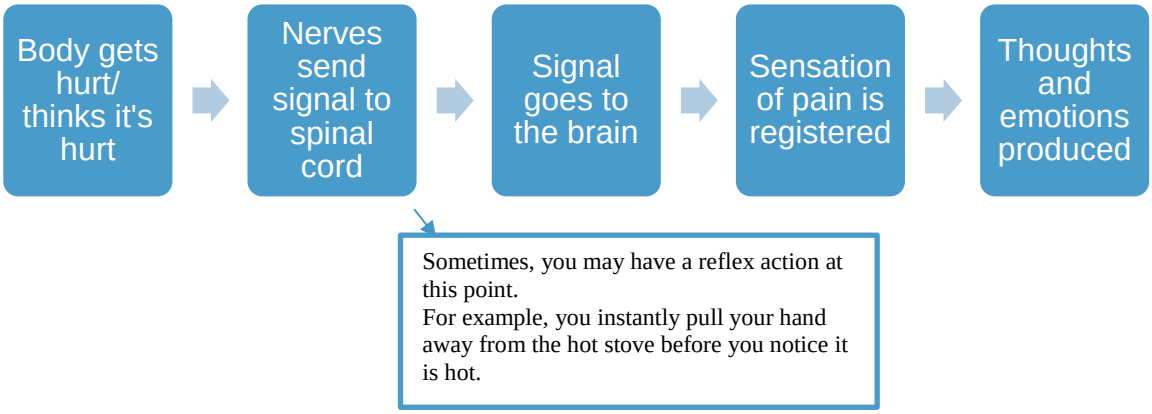
Ask them if they can identify the sensory, affective and cognitive components of their knee pain, and write it in their booklet.

It might look something like:
Sensory *component of pain = throbbing behind the knee cap*
Emotional *component of pain = annoyance*
Cognitive *component of pain = the thought "it is hurting again"*

Misconception about pain

A common misconception is that pain results from damage to tissue or bones.
Pain is produced by the nervous system, and can be experienced <u>without</u> any actual damage of tissue (e.g., as seen in functional pain syndromes without observable tissue damage).

Neurobiology of pain



Interesting fact: Different people perceive pain differently due to the extent of the parts of the brain that is activated by noxious (harmful/unpleasant) stimuli. (Tracey & Mantyh, 2007)
1 in 4 people have extra sensitive nervous systems after an injury or stressful event, so it takes less stimuli to trigger the body to send signals which result in feeling pain. Coping strategies can help to calm and retrain the system.

Note: For a more detailed explanation of pain processing, read article by Garland (2012)

Relationships between thoughts, behaviours, emotions and pain

Thoughts, feelings and behaviours are all interlinked in the way we experience our world. Changing thoughts can influence the others.

For example: You are lying in bed, and all of a sudden you hear a loud noise outside.

What are you <u>thinking</u>? How are you <u>feeling</u>? What do you <u>do</u>?

Write their responses in their booklet to outline the differences

Examples:

1) Thought = It's a burglar;
Feeling = Scared;
Behaviour = Get up to check/ get ready to call the police

2) Thought = It's the neighbour's cat again;
Feeling = Annoyed;
Behaviour = Continue lying in bed

The same event can be interpreted differently and influence the way you feel and behave.

An example with pain: *You had your surgery, and are experiencing a lot of pain.*

Present the <u>thought</u> to the patient and get them to come up with the emotion and behaviour.

1) **Thought = I'm in so much pain, nothing is working for me, the medications are useless and doing rehabilitation exercises is going to make it worse;**
Feeling = Frustrated/Angry;
Behaviour = Refuse to do physiotherapy exercises

Broader thoughts = I am never going to recover; this is a disaster.

2) **Thought = I'm in a lot of pain, imagine what it would be like without the medications. Doing rehabilitation exercises is going to be painful, but it is going to help me get my mobility in my knee back to normal;**
Feeling = Hopeful;
Behaviour = Do physiotherapy exercises despite the pain

Broader thoughts = This is to be expected; hang in there, and it will get better.

Ask patients what they think the difference is between thoughts in (1) and (2).
The thought in (1) is unhelpful, while (2) is more realistic – <u>not positive</u>.

Positive thinking can be helpful in some situations, but positive thinking is not always helpful. For example, is it helpful to tell yourself that you have no pain and that everything is going great, when you actually are experiencing pain and difficulties?

Realistic thinking is more helpful – it considers both the positive and negative.

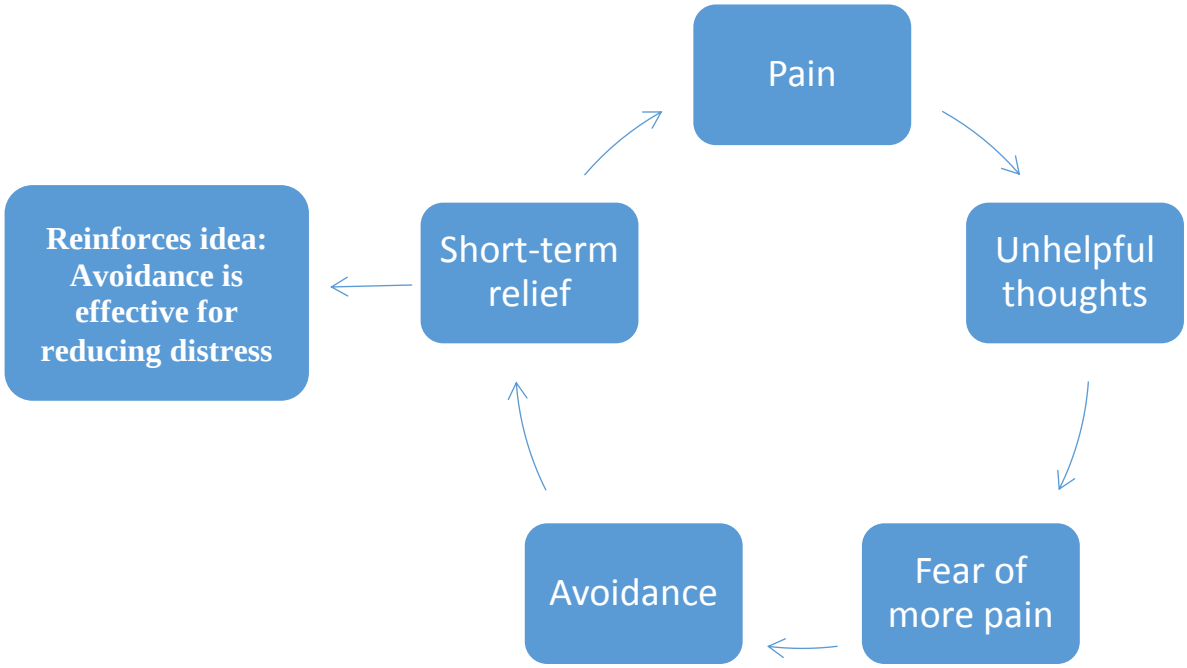
During the week, I would like you to start noticing your thoughts. Notice if they are they helpful or unhelpful. Notice whether you tell yourself negative, positive, or realistic things.

Cycle of Avoidance:

One thing that we tend to do when we don't like something is to avoid it.
For example, when children don't like the taste of vegetables, they avoid eating vegetables even though they get told that vegetables are good for them.

In the same way, when we think that something is going to be painful, we tend to avoid the situation if we can.

But here's the trouble with avoiding – there is a cycle: *Outline each step in the chart*

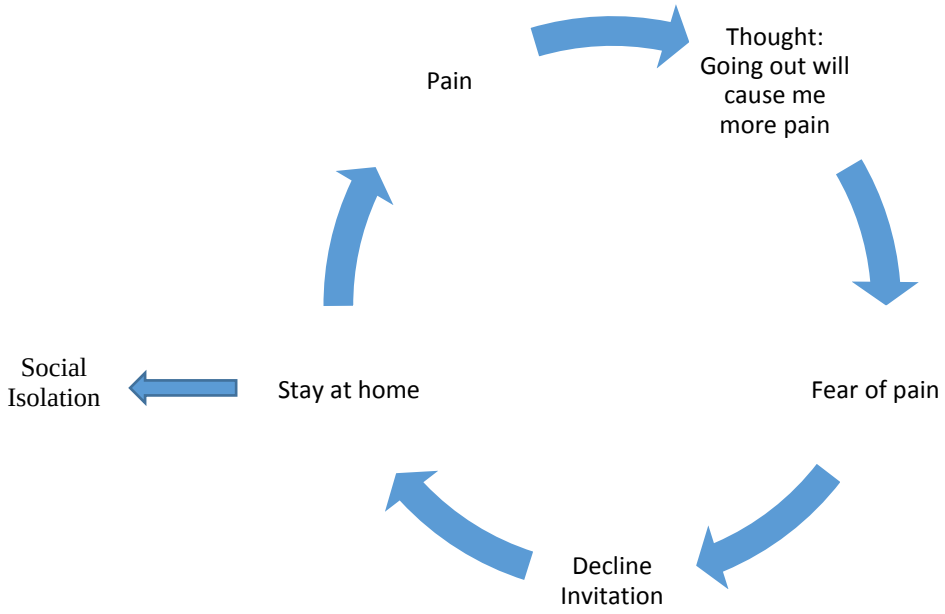


Avoidance behaviours reinforce the idea that avoidance is a helpful strategy in reducing your distress, so you do it over and over again. To an extent, yes it is helpful in reducing distress… until it causes more problems in the long-term.

What do you think some long-term problems are? *Get them to write their answer in their booklet*
The long term effect of avoiding activities that cause pain results in you doubting your ability to cope with pain, and reducing the activities you do in your life and may affect your well-being, and/or impede your recovery from surgery.

In the end, avoidance is actually keeping you from doing physical and psychological things that benefit you and that keep you well. (e.g., avoiding your rehabilitation exercises does not help you in the long term)

For example: Friends invite you to a dinner party. *Outline each step in the chart*



Social isolation can lead to you feeling down and dispirited, which can eventually lead to depression and anxiety.

Being by yourself and having little to interest you increases the likelihood that you will focus on your pain, and get caught up in it. This is because your attention is caught up in your sensations of pain, emotions surrounding pain, and thoughts surrounding pain because there is nothing else of interest to catch your attention.
On the other hand, when you are doing enjoyable or interesting things, or when you are with other people, your attention is focused on the activities or on other people, so you are less likely to get caught up in your pain.

Research has found that pain anticipation increases pain intensity, because anticipation of pain activates certain parts of the brain. The brain sites that are activated in anticipation of pain are similar to the sites that are activated by pain.

Anxiety also affects the amount of pain people experience, as some parts of the brain activate differently when anxiety is increased. (More anxiety tends to result in experiencing more pain.)

Read about gate control theory of pain – See Misc. Notes for reference

Strategies to help manage pain

In spite of the pain, clinicians will ask you to try to return to normal life as soon as you can.

*Ask: *Why do you think this is the case? What would happen if you stop doing the things you are doing in life now? What would that do to your psychological well-being? What would that do to your physical well-being?**

Stopping things that they are doing now will cause reduction in pleasurable activities and a decline in their mood, thus harming their psychological well-being. It could also relate to the cycle of avoidance (above), causing a reduction in self-efficacy, self-esteem and increased social isolation.

How do you think avoidance can cause a reduction in self-efficacy and self-esteem?

Using the same example from above:

Friends invite you to a dinner party -> you decline -> avoid more pain -> reinforces the idea that avoidance is a good solution -> start avoiding other activities (e.g., cleaning the house) -> reinforces idea that the less you do, the better off you will be, because you cannot cope with the pain -> reduced self-efficacy (e.g., you question yourself if you are able to clean the house by yourself and deal with the pain) -> reduced self-esteem because you have a poor sense of accomplishment.

Here are some strategies you can use to help to cope with your pain:

It takes more than 1 try to learn new skills – so encourage patients to keep practicing their skills (below). It's like learning a new language, you're not going to become good at it by only practicing it once. It takes many practice sessions before you start to see improvements!

1) Taking medication

The first obvious strategy is to take medications that relieve pain. These may include those prescribed by your doctor, or other medications such as paracetamol (e.g., Panadol).
It doesn't mean that you will feel no pain when you take pain medications, because medications only reduce rather than eliminate pain. The point of pain medications is to help you to function better, rather than removing all the pain.

Pain medications simply mask your symptoms; they don't treat the root cause of your pain. Pain medications on their own are not therapeutic if you don't engage in rehabilitation activities. Taking more than the recommended dose **will not** give you more pain relief, it actually can be dangerous.

2) Relaxation strategies & acceptance

Tug of war metaphor*

Say: *Imagine you are in a tug of war with a strong, tough person called Pain. You're holding one end of the rope, and they have the other end. Between you and Pain is a large bottomless pit. You're pulling as hard as you can, but they pull you closer and closer to the pit.*

Ask: *What is the best thing you can do in this situation?*
(If they say pull harder, say: *sure that's the natural thing to do, but the harder you pull, the harder they pull.*)
(If they say get a friend to help, say: *yes that's a great idea, so you're not in this alone, but Pain is stronger and still pulls you towards the pit. What else can you do?)*

(Answer: Drop the rope)

Say: *When you drop the rope, Pain is still there, but it is on the other side of the pit and you are no longer tied up in a struggle with them. They can still yell at you to bother you and tell you to pick up the rope, but you now have your hands free to do more useful things.*

Mindfulness and relaxation exercises help us to drop the rope.

Relaxation exercises and mindfulness can be very helpful in managing pain. *Mindfulness is about observing, not judging and not avoiding uncomfortable thoughts, emotions and sensations. Accepting that these experiences are real and part of life is the opposite of avoidance (refer back to cycle of avoidance). Avoiding pain does not mean that pain won't be there, in fact, you probably spend so much energy trying to avoid thinking and experiencing pain, that it becomes very tiresome.*

Being tense increases the amount of pain that people experience, because of the way the body is wired. Relaxation strategies can help you to become less tense, and therefore reduce the amount of pain that you experience.
(For more information, read about gate control theory of pain)

Relaxation is a state that the body is in. Mindfulness is the process and way of thinking, by being aware of what happens in your body and in your surroundings, observing events or objects, being gentle, not judging and not avoiding. The process of being mindful can result in a state of relaxation. Mindfulness is a skill that needs to be learnt and practiced, and can be difficult when you are just starting to learn it.

Ask the patient what they could do to relax?
If they are stuck, here are some examples: listening to calming music, singing, sitting outside and watching the world go by/enjoying the sunshine, hobbies such as writing, drawing, colouring, painting, etc. *Get them to write it down in their booklet*

Ask the patient if they've ever used relaxation or mindfulness strategies - if yes, which ones? Did they find it useful? *Discuss with them if they would be willing to try some mindfulness exercises*

The point of mindfulness exercises is <u>NOT</u> to relax. It is to help us be more aware of our internal states and external surroundings, so that we can let go of the rope and stop struggling in the tug of war.

***Email the Audio-recordings of mindfulness of the breath and body scan to patients** – discuss with them that they can upload it to their phones and use it when they notice they are tense and that their pain levels are elevated. Their job this week is to try some relaxation strategies and mindfulness of the breath.* *Ensure that you email them with instructions on how to download the audio-recordings on to their phone – suggest using VLC player*

Explain: *The mindfulness of the breath exercise will help you to bring your attention back to the present and help you to relax.*
The body scan exercise will help you to approach your pain rather than avoid your pain. We know that your experience of pain is real, and that avoiding it is not helpful. The exercise will direct your attention to different parts of your body.
Unfortunately we do not have time to do them together today, so how do you feel about trying them out at home and see if they help you, and we can discuss them next time I see you?

3) Mantras

When things get rough, what are some statements that you can tell yourself to encourage yourself? *Get them to write this in their booklet*

*Note to therapists: Mantras need to be specific rather than general.
Statements like "I can do it" is not specific enough – what is "it"? An example of a good mantra is "It is painful but I am strong and can persevere through this pain" or "This recovery period is only a short window of my life, it will get better"**

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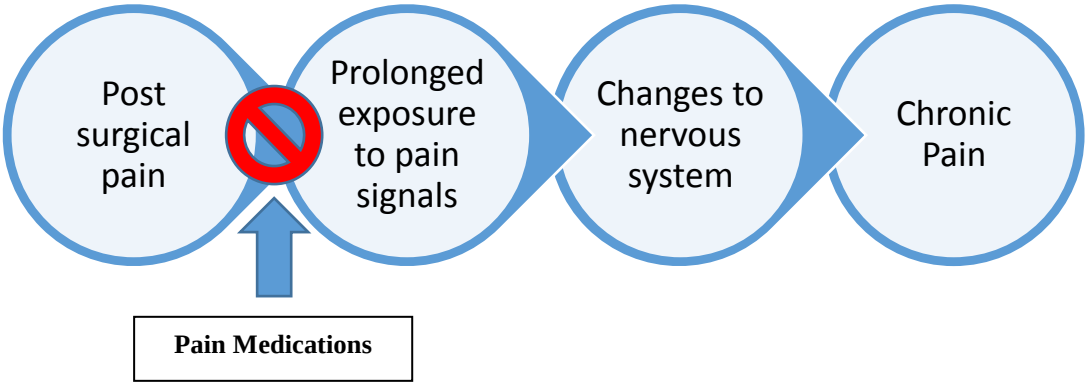
Stopping chronic pain from developing

Skip this section if you are running out of time – encourage them to read this when they get home

Many people don't like taking pain medications as they fear the side effects or getting addicted to them. However, prolonged transmission of pain signals in the body can cause long-term physiological changes in the nervous system.

These changes in the nervous system cause a reduced threshold for activation (takes less stimuli for the body to send pain signals) and an abnormal amplification of perception of pain. Initially, this process can be reversible, but over time can become permanent (Pergolizzi et al., 2013).

Pain medications stop the release of certain chemicals and activation of certain receptors. Taking them while your body recovers in the initial stage after surgery will stop the long-term changes in the nervous system from happening. Stopping pain medications too early can put your body at risk of changes in the nervous system, leading to chronic pain. Additionally, you will be putting up with more pain than necessary.



It is true that prolonged consumption of pain medicine (like opioids) can lead to addiction, but taking them responsibly, as directed in the short term will benefit you in both the short and long term. You will require the most amount of pain relief in the first 48 hours after surgery.

It is often recommended that you take paracetamol (e.g., Panadol) *to take the edge off the pain, if the pain is not so severe. – So you don't necessarily need opioids.*

Long-term consumption of opioids may result in development of tolerance, dependency, addiction, abnormal pain sensitivity, cognitive dysfunction, hormonal changes, immune modulation, cardiac events and risks of injury (Clarke, Soneji, Ko, Yun, & Wijeysundera, 2014; Højsted & Sjøgren, 2007)

Worried that you may be addicted? Here are some questions you can ask yourself:
Therapist: You do not need to discuss this. Just make the patient aware of this checklist so that they can refer back to it in the future.

- Does your body crave the drug?
- Do you swing between feelings of euphoria and feelings of pain or discomfort?
- Do you feel that the dose you use to take doesn't have the same effectiveness anymore?
- Have you experienced symptoms like nausea, pain sensitivity, constipation, or shallow breathing?

If you have answered "yes" to any of them, then you should speak to your doctor.

Hospital Stay

*Ask: *How are you feeling about being in hospital? How do you feel about going home a few days after surgery? How long would your ideal stay be?**

The aim of the hospital stay after your surgery is to ensure that your body is well after surgery, and that there is no complications from the surgery (such as side effects of medication and anaesthetics).

Once you are up and moving, and are able to shower/toilet yourself, you should be ready to go home! 99% of the recovery from surgery happens after you are discharged from the hospital. The physiotherapist or occupational therapist would have briefed you on the exercises you have to do every day, and your recovery will depend on the amount of effort that you put in, in the following months. You can still be in contact with your doctor after you go home if you have concerns, and go to out-patient clinics where the physiotherapists will continue to help you with your rehabilitation.

The longer you stay in hospital, the higher your risk of developing an infection. So if you are stable and ready to go home, then you should!

It may be necessary to do motivational interviewing for staying in hospital for longer than they need to (If they say "I would like to stay as long as possible"). You do not need to do motivational interviewing if they are happy to go home after a few days.

Explore pros and cons on the whiteboard – It might look something like this:

	Staying in hospital longer	**Shorter stay in hospital**
Pros (+)	• Constant care/support from staff • Food is provided	• Get to go back to comfort of home • Reduce the risk of infection • More independence
Cons (-)	• Less independence • Less privacy • May cost more money • Increased risk of infection	• No professional support 24/7 at home • Prepare own meals

Monitoring worksheets (home activity)

Refer to the monitoring sheet in the patient's booklet.

- Discuss with them the rationale behind monitoring: It helps to keep track of progress over time, in a concrete way as it is written down. If we did not write it down, then it is difficult to depend on our memory because so many things would have happened in between.

- Ask them how they would feel about filling out a row every day, to get used to monitoring their pain and mood, so they can use it as a guide to use coping strategies as you have discussed today in the session.

- Explain that the number of steps they took in the day is a measure of movement, and is an estimate and doesn't have to be exact. If they went for a 1km walk, then they can write "1km walk" rather than number of steps. We don't expect everyone to have a smart phone/watch and to be carrying it on them 24/7. **Show them the function on their smart phone if they don't know how to access it.** (e.g. "Health" app on iPhones, "Google Fit" on Android)

  Setting up "Google Fit": Google Fit is Google's competitor to Apple Health, and is included on some new Android phones. You can still install it from Google Play on older phones, but it'll work better on newer phones with the appropriate motion-tracking hardware. When setting it up, you will need to give it access to the sensors it needs to monitor your step counts.

Discuss with patients that they will be filling out this log every week for the rest of the program, except for when they are in hospital. They should start filling it out again when they go home.

- *Refer patients to Session 3's monitoring chart page: Discuss with them about completing this when they return home from hospital. You should remind them again during the next session. *
  We are introducing this now because you may already be overwhelmed with information given to you in hospital during our next session.

Make your next appointment with them (in hospital), 2 or 3 days after their surgery
Note: Some patients may get sent home on Day 3 after surgery, so Day 2 is the best day to visit. (Day 0 is the day of operation, so Day 2 would be 2 days after their surgery) If Day 2 happens to be on a Sunday, then just visit them on Monday morning.

They are unlikely to know their ward number before their surgery, so send them a text message from the 2-way SMS system, and tell them to reply to it with their ward number. If you have set up your 2-way SMS system to receive emails, you should receive their reply via your email. Please advise them in the text that they should call 64882644 or text back, rather than call the number as you will not receive their call through the SMS system.

Make your appointment (Session 4) with them for 2 weeks after their surgery - do this now because they may not remember in the next session due to medication effects/overwhelming information from the hospital.

Discuss with them their activities for the week.

Activities for this week

- Read section about stopping chronic pain from developing
- Notice thoughts:
    - Are they helpful/unhelpful, negative/positive/realistic?
- Experiment with relaxation and mindfulness strategies to see what works
- Complete monitoring sheet

***Remind:** *Don't forget to pack your booklet when you go to hospital for your surgery! We will be visiting you in hospital after your surgery**

End of Session 2

My activity this week: Notice thoughts, experiment with relaxation & mindfulness strategies to see what works for me.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week

Mindfulness of Breath Script

Let's begin by making yourself comfortable, allowing your arms to rest in your lap, or by your side. Allow your eyes to close, or gently rest them by fixing on a spot in the room.

Take some long, slow, deep breaths, inhaling and exhaling gently… (Pause)

Allow your breath to find a natural rhythm… (Pause)

Notice each breath as in enters your body, as it travels from your nose or mouth to your lungs, causing your chest and belly to expand… (Pause)

Notice each breath as it exits your body, as it travels from your lungs to your nose or mouth, causing your chest and belly to return to its original position… (Pause)

Notice the different temperatures of the air you breathe in, and the air you breathe out… (Pause)

You may notice that the air is cool as it enters your nose or mouth, and warmer when you exhale… (Pause)

Now and then, you may be distracted by sounds around you, pain, thoughts in your head, or emotions. Simply acknowledge your experience with these sensations, thoughts and emotions, notice what distracted you, and gently redirect your attention to your breaths… (Pause)

There is no need to push sensations, thoughts and emotions away. You may allow them to sit in the back of your mind, but re-focus your attention to your breaths, as you breathe in, and out again… (Pause)

Allow yourself to breathe naturally, with no force or intention to speed up or slow down… (Pause)

Continue to notice the sensations of your breath, and the effect of your breathing on your body… (Pause)

As this exercise draws to an end, gently allow your attention to expand to your surroundings… (Pause)

When you are ready, you may open your eyes.

Remember that your breath is always with you and that you may do this exercise whenever and wherever you need.

Body Scan Script

Let's begin by making yourself comfortable, and resting your hands gently on your stomach or by your side. If your mind begins to wander during this exercise, gently notice and acknowledge this without judgment, and bring your attention back to noticing your breath, or the sensations in your body.
Allow your eyes to close, or to remain open with a soft gaze if you would prefer.
Take some long, slow, and deep breaths. Breathing in and out slowly… (Pause)
Feel the rising of your stomach as you inhale… and the falling as you exhale… (Pause)

Now, gently bring your attention to your feet, and begin observing the sensations in your feet… (Pause)
Wriggling your toes a little, and noticing their movements… (Pause)
Just notice, without judgement, as these sensations are neither good nor bad… (Pause)

When you are ready, gently bring your attention to your knees… (Pause)
Begin observing the sensations in your knees, without judging… Allowing the sensations to be there, just as they are... (Pause)
Continue taking slow and deep breaths, and noticing the sensations in your knees… You may notice some pain, numbness or aching, or nothing at all… Just allow it to be and notice what it feels like… (Pause)
It is neither bad, nor good, it is just what you are feeling… (Pause)
Noticing how the sensations shift and change from moment to moment… (Pause)

When you are ready, gently bring your attention to your hips… (Pause)
Begin observing the sensations in your hips, being curious about your position and sensations there… (Pause)
Noticing the points of contact with the bed/furniture… (Pause)

When you are ready, gently bring your attention to your shoulders… (Pause)
Begin observing the sensations in your shoulders… (Pause)
Noticing any tension that you may have, and continue breathing in and out, slowly… (Pause)

When you are ready, gently bring your attention to your head and face… (Pause)
Begin observing the sensations on your head and face… (Pause)
Noticing any tension in your forehead, and observing what that feels like… (Pause)
Continue breathing in and out, slowly… (Pause)

Now, let your attention expand out to include the entire body as a whole… (Pause)
Feeling the rhythm of your breath and movement of your body… (Pause) When you are ready, you may gently open your eyes, and bring your attention back to the room.

Checklist: Session 2

☐ Administer the weekly questionnaire.

☐ Check in on preparation for surgery during the past week.

☐ Measure range of motion with goniometer.

☐ Explore the definition and components of pain.

☐ Explain the misconception and neurobiology of pain.

☐ Explore relationships between thoughts, emotions, behaviours and pain.

☐ Explore the strategies to help manage pain:

- Taking medications ≠ No pain
- Tug of war metaphor and relaxation activities
- Specific mantras

☐ Explore expectations of hospital stay and explain the role of the hospital stay.

☐ Explain how to complete monitoring worksheets.

☐ Outline activities for the week:

- Read sections that were skipped during this session, notice thoughts, experiment with strategies, & monitoring chart.

☐ Arrange appointments for sessions 3 and 4.

☐ Send audio recordings to patient: Mindfulness of Breath, and Body Scan.

Session 3

(In Hospital)

- Find out what they are struggling with – validate and support
- Review managing pain
- Strategies to help manage recovery
- How they feel about going home
- Medication chart (for keeping track at home)
- Monitoring progress (worksheet)

Materials:

- Manual
- Audio-recording device

This session is going to be held in hospital. Some patients may still be on opioids and may seem "out of it", so the aim of this session is to validate and support them through their hospital experience, and to remind them of the skills taught in session 2.

Audio-record this session, as you will not have the clinic's video recording system available. Explain to them that this is for supervision and data analysis purposes and it will be deleted as soon as possible.

In today's session, we are going to discuss:

- *How you are*
- *More helpful strategies to help in your recovery*
- *Going home*
- *Medications chart and monitoring.*

Check in

Note: Spend most of this session checking how they are and supporting them.

- *How are you feeling?*
- *How are you coping after your surgery?*
- *What are you struggling with?*
- *Have you been able to walk? How much have you walked?*
- *Have you managed to toilet and shower yourself?*
- *How is your mood?*
- *How did you feel while waiting to go into surgery?*
- *How have you been sleeping?*
- *Have you been eating well?*
- *How much pain are you in?*
- *Has your support person been checking on you?*
- *Have they used any coping strategies yet? Have they been useful?*
    - Medications, relaxation activities, mindfulness, pacing, mantras, talking to friends/family, icepacks, realistic thinking.

    Revisit session 2's content if they don't remember what strategies they can use
    - Did they find the mindfulness audio recordings helpful? Y/N – which ones?

If they have not used any coping strategies, ask them what might trigger some uncomfortable emotions like stress and anxiety, and what they could do to cope in those situations.

If they are feeling very anxious, you may want to do a mindfulness exercise with them, preferably a short mindfulness of breath exercise, to help ground and calm them – the script is at the end of the 2nd session. Ask if they would be willing to do it with you. If they say no, brainstorm with them what they could do to ease their anxiety.

Remember that your recovery is not just about the physical body healing, you need to look after your psychological well-being and activities of daily living too. It comes as a package - if you only look after one part, your body will turn on you, to send you the message that things are not going well.

More Helpful Strategies

During the previous session, we talked about taking medications, using mindfulness, and mantras to help with managing pain. Now we are going to discuss more strategies that you can use to help manage your recovery.

1) Pacing activities

Pushing too hard to get things done can cause your body to react with more pain and discomfort, but avoiding activities can also lead to more pain and poor outcomes. So what can you do?

You can break your day-to-day activities and rehabilitation exercises into chunks. Do small amounts of activity many times throughout the day, and find a balance between not overdoing it, and not under-doing it.

For example, instead of doing 30 repetitions of a knee bending exercise at once, you could do 5 repetitions every 2 hours. Or, if you have to clean the house, you could do 1 room at a time, taking breaks in between rooms.

You should use pacing to help you achieve your goals, rather than to avoid pain. Pacing can help you to increase your tolerance for activities over time.

It is like building up the amount of activity that an athlete can do. When an athlete first starts out, they might only be able to run 5km before they feel that they cannot go on. But as time goes on and they keep training, their tolerance for activity increases, and they can run 10km, 20km and eventually a full marathon.

You probably do not need to run a full marathon, but you can use pacing to help you increase your tolerance for activities, so you can return to your normal lifestyle after surgery.

Can you think of some examples of activities that you could pace after your surgery? How will you break them up?

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IMPORTANT NOTE: ***Doing more is not necessarily better!*** *Overdoing things will cause you a significant increase in pain and may even cause some damage – remember that pain is trying to remind you of your surgery and the healing that the body needs to do.* ***It is about finding a balance between moving and resting.***

2) Keep up with your social life

Maintaining your social life, such as spending time with friends, family and loved ones on a regular basis is important to keep you mentally healthy. Talk about your pain, but make sure you talk about other daily things too!

Research has shown that social factors can affect emotional and mental wellbeing, which can have an indirect effect on the amount of pain you experience and the way you cope with pain.

Who can you spend time with after you go home?

3) Icepacks

Regular cooling of your knee using icepacks can be helpful in reducing the amount of discomfort experienced from the heat and inflammation.

Some patients in the past have said it is useful to have more than one in your freezer, so you can rotate them throughout the day.

Going home

- *Do you feel ready to go home yet? Why/why not?*
- *Are you looking forward to going home? Why/why not?*

If needed: reflect to them the pros and cons of going home and staying in hospital.

Remember that 99% of your recovery from surgery happens after you go home.

Medications when going home

Refer to medication chart sheet.

Your doctor is going to prescribe some medications when you are discharged from the hospital. Some people get confused about their new medications, so we have provided you with a chart to help you keep track of them.

This is for your reference so that you can understand your medications better. You may fill it out however you would like to – there's no wrong or right way to do it. Do you think this might be helpful for you? *Discuss willingness to use it*

Encourage them to discuss the "what is it for" column with the nurses/doctors if they are unsure of the reason they were prescribed the medication.

Note to therapist: Patients should use this chart however they would like to, as it is for their own reference only. We will not check whether it is right or wrong, however, we will check if they used it. They may wish to include all their medications, or just the medications that are specifically related to their knee operation. They may even include supplements (e.g., vitamins) if they want to.

Monitoring when at home

*Refer to the monitoring sheet. *
Say: *Remember that I mentioned that we were going to ask that you complete the monitoring sheet again when you return home from hospital? I am just reminding you now, to do it in the same way that you did last week, when you get home.* – *Ask if they have any questions.*

Their job for the next 2 weeks is to continue using coping strategies, and to fill in the charts.

Discuss with the patient that your next appointment will be in 2 weeks, and to contact the clinic if they are still in hospital by the end of next week - Check in with them 1 or 2 days before your agreed appointment any way, as they might not remember to contact you due to the medication they are on.

Activities for this fortnight

- Complete medication chart
- Complete monitoring chart

End of Session 3

Medications chart

Name of Medication	What is it for?	How many tablets to take each time?	When do I need to take it?	How long should I take it for?	Do I need to get repeats? If so, when?

My activity this week: Use helpful strategies to manage pain.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Checklist: Session 3

☐ Check in on how the patient is feeling.

☐ Check in on what they are struggling with and validate.

☐ Check whether they have used strategies from session 2.

☐ Explore the strategies to help manage their recovery:

- Breaking up activities into smaller chunks (Pacing)
- Keeping up with social interactions
- Icepacks

☐ Explore readiness to go home.

☐ Explain medicine chart.

☐ Remind them of their monitoring chart for when they go home.

☐ Remind them that the next session is in 2 weeks.

Session 4

(Week 2 post-surgery)

- Check in on patient
- Discuss expectations vs reality (Manage expectations if applicable)
- Managing uncertainty
- Setting goals/rewards: short and long term
- Mindfulness of thoughts
- Monitoring progress (worksheet)

Materials:

- Manual
- Weekly questionnaire
- Goniometer
- Mindfulness of thoughts audio

Patients are to fill out weekly questionnaire.

In today's session, we are going to discuss:

- *How you are managing in your recovery*
- *How your expectations compare to reality*
- *Managing uncertainty*
- *Goals and rewards*
- *Another mindfulness tool*

Check in

- *How is your recovery going?*
- *What are you struggling with?*
- *Did you manage to walk much this week?*
- *What activities did you manage to do this week?*
- *How is your mood?*
- *Did you experience pain this week?*
- *How have you been sleeping?*
- *Have you been eating well?*
- *Has your support person checked in on you?*
- *Have you used any helpful coping strategies? Have they been useful?*
    - Medications, relaxation activities, mindfulness, pacing, mantras, talking to friends/family, icepacks, realistic thinking.

  Revisit session 2's content if they don't remember what strategies they can use
    - Did they find the mindfulness audio recording helpful? Y/N, which ones?

Are they engaging in helpful or unhelpful coping styles? If it is unhelpful, then you may need to do motivational interviewing

- *Do you have any questions about the previous session?*

Expectations

- *How did your expectations of being home compare to reality?*
- *How did your expectations of recovery compare to reality?*

Review activities since session 2

<u>*Take a photocopy of the patient's charts (from sessions 2 & 3) to include in your file!*</u>

- Did they notice their thoughts? Were they able to tell if they were helpful/unhelpful, negative/positive/realistic? – Get some examples, what did they make of this?
- Did they experiment with relaxation exercises? What worked for them? Have they used the strategies since they got home? What have they found?
    - If not, what got in the way? Work out how they can overcome these obstacles – if it's a matter of motivation, you may want to do a motivational interviewing exercise on the board
- Monitoring sheet (x2 weeks – any differences between the 2?)
    - Their pain
    - Their mood
    - Their movement
    - Their rehabilitation exercises

Measure their range of motion using the goniometer and record on their weekly questionnaire.

Managing uncertainty (Adapted from Saulsman et al., 2015)

- *How do you feel when you are uncertain about how things will turn out?*
- *How do you feel about what is going to happen in your recovery over the next year?*

People who don't like uncertainty, tend to say things like:

"I need to be 100% sure, I can't stand it otherwise."

"I know that the chances of it happening are so small, but it could still happen."

- *Do you think worrying is helpful? Does worrying help you to become more certain or make events more predictable?*
- *Does worrying change events that will happen?*

Worrying about uncertainty may give you a sense that you are in control of your situation, but in reality, all you have done is think of all the worst case scenarios and made yourself very uncomfortable.

Of course it is not good to ignore problems and not think about them at all. That is avoidance – We have talked about avoidance in earlier sessions, so now we are talking about the opposite problem: obsession.

- *Ask if they have something uncertain in their life that they are worried about.*
    - Use the topic to run through the questions below

If the patient does not identify with any of the above and is totally fine with uncertainty, then get them to think of someone in their life that the statements and intolerance of uncertainty may apply to.

What can you do instead?

a. Challenge your intolerance of 'the unknown'
b. Accept 'the unknown'

a. Challenging intolerance

- Is it possible to be absolutely certain about everything in life?
- What are the **advantages** of needing certainty in your life?
- What are the **disadvantages** of needing certainty in your life?
- Is it reasonable to predict that something **bad** is going to happen if you are not certain about events?
    - What else might happen?
- What is the **likelihood** that your predictions will come true?
    - If it is low, can you live with that small risk?
- Are there uncertainties in your life that you are currently ok with?
    - How do you do that?
- How do **other people** you know cope with uncertainty in their life?

b. Accepting 'the unknown'

1) **Be aware** of what you do when you think about uncertainty. What do you tend to do?

2) Don't go down the rabbit hole

What can you tell yourself to stop thinking of every worst possible thing that can happen?

3) Let go of your need to be certain

How can you do this?
(*therapists can suggest: put need for uncertainty on clouds and watch them drift by in the wind, or on leaves drifting down a stream. Remind self that uncertainty is part of life*)

4) Focus on the present

What can you do/tell yourself to help yourself focus on the present rather than the past/future? (*therapists can suggest: mindfulness exercises of the breath*)

5) Refocus

What can you do/tell yourself when your mind drifts back to wanting certainty?

Setting goals and rewards

Professional athletes and many successful people set goals, as goals give them a sense of direction and help to motivate them. Goals help professional athletes and successful people to focus their attention on what is relevant, and help them to organize and prioritize how their time and resources should be spent.

For example, an athlete may have a goal to compete in the Olympics, so they must plan and organize their time and resources so that they can qualify for the Olympics team. If they do not know how to qualify for the Olympics team, the goal itself gives them motivation to go and find out all the information needed to get onto the team. On the other hand, if they did not have goals, then they could train as hard as they can and see where their training takes them. Are they likely to end up on the Olympics team?

In the same way, you may work really hard in your recovery, doing all the exercises prescribed to you and following all the instructions given to you, but if you do not have any goals, you are likely to be 'going with the flow'. Without goals, do you think it will be easy achieving things that matter to you?

Goals give us direction and help us to check whether we are on the right track to achieve the things we want. Additionally, setting and being able to put a tick next to your goal can be satisfying, as you can feel a sense of achievement and some control over your life.

How would you feel about setting some goals for your recovery?

When setting goals, remember to make them SMART.
***S** = Specific; **M** = Measurable; **A** = Attainable; **R** = Relevant; **T** = Time-based*

> Example of a **not**-SMART goal:
> I would like to be able to bend my knee by the end of my recovery.
>
> Example of a **SMART** goal:
> I would like to achieve 120 degrees bend in my knee, by 6 months post-surgery.

Remember to reward yourself for achieving your goals too!
Rewarding is important, it can keep us motivated and give us a sense of achievement. Your rewards do not have to be big, they should be proportionate to the size of your achievement and goal.

> An example of a *small* reward is treating yourself to an ice-cream for achieving your 120 degrees of bend in your knee.
>
> An example of a *bigger* reward may be going to your favourite restaurant for being able to go up and down more than 20 stairs.

If you can, try to involve other people in your rewards!
For example, you may agree with your support person that your goal is to be able to walk to the local shops, and that your reward would be for them to buy you a coffee.

Therapists: complete the short-term goals with them, and encourage them to think about their long-term goals <u>at home.</u> You discuss long-term goals at the end of the session if you still have time. Other goals at the end of this section refers to any other time periods or extra space for them to write more goals

Short-term goals:

- What would you like to achieve tomorrow?

_____

My reward:

_____

- What would you like to achieve by next week?

_____

My reward:

_____

- What would you like to achieve in 2 weeks' time? (Final session)

_____

My reward:

_____

Note: You can start by asking them what their long-term goal is (in a year's time), and then work backwards from there. *What would you like to be able to do in a year's time? What do you need to be able to achieve tomorrow, or next week, in order to work towards achieving that goal in a year's time?*

Long-term goals:

- What would you like to achieve in a month's time?
  Reward:

- What would you like to achieve by 3 months post-surgery? (1st follow up for this study)
  Reward:

- What would you like to achieve by 6 months post-surgery? (2nd follow up)
  Reward:

- What would you like to achieve by 12 months post-surgery? (3rd follow up)
  Reward:

  Other **SMART** goals and rewards?

Mindfulness of thoughts

In session 2, we talked about avoidance of pain. Do you remember? (If they say no, you will need to review the content.)

We tend to want to avoid uncomfortable things, and this is also the case with thoughts that make us frustrated, sad, anxious or angry. How do you think you can manage such uncomfortable emotions or thoughts?

We can manage frustrations and low mood in the same helpful way that we manage our pain. Instead of avoiding thoughts surrounding uncomfortable emotions, we can simply watch them float by, which will help us to calm down and enable us to deal with situations effectively.

Say: *I will email you another audio recording, which I would like you to try at home. The exercise is about observing and allowing thoughts to be there – whether they are positive, negative or neutral thoughts. It may be particularly useful when you're feeling overwhelmed or when you need to clear your busy mind. It is another tool you can use along with the other 2 exercises (breath and body scan).*

Send them a copy of the mindfulness of thoughts audio recording

Discuss their activity for the week.

Activities for this week

- Set long-term goals and rewards
- Notice how they manage uncertainty
- Try mindfulness of thoughts
- Complete monitoring chart

End of Session 4

My activity this week: Set long-term goals.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Mindfulness of thoughts Script: Leaves on a stream exercise

Adapted from Russ Harris (2009)

Sit in a comfortable position, and close your eyes, or gently rest them by fixing on a spot in the room.
Imagine yourself sitting next to a gently flowing stream in the middle of a calm forest, with leaves floating on the surface of the water… (Pause)

For the next few minutes, place each thought that enters your mind on a leaf, and allow the leaf to float by you, down the stream… (Pause)
Continue to do this with each thought that enters your mind, whether it is pleasurable, painful, or neutral... (Longer pause)

From time to time, your thoughts may distract you from being fully present by the stream. Acknowledge that you have become distracted, and gently bring yourself back to the stream… (Pause)

If no thoughts come to mind, continue to observe the stream of flowing water… (Pause)
Allow the stream to flow at its own pace, without speeding it up or slowing it down… (Pause)
Allow your thoughts to drift at their own pace, as you are not in a rush to get rid of your thoughts… (Pause)

If your mind says "This is dumb", "I am bored", or "I am not doing this right", place those thoughts on leaves too, and allow them to drift down the stream… (Pause)

If a leaf gets stuck behind a rock and the thought lingers, allow it to hang around until it is ready to float down the stream… (Pause)

If the same thoughts come up again, allow them to float by you again… (Pause)

If difficult emotions or pain catches your attention, simply acknowledge it. Say to yourself, "I notice that I am feeling pain or uncomfortable emotions". Place those thoughts on a leaf and allow it to drift down the stream… (Pause)

When you are ready, gently open your eyes and bring your attention back to your surroundings.

Checklist: Session 4

☐ Administer the weekly questionnaire.

☐ Measure range of motion with goniometer.

☐ Check in on how the patient is feeling.

☐ Check in on what they are struggling with and validate.

☐ Check if they used strategies to manage difficulties and explore what worked/did not work.

☐ Explore how their expectations compare to reality.

☐ Review monitoring charts since session 2.

☐ Explore if they noticed helpful vs unhelpful thoughts.

☐ Explore Managing uncertainty

☐ Explain role of goals and rewards.

☐ Set short-term goals.

☐ Discuss mindfulness of thoughts.

☐ Outline activities for the week:

- Set long-term goals and rewards, notice how they manage uncertainty, & monitoring chart.

☐ Arrange appointment for session 5.

☐ Send audio recording to patient: Mindfulness of thoughts.

Session 5

(Week 3 post-surgery)

- Check in on patient
- Review goals/rewards – achievements in short term, what to do if you don't achieve your goals
- Values
- Catastrophizing
- Continue to monitor progress (worksheet)
- Last session next week

Materials:

- Manual
- Weekly questionnaire
- Goniometer

Patients are to fill out weekly questionnaire.

In today's session, we are going to discuss:

- *How you are managing your recovery*
- *Goals and rewards*
- *Things you value in life*
- *Thinking styles and reframing thoughts*

Check in

- *How is your recovery going?*
- *What are you struggling with?*
- *Did you manage to walk much this week?*
- *What activities did you manage to do this week?*
- *How is your mood?*
- *Did you experience pain this week?*
- *How have you been sleeping?*
- *Have you been eating well?*
- *Has your support person checked in on you?*
- *Have you used any helpful coping strategies? Have they been useful?*
    - Medications, relaxation activities, mindfulness, pacing, mantras, talking to friends/family, icepacks, realistic thinking.
    - Did they find the mindfulness audio recording helpful? Y/N, which ones?
- *Have you got any questions about last week's session?*

Measure their range of motion using the goniometer and record on their weekly questionnaire.

Review activities

- Goals and rewards
    - *How did you go with coming up with goals and rewards?*
    - *Did you achieve your short-term goals?*
        - If no, why not? Re-set goals if they are too big, and remind them of the SMART abbreviation.
    - *Did you reward yourself?*
        - If no, why not? *We take time to take care of our physical well-being, so we should also take time to take care of our psychological well-being.*
- Did they try mindfulness of thoughts?
    - What did they make of it?
    - If they didn't do it, find out why and what got in the way.
- Monitoring sheet
    - Their pain
    - Their mood
    - Their movement
    - Their rehabilitation exercises
- Approaching vs avoiding discomfort
    - Did they do this? If so, give an example?

<u>*Take a photocopy of the patient's chart to include in your file!*</u>

Today's session is the 2nd last session
How do you feel about finishing the program?
What have they found helpful so far?
What would you like to concentrate on in the next 2 weeks?
You may review previous sessions' content with them if they want to in the next session

If they are anxious and want to continue receiving psychological support, then you should discuss with them to see if they want referral options – bring this up in supervision, and you can provide them with the information in their final week

Values

Another way to make your recovery more pleasant, is to ask yourself the following questions:

- *What do you value in life?*
    - Examples: Building relationships, education, creativity, fun, fitness, helpfulness, justice, spirituality, etc.
- *Are your daily activities/actions in line with your values?*
    - If not, what actions or activities are not in line with your values?
    - What can you do instead, to make them in line with your values?

Catastrophizing

Note: You may choose to use different terminology, depending on your patient's style, instead of calling it 'catastrophizing' as it is quite a strong/difficult word. You may term it 'thinking of the worst possible outcomes', or 'blowing things out of proportion'.

Sometimes our mind plays up problems to be bigger than they actually are, and when we take time to look at the problem, we realise how blown out of proportion our perception is. *Ask patient if they have ever experienced this*.

When things are not going our way or when we are under a lot of stress or pain, we tend to blow things out of proportion, and label our experiences as 'awful', 'dreadful', 'terrible' and 'horrible'. This style of thinking is called Catastrophizing, where we instantly think of the worst outcomes that can happen.

Do you remember that in session 2, we discussed how thoughts, feelings and behaviours are all interlinked, and that realistic thinking is the most helpful thing we can do? (If they do not remember, go back to session 2 and work through the burglar and pain examples)

Would you say that thinking about the worst-case scenarios (catastrophizing) is realistic thinking?

Now let's do an experiment. *Ask patients to notice the difference when they tell themselves the following statements. Tell them to say them out loud. (How do they feel when they tell themselves one, and then the other?)*:

"My pain is overwhelming and I cannot deal with this."
"My knee is pretty painful, so I need to do something about it."

The first thought is one that is catastrophizing, and the second one is using helpful coping actions. *Remember that we discussed unhelpful versus helpful coping in session 1? Catastrophizing thoughts tend to lead us to use unhelpful coping strategies.*

Here is another example:

"My pain is awful and it is never going to get better. I am going to be disabled for the rest of my life."
"My knee is pretty painful, but if I can do something about it now, the pain will most likely decrease as I recover more."

- *How do you feel when you tell yourself the first statement?*
- *What are you likely to do when you tell yourself the first statement?*
- *How do you feel when you tell yourself the second statement?*
- *What are you likely to do when you tell yourself the second statement?*

What do you think you can do, when you notice yourself catastrophizing?

You can reframe your mood and pain, so that it is not blown out of proportion and labelled using extreme words such as 'awful', 'dreadful', 'terrible' and 'horrible'.

Here is a chart to help you reframe your thoughts: *Work through one of their own thoughts with them*

Catastrophizing thought	**How does the catastrophizing thought make me feel? What am I likely to do?**	**Come up with a more realistic and helpful thought**	**How does this new thought make me feel? What am I likely to do now?**
Example: ***My pain is overwhelming and I cannot deal with this.***	*Example:* *Very Frustrated and helpless. I am likely to engage in unhelpful coping strategies. I am likely to avoid moving, and activities that cause more pain even though I enjoy them or are good for me.*	*Example:* ***My knee is pretty painful, so I need to do something about it.***	*Example:* *Slightly frustrated but hopeful. I am likely to use helpful coping strategies, such as take my medication, use mindfulness, or talk to a friend about it. I probably will not let my pain get in the way of my pleasurable activities.*

Discuss their activities for the week.

Activities for this week

- Practice reframing thoughts
- Complete monitoring chart

End of Session 5

My activity this week: Practice reframing thoughts.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Checklist: Session 5

☐ Administer the weekly questionnaire.

☐ Measure range of motion with goniometer.

☐ Check in on how the patient is feeling.

☐ Check in on what they are struggling with and validate.

☐ Check if they used strategies to manage difficulties and explore what worked/did not work.

☐ Explore goals/rewards and monitoring chart from last session.

☐ Explore values.

☐ Discuss catastrophizing.

☐ Outline activities for the week:

- Practice reframing thoughts,
- Monitoring chart

☐ Arrange appointment for session 6.

Session 6

(Week 4 post-surgery, final session)

- Check in on patient
- Review goals/rewards – achievements in short term
- Review progress (worksheet)
- Preparation for ongoing recovery: Most difficult time (1st 3 weeks) – moving forward after intervention is over
- Post intervention questionnaires
- Feedback

Materials:

- Manual
- Weekly questionnaire
- Goniometer
- Camera: for taking photo of knee range of motion
- Questionnaires
- RWC evaluation form

Patients are to fill out weekly questionnaire.

Today is our final session! How do you feel about finishing the program?
Discuss referral options if needed

In today's session, we are going to discuss:

- *How you are managing your recovery*
- *Goals/rewards and progress*
- *Preparing for ongoing recovery*

Say: A*t the end, you will complete some questionnaires, and these should take about 30mins.*

First, we are going to do your final range of motion measurement, and then take a photo of your knee.

> ***Measure their range of motion using the goniometer and record on their weekly questionnaire.***

Take a photo of their knee at their maximum flexion (Photo of the legs only! No faces to be in the photo)

Email photo to Sam with their Participant ID and date.
Instructions on how to take the photo is at the end of Session 1.

Check in

- *How is your recovery going?*
- *What are you struggling with?*
- *Did you manage to walk much this week?*
- *What activities did you manage to do this week?*
- *How is your mood?*
- *Did you experience pain this week?*
- *How have you been sleeping?*
- *Have you been eating well?*
- *Has your support person checked in on you?*
- *Have you used any helpful coping strategies? Have they been useful?*
    - Medications, relaxation activities, mindfulness, pacing, mantras, talking to friends/family, icepacks, realistic thinking, reframing experiences.
    - Did they find the mindfulness audio recording helpful? Y/N, which ones?
- *Did you notice how you managed uncertainty during the week?*
- *Do you have any questions about last week's session?*

Review monitoring sheets

Compare to previous weeks to see progress

- Their pain
- Their mood
- Their movement
- Their rehabilitation exercises

<u>*Take a photocopy of the patient's chart to include in your file!*</u>

Review goals/rewards

Refer back to their goals from session 4 (What did they want to achieve by the final session of this program?)

Have they achieved their goals?

- If not, what got in the way? Was the goal unrealistic? Can you break it down into smaller steps? Re-set goals if needed.

Did they reward themselves?

- *How did it feel to reward yourself?*
- If not, why not?

You need to be kind to yourself – We take time to take care of our physical well-being, so we should also take time to take care of our psychological well-being.

Preparing for ongoing recovery

Adapted from Nathan, Correia, & Lim (2004)

Say: *Many patients have said that the first month is the toughest time during their recovery. Well done for getting through that period! However, your recovery doesn't stop here, because your job is not done yet! Your body will continue to recover over the next year, and it is important to recognize when you aren't doing so well, and to know what to do.*

What may be your biggest challenges over the next few months?

What activities may be problematic during your recovery?

What are some warning signs that tell you that you are not coping well?

What strategies can you use when you notice that you are not coping well?

- What strategies have you learnt in this program that you could use?

Who can I go to for support/help? (*Therapists: for both social and professional support*)

What activities do I need to keep up, to ensure that my recovery goes well?

Ask: *Have you got any questions about anything we've covered so far?*
Answer their questions, and if you are not sure, direct their questions to Sam or discuss during supervision sessions

Questionnaires

Say: *Here are some questionnaires and a feedback form. You have done all the questionnaires before. There are less questionnaires than last time, so it should take less time to complete. I will leave the room to let you complete them, and will come back to check on you in a few moments. As you did at the start of the program, please answer the questions as honestly as you can, as this is the early stage of designing the program for patients like yourself, and we would really like to know if it works.*

*Administer the following: **KOOS, FJS-12 & RWC client evaluation form** – ensure you tell them that there are 2 sides*

The questionnaires should take less than 30min to complete as there are less questionnaires than the first time. Clinicians may leave the room once the participant is settled and is filling out the questionnaires.

*Offer to make them a cup of coffee/tea while they fill out the questionnaires. Check in on them after 15min to see if they have any questions, and if not to see how much longer may need for your next check in so you can collect the questionnaires. When they have completed them, collect them, score them and put them in their client file under "tests". *

Let the patient know that they will receive the same questionnaires in the mail for follow ups, with a pre-paid return envelope to UWA.

Thank them for completing the questionnaires, and participating in the program!

THE END OF THE PROGRAM

Checklist: Session 6

☐ Administer the weekly questionnaire.

☐ Measure range of motion with goniometer.

☐ Take photo of knee at maximum flexion.

☐ Check in on how the patient is feeling.

☐ Check in on what they are struggling with and validate.

☐ Check if they used strategies to manage difficulties and explore what worked/did not work.

☐ Discuss goals/rewards to date, and re-set if necessary.

☐ Review monitoring sheets over the program and outline progress.

☐ Discuss early warning signs and strategies to manage future difficulties.

☐ Administer questionnaires and evaluation form.

☐ Send photo of knee to Sam with Participant ID and date.

Questionnaire for sessions: 1, 2, 4, 5, 6

Name: **Date:** **Session no:** **Therapist:**

---

1. **On average, how has your mood been in the last week?**

   (Poor) 1 2 3 4 5 (Great)

2. **What is the average amount of pain you experienced in the last week?**

   0 1 2 3 4 5 6 7 8 9 10

   (0 = no pain, 10 = most unbearable pain)

3. **Did you take any medications for your knee this week?** Y / N

   If so, what did you take?

   _____

   _____

4. **Did you use any other coping strategies this week?** Y / N

   If so, what did you do?

   _____

   _____

5. **How many degrees of bend did you get in your knee today?**

   (You will be measured in session)

   _____

Misc. Notes for Therapists

- **"Well-being"** is a very difficult thing to define. Perhaps, the easiest definition could be: a global assessment of a person's quality of life according to their own chosen criteria (Shin & Johnson, 1978). "Well-being is more than just happiness. As well as feeling satisfied and happy, well-being means developing as a person, being fulfilled, and making a contribution to the community." (Shah & Marks, 2004, pg.2)
  The core dimensions of psychological well-being are: self-acceptance; purpose in life; environmental mastery; positive relationships; personal growth; and autonomy (Ryff & Singer, 2008).
  For more information, read article by Dodge, Daly, Huyton & Sanders (2012).
- **Neurobiology of pain**
  - The insula and anterior cingulate cortex are consistently activated when nociceptors are stimulated by noxious stimuli, and activation in these brain regions is associated with the subjective experience of pain.
    (Tracey & Mantyh, 2007)
- **Control gates theory of pain readings:**
  Melzack (1996)
  Shackman et al. (2011)
- **More readings for activation of the brain in pain:**
  Ahmad & Abdul Aziz (2014)
  Jensen et al. (2016)
  Wiech & Tracey (2009)
- **Knee Anatomy**

  Tibia: the shin bone.

  Femur: the thighbone.

  Patella: the kneecap.

  Cartilage: A tissue that helps reduce the friction within a joint.

  Meniscus: A curved part of cartilage in the knees and other joints that acts as a shock absorber.

  Synovial membrane: A tissue that lines the joint, seals it into a joint capsule, and secretes synovial fluid to lubricate the joint.

  Ligament: A tough, elastic connective tissue that gives support and limits the joint's movement.

Tendon: A tough connective tissue that connects muscles to bones and helps to control movement of the joint.

- **Some patients may feel as if their knee is a foreign object and that it doesn't belong to them. Some may describe it as feeling like a fake knee.**
    - Explore if they are distressed by it
    - Get them to describe the sensations in their knee
    - Encourage them to do the body scan mindfulness exercise – to increase awareness and acceptance
    - You could say: *yes it is a foreign/artificial joint and it is not your natural knee. However it's like getting your hair dyed, it's not your natural hair colour and you might feel that it looks strange, but over time you will get used to it.*
- **Numbness of the knee after surgery**
    - This numbness is normal and due to a cutaneous nerve that must be cut during the skin incision. This numbness will improve but can remain for ever. Generally, it does not disturb functioning
- **Most knees feel a bit stiff for a year after surgery**. However, their osteoarthritis pain should go away. Some stiffness and tightness around the knee often remain and is normal.
- **Kneeling after surgery is allowed**, but most people describe it to be uncomfortable. Some patients may worry about damaging the prosthesis by kneeling on it.
- **Early post-discharge opioid use** can be defined as prescriptions for opioids within 1 to 90 days after surgery. Prolonged opioid use after hospital discharge can be defined as having prescriptions for opioids within 91 to 180 days after surgery (Clarke et al., 2014).

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Appendix C: Patient’s Booklet

Psychological Coaching for Knee Replacements:

Patient's booklet

Authors:

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Session 1

Introduction

This program aims to help patients through their knee replacement surgery, to prepare for it, to manage difficulties and speed up recovery from their surgery. Psychology is a big part of recovery from damage to the body, such as physical injuries and surgery. Professional athletes/sports people have psychological support to supplement their physical rehabilitation program throughout their recovery. You could probably think of yourself going through a similar recovery to athletes who had an injury (in your case, your injury is osteoarthritis), and needed surgery to fix it (your knee replacement). The aim of your recovery is to get you back on the field to play again (in your case, to get back to your life activities).

Session 2 = Next week
Session 3 = While in hospital
Session 4 = 2 weeks post-surgery
Session 5 = 3 weeks post-surgery
Session 6 = 4 weeks post-surgery, final session.

Expectations:

- We think that it is important that there is continuity in the program, so we hope that you will be able to attend all the scheduled sessions. If you can't make it, please call the clinic on 6488 2644, and you can reschedule (+/- 5 days). The clinic is open on Mon-Wed 8.30am-8pm, Thu-Fri 8.30am-5pm.
- Bring your booklet with you every time.
- We will be asking you to fill out various questionnaires as we go through the program and we ask that you fill these out as requested as honestly as possible, as this will allow us to assess the effectiveness of our program, and more specifically how you are progressing in your recovery.
- We want to make sure that this program is working for you so if there is any aspect of a session that you believe might have been better please let us know so we can attempt to make the appropriate modifications.

Today's session

- Find out about your experiences with your knee;
- Give you some information;
- Complete some questionnaires.

Your expectations

What are your expectations for the surgery and recovery period?

_____

_____

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_____

Well-being

Well-being can refer to physical well-being, and/or psychological well-being. Many people think that ‘well-being’ refers to physical aspects only, like how fit you are, how healthy you eat, and living comfortably. However, they ignore psychological factors like having positive relationships, satisfaction, personal growth and sense of accomplishment.

Both psychological well-being and physical well-being are related to each other and can influence each other. For example, low mood, worries and stress can affect activities of daily living. In the same way, being physically ill can also affect our mood and satisfaction with life. So it is important to consider both psychological factors as well as physical factors, when we try to improve our well-being as they are related to each other.

Coping

People do different things in response to life's challenges (pain can be a life challenge). Every person's style of coping is a reflection of their personality, in the way that they handle life experiences.

There are helpful and unhelpful styles of coping.

Helpful strategies tend to involve you do something to change the situation and approach the problem, while unhelpful strategies happens when you avoid or surrender to the situation.

Examples: Unhelpful –

Helpful –

Which one achieves better outcomes?

_____

Information sheets

These information sheets are based on feedback of other patients in the past, who have found this information helpful.

a. **Frequently asked questions**
b. **Recovery from surgery**
c. **Advice from previous patients**
d. **Checklist: preparation for surgery**

Frequently asked questions

What are common complaints after knee replacement surgery?
There are 5 common complaints after surgery, which are all normal: 1) numbness along the scar and leg; 2) clicking of the prosthesis when walking; 3) stiffness/tightness in the knee compared to the natural knee; 4) discomfort when kneeling; 5) being unable to fully flex the knee. The average knee replacement bends about 110 degrees, and most people are unable to fully flex the knee after a total knee replacement.

How much pain will I be in after surgery?
The amount of pain people experience varies from person to person. The first few days tend to be the most painful, and the pain should ease off over the weeks/months following surgery. You may also experience a bruised feeling, soreness in your thigh, and aching at the back of your knee as a result of realignment of your knee which should settle down after a few days. You will be given pain medications to take the edge off your pain, but you may still experience pain when you move/walk on it.

Why is it important to move even though I am in pain?
Movement (such as walking and swimming) promotes flow of oxygen throughout your body and maintains your normal breathing function. Moving around also improves blood flow, speeds up wound healing, and strengthens your muscles. Gastrointestinal and urinary tract functions can be improved by moving around, as these body systems are slowed down after surgery.

What should I keep in mind when I go home?
Be wary of things that you can trip or slip on, including slippery floors, rugs, furniture and pets. Use your crutches/supports in the first few weeks, even if you are feeling strong, as your knee may not be healed enough to catch yourself if you slip/trip in the first few weeks.

What is the general recovery period?
The recovery period ranges from person to person. Most patients say that they are not fully recovered until a year after their surgery, as it takes time for the swelling and pain to disappear, and to re-gain their full mobility and strength. Generally, you can expect to be back in your day-to-day activities within 6-12 weeks after surgery if you are diligent with your rehabilitation exercises.

Recovery from surgery

There is no set path to normal recovery, and your recovery will look different to another person's recovery. Most recoveries are not without some pain and difficulties. Here are some cases of NORMAL recovery (based on real experiences):

1) Jane was 58 years old when she received her new knee. She was ready to go home on the 3rd day after surgery, however there was liquid seeping out of her wound and the hospital kept her for an extra day, just in case she had an infection. Jane found her hospital stay to be untroublesome, and said that the most difficult thing was adjusting to pain and restrictions in movement after she went home. She said that the most challenging thing about her recovery was pushing through the pain while doing exercises for rehabilitation. She said that it took about 9 weeks for the pain to subside, but she was able to work 6 weeks after surgery and took Panadol for pain relief at work. She reported that her pain had completely disappeared about 12 months after surgery. She rated her satisfaction with her new knee to be 10/10. Jane is able to kneel, but puts a cushion under her knees to make it more comfortable. She is also able to play 18 holes of golf.

2) Eric was 72 years old when he received his new knee. He started walking with crutches the next day, however he had numbness in his leg after surgery which he found very annoying as it made it difficult to walk. The numbness resolved after 3 days. He spent most of his time in bed for the first 10 days, but got up and wandered around often. Eric said that on the 5th day after surgery, he had more pain than usual because he didn't take his medication at the right time. Eric found that the first 3 weeks of recovery was the most difficult time period after surgery. 12 months after his surgery, Eric said that he had just spent a whole day cycling around Rottnest Island and felt stiffness in his knee afterwards, but was happy that he was able to cycle all day. Eric rated his satisfaction with his new knee to be 9/10, and said that the best part of having his surgery was that he is now able to stand for long periods of time.

3) Peter was 63 years old when he received his new knee. He experienced some adverse side effects from the opioid medications during his hospital stay, but had this sorted out by the doctors and nurses on the ward. His blood pressure was abnormally high while in hospital, but it settled down after he went home and managed it with his GP. He found that the hardest part of his recovery was motivating himself to do the rehabilitation exercises every day. Peter said that he found it more difficult to straighten his leg than to bend it. About 3 weeks after surgery, Peter reported feeling very gloomy, and felt that he did not want to do anything, or see any of his friends or family members. Peter had an episode of Deep Vein Thrombosis (DVT) 10 days after he went home, after he had dozed off for 2.5 hours with his legs elevated. Peter had his DVT treated immediately by his doctor and continued his recovery and rehabilitation exercises. Although Peter experienced a number of difficulties as he recovered, he reports that he is happy with the outcomes of his new knee. He said that he is now able to hop, jump, walk and swim, and he rates his satisfaction with his new knee to be 8/10. He thinks that the best part about getting his new knee is the long-term reduction of pain and swelling in his knee as compared to before his surgery.

Note: Ensure that you seek immediate medical attention if you suspect that you have Deep Vein Thrombosis.

Here are some symptoms that you should seek medical attention for:

- Discolored/foul smelling discharge from your wound/excessive bleeding
- Feeling out of breath, chest pain or difficulty breathing (Not after physical exertion)
- Hot streaking down the leg from your incision
- Sharp pain in the back of your surgical leg calf
- Body temperature of 38 degrees or greater (Fever)
- Muscle cramps that cause involuntary contractions and jerking of your operated leg
- Rash around the surgical site
- Grinding of the knee when you move

Note: If you experience any of these symptoms, please seek medical attention immediately.

Advice from previous patients

Here are some tips/advice given by patients with knee replacements:

- Read all the information given to you, if you don't understand or are missing information, ask questions.
- Take your pain medications 20 minutes before you do your exercises/physiotherapy – it will help to take the edge off the pain.
- Be prepared for some pain and discomfort even though you have medications, it's not a walk in the park, it's a major surgery.
- Do your exercises every day! Don't skip them even if you're in pain, it gets better over the days and weeks. Your recovery depends on what you put in.
- Listen to your body. You will know when you've done too much.
- Follow the instructions given by the professionals (Doctors, Nurses, Physiotherapists, etc.), as they are trying to help you to get the best results.
- Don't stop taking your medications in the first few weeks!
- It's not weakness or cowardly to ask for help.
- Don't stop your exercises even if you have achieved your goals, if you stop, you will lose the progress you have made.
- Use cold packs on your knee every day, as often as you can, to help bring down the swelling. Have a few in your freezer so you can rotate through them.
- Do some physical exercise to get yourself fitter before your surgery, it will make it easier to bounce back after your surgery. You could walk, cycle or swim.
- At times, you might get to a point where you think the pain and restrictions are not going to get better – but you need to persevere, push through and keep doing what you're meant to, because it will get better and you will get your functionality and independence back.
- Prepare yourself before activities. For example, lay out your clothes and towels before your shower, so you don't have to hobble around afterwards.
- Remember to take care of your new knee, it's not magic.

Checklist: preparation for surgery

Before going into surgery, check that you have considered/arranged the following:

- Set up the house so it is easy to get around (Remove trip hazards)
- Home aids/equipment (Tick when arranged):
    - Comfortable seats with armrests
    - Toilet seat with handles
    - Shower chair
    - Crutches
    - Others: _____
- Meals for when you come home (Frozen meals?)
- Who will be your support person: _____
  (This person should check in on you regularly whether it's in person or over the telephone, and someone you can talk to when you're having a difficult time)

- Who you can go to for medical support: _____
- Who you can go to for physiotherapy: _____
- Who will do the cleaning of the house: _____
- Who will do grocery shopping: _____
- How you will get to appointments:

  _____

- Activities you can do to fill your day:

  _____

  _____

  _____

    - Have you got all the materials you need for activities after surgery? (e.g., Books, puzzles, etc.)

Questionnaires

There are some questionnaires and a demographics form, and they should take less than-45 minutes to complete.
Each one will be described to you.

Please ask any questions that you may have about them.

Thank you for completing the questionnaires.

Activities for this week

- Read the information sheets
- Write down any questions that you have for your surgeon.

End of Session 1

Session 2

In today's session, we are going to discuss:

- Pain;
- Coping strategies;
- Hospital Stay;
- Monitoring physical and psychological factors.

Pain

What is pain?

_____

_____

_____

_____

Pain is NORMAL and HELPFUL, it helps our survival – it's not all bad. Pain is the signal that the body is sending to tell you that something needs your attention.

For example: When you touch a hot oven – what do you feel?
What message do you get from this pain?

What message is pain trying to send you, after surgery?

_____

_____

_____

_____

When we talk about experiencing pain, we should consider all 3 aspects.
Pain has **sensory** and **emotional** components, as well as a **thoughts** component.

An example of each component in your knee:

Sensory component of pain =

_____

Emotional component of pain =

_____

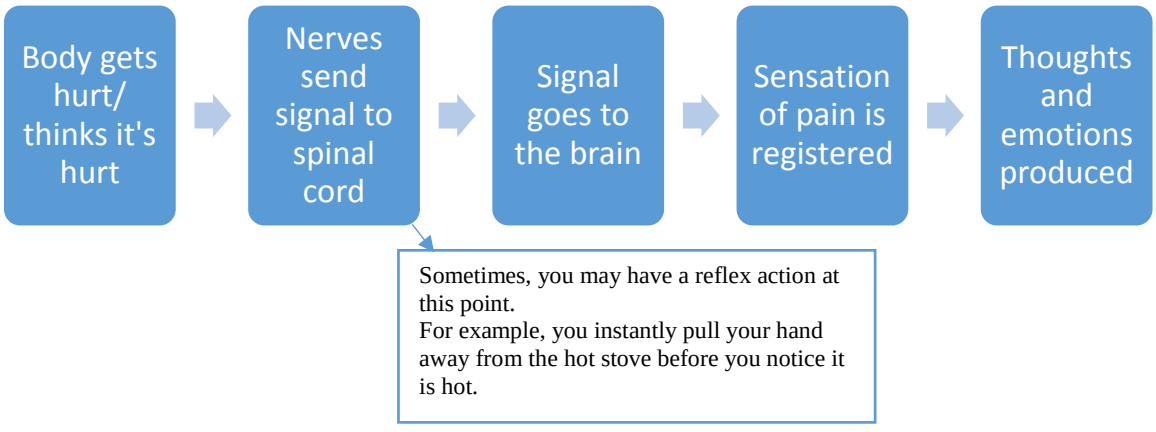
Thoughts component of pain =

_____

Misconception about pain

A common misconception is that pain results from damage to tissue or bones.
Pain is produced by the nervous system, and can be experienced without any actual damage of tissue.

Neurobiology of pain



Interesting fact: Different people perceive pain differently due to the extent of the parts of the brain that is activated by noxious (harmful/unpleasant) stimuli.

Some people have extra sensitive nervous systems after an injury or stressful event, so it takes less stimuli to trigger the body to send signals which result in feeling pain.
Coping strategies can help to calm and retrain the system.

Relationships between thoughts, behaviours, emotions and pain

Thoughts, feelings and behaviours are all interlinked in the way we experience our world.

For example: **You are lying in bed, and all of a sudden you hear a loud noise outside.**

What are you <u>thinking</u>? How are you <u>feeling</u>? What do you <u>do</u>?

Thought =

Feeling =

Behaviour =

Thought =

Feeling =

Behaviour =

An example with pain:

You had your surgery, and are experiencing a lot of pain.

1) **Thought = I'm in so much pain, nothing is working for me, the medications are useless and doing rehabilitation exercises is going to make it worse;**

   Feeling =

   Behaviour =

2) **Thought = I'm in a lot of pain, imagine what it would be like without the medications. Doing rehabilitation exercises is going to be painful, but it is going to help me get my mobility in my knee back to normal;**

   Feeling =

   Behaviour =

The thought in (1) is unhelpful, while (2) is more realistic – ***not positive.***

Positive thinking can be helpful in some situations, but positive thinking is not always helpful. For example, is it helpful to tell yourself that you have no pain and that everything is going great, when you actually are experiencing pain and difficulties?

Realistic thinking is more helpful – it considers both the positive and negative.

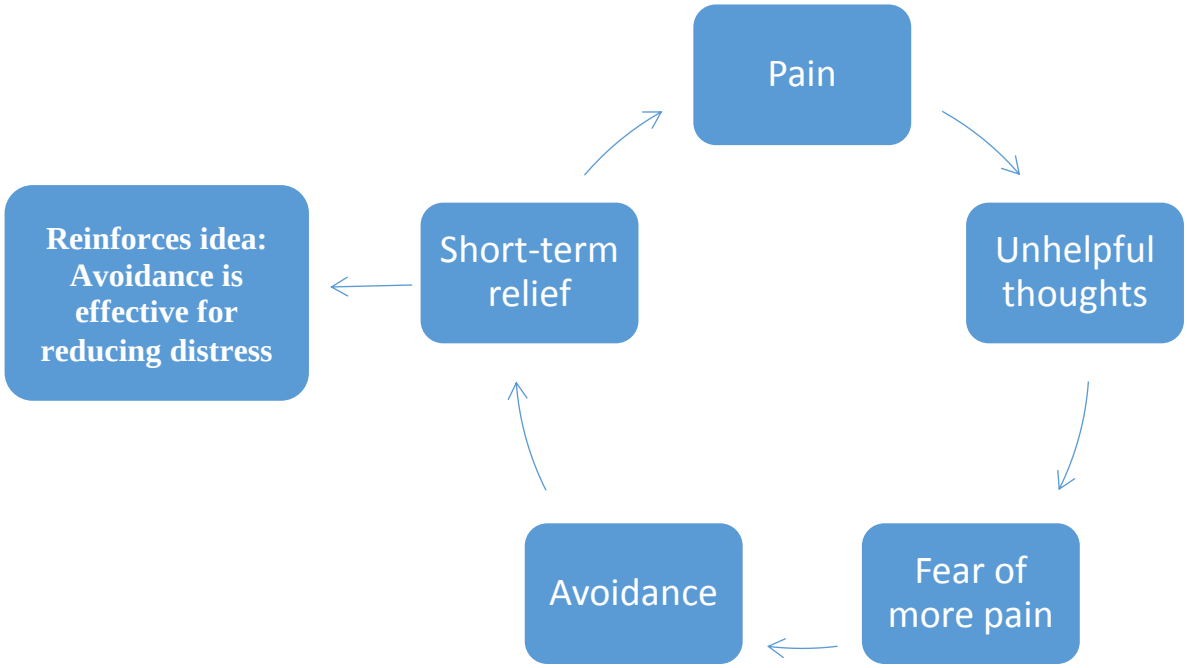
During the week, start noticing your thoughts. Notice if they are they helpful or unhelpful. Notice whether you tell yourself negative, positive, or realistic things.

Cycle of Avoidance:

One thing that we tend to do when we don't like something is to avoid it.
For example, when children don't like the taste of vegetables, they avoid eating vegetables even though they get told that vegetables are good for them.

In the same way, when we think that something is going to be painful, we tend to avoid the situation if we can.

But here's the trouble with avoiding – there is a cycle:



Avoidance behaviours reinforce the idea that avoidance is a helpful strategy in reducing your distress, so you do it over and over again.
To an extent, yes it is helpful in reducing distress, until it causes more problems in the long-term.

What are some long-term problems with avoidance?

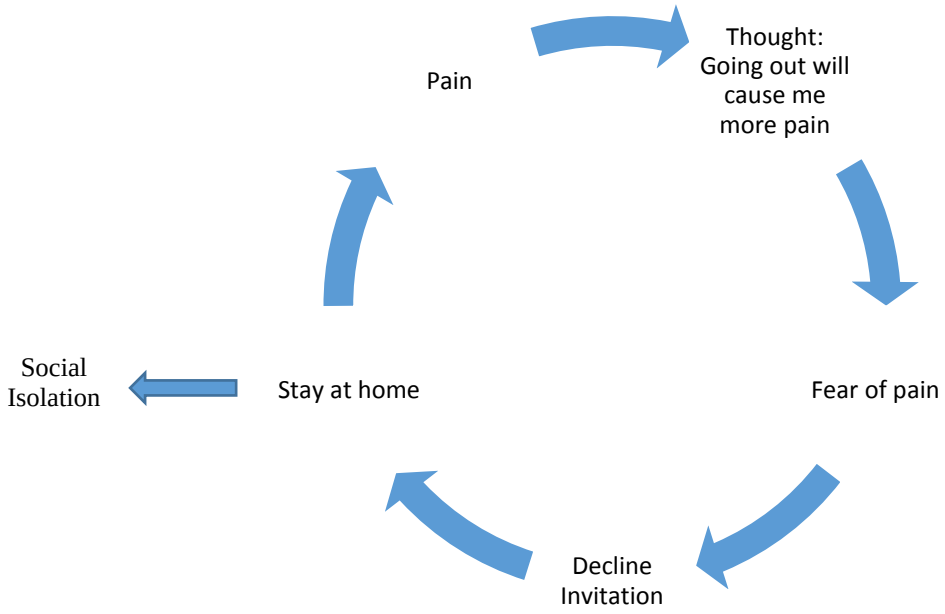
_____

_____

_____

In the end, avoidance is actually keeping you from doing physical and psychological things that benefit you and that keep you well. (e.g., avoiding your rehabilitation exercises does not help you in the long term)

For example: **Friends invite you to a dinner party.**



Social isolation can lead to you feeling down and dispirited, which can eventually lead to depression and anxiety.

Being by yourself and having little to interest you increases the likelihood that you will focus on your pain, and get caught up in it. This is because your attention is caught up in your sensations of pain, emotions surrounding pain, and thoughts surrounding pain because there is nothing else of interest to catch your attention.

Research has found that pain anticipation increases pain intensity, because anticipation of pain activates certain parts of the brain.

Anxiety also affects the amount of pain people experience, as some parts of the brain activate differently when anxiety is increased. (More anxiety tends to result in experiencing more pain.)

Strategies to help manage pain

Stopping things that you are doing now will cause reduction in pleasurable activities and a decline in your mood, thus harming your psychological well-being. It could also relate to the cycle of avoidance, causing a reduction in self-efficacy, self-esteem and increased social isolation.

Here are some strategies you can use to help to cope with your pain:

1) Taking medication

Pain medications simply mask your symptoms; they don't treat the root cause of your pain. Pain medications on their own are not therapeutic if you don't engage in rehabilitation activities.

Taking more than the recommended dose **will not** give you more pain relief, it can be dangerous.

2) Relaxation strategies & acceptance

Being tense increases the amount of pain that people experience, because of the way the body is wired. Relaxation strategies can help you to become less tense, and therefore reduce the amount of pain that you experience.

What can you do to relax?

_____

_____

_____

_____

Your therapist will email some audio-recordings of mindfulness exercises to try.

Mindfulness is about observing, not judging and not avoiding uncomfortable thoughts, emotions and sensations. Accepting that these experiences are real and part of life is the opposite of avoidance. Avoiding pain does not mean that pain won't be there, in fact, you probably spend so much energy trying to avoid thinking and experiencing pain, that it becomes very tiresome.

As with any other skill, it takes more than 1 try to learn new skills, so give it a few tries before giving up!

3) Mantras

When things get rough, what are some statements that you can tell yourself to encourage yourself?

_____

_____

_____

_____

_____

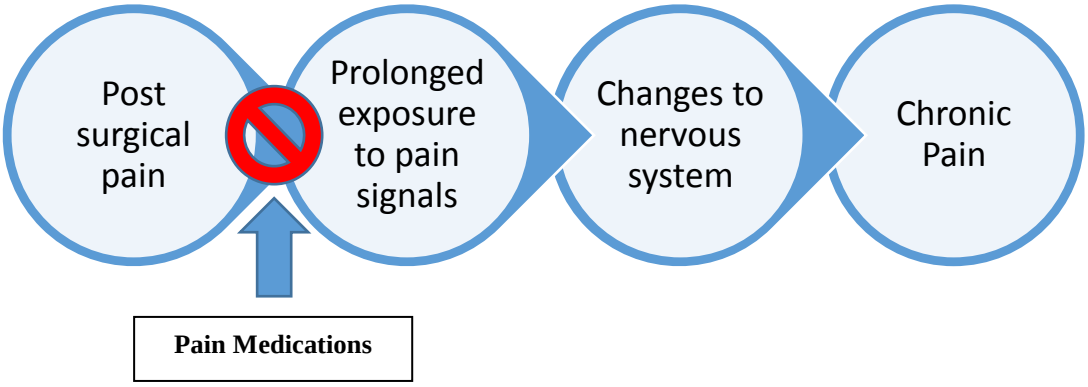
_____

_____

Stopping chronic pain from developing

Many people don't like taking pain medications as they fear the side effects or getting addicted to them. However, prolonged transmission of pain signals in the body can cause long-term physiological changes in the nervous system. These changes in the nervous system cause a reduced threshold for activation (takes less stimuli for the body to send pain signals) and an abnormal increase in perception of pain. Initially, this process can be reversible, but over time can become permanent.

Pain medications stop the release of certain chemicals and activation of certain receptors. Taking them while your body recovers in the initial stage after surgery will stop the long-term changes in the nervous system from happening. Stopping pain medications too early can put your body at risk of changes in the nervous system, leading to chronic pain. Additionally, you will be putting up with more pain than necessary.



It is true that prolonged consumption of pain medicine (like opioids) can lead to addiction, but taking them responsibly, as directed in the short term will benefit you in both the short and long term. You will require the most amount of pain relief in the first 48 hours after surgery. It is often recommended that you take paracetamol (e.g., Panadol) to take the edge off the pain, if the pain is not so severe. – So you don't necessarily need opioids.
Long-term consumption of opioids may result in development of tolerance, dependency, addiction, abnormal pain sensitivity, cognitive dysfunction, hormonal changes, immune modulation, cardiac events and risks of injury.

Worried that you may be addicted? Here are some questions you can ask yourself:

- Does your body crave the drug?
- Do you swing between feelings of euphoria and feelings of pain or discomfort?
- Do you feel that the dose you used to take doesn't have the same effectiveness anymore?
- Have you experienced symptoms like nausea, pain sensitivity, constipation, or shallow breathing?
-

If you have answered "yes" to any of them, then you should speak to your doctor.

Hospital Stay

The aim of the hospital stay after your surgery is to ensure that your body is well after surgery, and that there is no complications from the surgery (such as side effects of medication and anaesthetics).

Once you are up and moving, and are able to shower/toilet yourself, you should be ready to go home! **99% of the recovery from surgery happens after you are discharged from the hospital.**

The physiotherapist or occupational therapist would have briefed you on the exercises you have to do every day, and your recovery will depend on the amount of effort that you put in, in the following months. You can still be in contact with your doctor after you go home if you have concerns, and go to out-patient clinics where the physiotherapists will continue to help you with your rehabilitation.

The longer you stay in hospital, the higher your risk of developing an infection. So if you are stable and ready to go home, then you should!

Monitoring worksheets

- Fill out a row every day, so that you can get used to monitoring your pain and mood.
    - You can use it as a guide to use strategies discussed in today's session.
- The number of steps taken is a measure of movement, and is an estimate and doesn't have to be exact.

Activities for this week

- Read sections about pacing and stopping chronic pain from developing
- Notice thoughts:
    - Are they helpful/unhelpful, negative/positive/realistic?
- Experiment with relaxation and mindfulness strategies to see what works
- Complete monitoring sheet

Don't forget to pack your booklet when you go to hospital! The next session will be in hospital after your surgery

My activity this week: Notice thoughts, experiment with relaxation & mindfulness strategies to see what works for me.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week
				N/A for this week

Session 3

In today's session, we are going to discuss:

- How you are;
- More strategies;
- Going home;
- Medications chart and monitoring.

Remember that your recovery is not just about the physical body healing, you need to look after your psychological well-being and activities of daily living too. It comes as a package - if you only look after one part, your body will turn on you, to send you the message that things are not going well.

Remember that 99% of your recovery from surgery happens after you go home.

More Strategies

During the previous session, we talked about taking medications, using mindfulness, and mantras to help with managing pain. Here are more strategies that you can use to help manage your recovery.

1) Pacing activities

Pushing too hard to get things done can cause your body to react with more pain and discomfort, but avoiding activities can also lead to more pain and poor outcomes. So what can you do?

You can break your day-to-day activities and rehabilitation exercises into chunks.

Do small amounts of activity many times throughout the day, and find a balance between not overdoing it, and not under-doing it.

For example, instead of doing 30 repetitions of a knee bending exercise at once, you could do 5 repetitions every 2 hours. Or, if you have to clean the house, you could do 1 room at a time, taking breaks in between rooms.

You should use pacing to help you achieve your goals, rather than to avoid pain. Pacing can help you to increase your tolerance for activities over time.

It is like building up the amount of activity that an athlete can do. When an athlete first starts out, they might only be able to run 5km before they feel that they cannot go on. But as time goes on and they keep training, their tolerance for activity increases, and they can run 10km, 20km and eventually a full marathon.

You probably do not need to run a full marathon, but you can use pacing to help you increase your tolerance for activities, so you can return to your normal lifestyle after surgery.

Can you think of some examples of activities that you could pace after your surgery? How will you break them up?

_____

_____

_____

_____

_____

_____

IMPORTANT NOTE: ***Doing more is not necessarily better!*** Overdoing things will cause you a significant increase in pain and may even cause some damage – remember that pain is trying to remind you of your surgery and the healing that the body needs to do. It is about finding a balance between moving and resting.

2) Keep up with your social life

Maintaining your social life, such spending time with friends, family and loved ones on a regular basis is important to keep you mentally healthy.

Talk about your pain, but make sure you talk about other daily things too!

Research has shown that social factors can affect emotional and mental wellbeing, which can have an indirect effect on the amount of pain you experience and the way you cope with pain.

3) Icepacks

Regular cooling of your knee using icepacks can be helpful in reducing the amount of discomfort experienced from the heat and inflammation.

Some patients in the past have said it is useful to have more than one in your freezer, so you can rotate them throughout the day.

Medications when going home

Your doctor is going to prescribe some medications when you are discharged from the hospital. Some people get confused about their new medications, so we have provided you with a chart to help you keep track of them.

This is for your reference so that you can understand your medications better. You may fill it out however you would like to – there is no wrong or right way to do it.

Monitoring when at home

Complete the monitoring sheet in the same way that you did last week, when you get home.

Continue using coping strategies over the next 2 weeks:

- Medications, relaxation activities, mindfulness, pacing, mantras, talking to friends/family, icepacks, realistic thinking.

Activities for this fortnight

- Complete medication chart
- Complete monitoring chart

End of Session 3

My medications chart for when I go home

Name of Medication	What is it for?	How many tablets to take each time?	When do I need to take it?	How long should I take it for?	Do I need to get repeats? If so, when?

My activity this week: Use helpful strategies to manage pain.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Session 4

In today's session, we are going to discuss:

- How you are managing in your recovery;
- How your expectations compare to reality;
- Managing uncertainty;
- Goals and rewards;
- Another mindfulness tool.

Managing uncertainty

People who don't like uncertainty, tend to say things like:

"I need to be 100% sure, I can't stand it otherwise."
"I know that the chances of it happening are so small, but it could still happen."

Worrying about uncertainty may give you a sense that you are in control of your situation, but in reality, all you have done is think of all the worst case scenarios and made yourself very uncomfortable.

Of course it is not good to ignore problems and not think about them at all. That is avoidance – We have talked about avoidance in earlier sessions, so now we are talking about the opposite problem: obsession.

What can you do instead?

a. Challenge your intolerance of 'the unknown'
b. Accept 'the unknown'

a. Challenging intolerance

- Is it possible to be absolutely certain about everything in life?

- What are the **advantages** of needing certainty in your life?

- What are the **disadvantages** of needing certainty in your life?

- Is it reasonable to predict that something **bad** is going to happen if you are not certain about events?
    - What else might happen?

- What is the **likelihood** that your predictions will come true?
    - If it is low, can you live with that small risk?

- Are there uncertainties in your life that you are currently ok with?
    - How do you do that?

- How do **other people** you know cope with uncertainty in their life?

---

b. Accepting 'the unknown'

1) Be aware: of what you do when you think about uncertainty

What do you tend to do?

_____

_____

2) Don't go down the rabbit hole

What can you tell yourself to stop thinking of every worst possible thing that can happen?

_____

_____

3) Let go of your need to be certain

How can you do this?

_____

_____

4) Focus on the present

What can you do/tell yourself to help yourself focus on the present rather than the past/future?

_____

_____

5) Refocus

What can you do/tell yourself when your mind drifts back to wanting certainty?

_____

_____

Setting goals and rewards

Professional athletes and many successful people set goals, as goals give them a sense of direction and help to motivate them. Goals help professional athletes and successful people to focus their attention on what is relevant, and help them to organize and prioritize how their time and resources should be spent.

Goals give us direction and help us to check whether we are on the right track to achieve the things we want.

When setting goals, remember to make them SMART.
S = Specific; **M** = Measurable; **A** = Attainable; **R** = Relevant; **T** = Time-based

> Example of a **not**-SMART goal:
> I would like to be able to bend my knee by the end of my recovery.
>
> Example of a **SMART** goal:
> I would like to achieve 120 bend in my knee, by 6 months post-surgery.

Remember to reward yourself for achieving your goals too!
Rewarding is important, it can keep us motivated and give us a sense of achievement. Your rewards do not have to be big, they should be proportionate to the size of your achievement and goal.

> An example of a *small* reward is treating yourself to an ice-cream for achieving your 120 degrees of bend in your knee.
>
> An example of a *bigger* reward may be going to your favourite restaurant for being able to go up and down more than 20 stairs.

If you can, try to involve other people in your rewards!

> For example, you may agree with your support person that your goal is to be able to walk to the local shops, and that your reward would be for them to buy you a coffee.

Short-term goals:

- What would you like to achieve tomorrow?

_____

My reward: _____

- What would you like to achieve by next week?

_____

My reward: _____

- What would you like to achieve in 2 weeks' time? (Final session)

_____

My reward: _____

Long-term goals:

- What would you like to achieve in a month's time?

_____

My reward: _____

- What would you like to achieve by 3 months post-surgery? (1st follow up for this study)

_____

My reward: _____

- What would you like to achieve by 6 months post-surgery? (2nd follow up)

_____

My reward: _____

- What would you like to achieve by 12 months post-surgery? (3rd follow up)

_____

My reward: _____

Other **SMART** goals and rewards:

_____

_____

_____

_____

_____

Mindfulness of thoughts

We can manage frustrations and low mood in the same helpful way that we manage our pain. Instead of avoiding thoughts surrounding uncomfortable emotions, we can simply watch them float by, which will help us to calm down and enable us to deal with situations effectively.

Your therapist will email you another audio recording.

Activities for this week

- Set long-term goals and rewards
- Notice how you manage uncertainty
- Experiment with mindfulness of thoughts
- Complete monitoring chart

End of Session 4

My activity this week: Set long-term goals.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Session 5

In today's session, we are going to discuss:

- How you are managing your recovery;
- Goals and rewards;
- Things you value in life;
- Thinking styles and reframing thoughts.

Values

Another way to make your recovery more pleasant, is to ask yourself the following questions:

- What do you value in life?
    - Examples: Building relationships, education, creativity, fun, fitness, helpfulness, justice, spirituality, etc.

_____

_____

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- Are your daily activities/actions in line with your values? Y / N
    - If not, what actions or activities are not in line with your values?
    - What can you do instead, to make them in line with your values?

_____

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Catastrophizing

When things are not going our way or when we are under a lot of stress or pain, we tend to blow things out of proportion, and label our experiences as ‘awful’, ‘dreadful’, ‘terrible’ and ‘horrible’. This style of thinking is called Catastrophizing, where we instantly think of the worst outcomes that can happen.

Now let’s do an experiment:

“My pain is overwhelming and I cannot deal with this.”
“My knee is pretty painful, so I need to do something about it.”

“My pain is awful and it is never going to get better. I am going to be disabled for the rest of my life.”
“My knee is pretty painful, but if I can do something about it now, the pain will most likely decrease as I recover more.”

Catastrophizing thoughts tend to lead us to use unhelpful coping strategies.

You can reframe your mood and pain, so that it is not blown out of proportion and labelled using extreme words such as ‘awful’, ‘dreadful’, ‘terrible’ and ‘horrible’.

Notes:

_____

_____

_____

Here is a chart to help you reframe your thoughts:

Catastrophizing thought	**How does the catastrophizing thought make me feel? What am I likely to do?**	**Come up with a more realistic and helpful thought**	**How does this new thought make me feel? What am I likely to do now?**
Example: ***My pain is overwhelming and I cannot deal with this.***	*Example:* *Very Frustrated and helpless. I am likely to engage in unhelpful coping strategies. I am likely to avoid moving, and activities that cause more pain even though I enjoy them or are good for me.*	*Example:* ***My knee is pretty painful, so I need to do something about it.***	*Example:* *Slightly frustrated but hopeful. I am likely to use helpful coping strategies, such as take my medication, use mindfulness, or talk to a friend about it. I probably will not let my pain get in the way of my pleasurable activities.*

Catastrophizing thought	How does the catastrophizing thought make me feel? What am I likely to do?	Come up with a more realistic and helpful thought	How does this new thought make me feel? What am I likely to do now?

Activities for this week

- Practice reframing thoughts
- Complete monitoring sheet

End of Session 5

My activity this week: Practice reframing thoughts.

Fill in each box at the end of each day (before you go to bed).

Day/Date	**Pain (?/10)**	**Mood (?/10)**	**No. of steps I took today** (Measured on your smartphone) **Otherwise: How far did you walk today?** (estimate)	**Did you do your exercises/ physiotherapy today? How many times?**
Example: Thurs 28/04	*4/10*	*8/10 - content*	*180 steps/140metres – Didn't leave the house.*	*No. 0 times.*

Session 6

In today's session, we are going to discuss:

- How you are managing your recovery;
- Goals/rewards and progress;
- Preparing for ongoing recovery.

Preparing for ongoing recovery

What may be your biggest challenges over the next few months?

_____

_____

What activities may be problematic during your recovery?

_____

_____

What are some warning signs that tell you that you are not coping well?

_____

_____

What strategies can you use when you notice that you are not coping well?

- What strategies have you learnt in this program that you could use?

_____

_____

_____

Who can I go to for support/help?

_____

_____

What activities do I need to keep up, to ensure that my recovery goes well?

_____

_____

_____

Questionnaires

There are some questionnaires, and a feedback form. They should take no longer than 30 minutes to complete.

Thank you for completing the questionnaires.

Follow up questionnaires will be sent to you in the mail.

Thank you for participating in this study!

THE END OF THE PROGRAM

Appendix D: TIDieR Checklist

The TIDieR (Template for Intervention Description and Replication) Checklist*:

Information to include when describing an intervention and the location of the information

Item number	Item	Where located **	
		Page number or appendix	Other †
	BRIEF NAME		
1.	Provide the name or a phrase that describes the intervention.	112	N/A
	WHY		
2.	Describe any rationale, theory, or goal of the elements essential to the intervention.	107-108, 110-112	N/A
	WHAT		
3.	Materials: Describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (e.g. online appendix, URL).	Appendices B and C	N/A
4.	Procedures: Describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities.	112-122	N/A
	WHO PROVIDED		
5.	For each category of intervention provider (e.g. psychologist, nursing assistant), describe their expertise, background and any specific training given.	110	N/A
	HOW		
6.	Describe the modes of delivery (e.g. face-to-face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group.	112	N/A
	WHERE		
7.	Describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features.	Chapter five, 135	N/A
	WHEN and HOW MUCH		
8.	Describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose.	111-112	N/A
	TAILORING		
9.	If the intervention was planned to be personalised, titrated or adapted, then describe what, why, when, and how.	118-119	N/A
	MODIFICATIONS		
10.‡	If the intervention was modified during the course of the study, describe the changes (what, why, when, and how).	N/A	N/A
	HOW WELL		

Item number	Item	Where located **	
		Page number or appendix	Other †
11.	Planned: If intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them.	Chapter five	N/A
12.ǂ	Actual: If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned.	Chapter five	N/A

** **Authors** - use N/A if an item is not applicable for the intervention being described. **Reviewers** – use '?' if information about the element is not reported/not sufficiently reported.

† If the information is not provided in the primary paper, give details of where this information is available. This may include locations such as a published protocol or other published papers (provide citation details) or a website (provide the URL).

ǂ If completing the TIDieR checklist for a protocol, these items are not relevant to the protocol and cannot be described until the study is complete.

* We strongly recommend using this checklist in conjunction with the TIDieR guide (see *BMJ* 2014;348:g1687) which contains an explanation and elaboration for each item.

* The focus of TIDieR is on reporting details of the intervention elements (and where relevant, comparison elements) of a study. Other elements and methodological features of studies are covered by other reporting statements and checklists and have not been duplicated as part of the TIDieR checklist. When a **randomised trial** is being reported, the TIDieR checklist should be used in conjunction with the CONSORT statement (see www.consort-statement.org) as an extension of **Item 5 of the CONSORT 2010 Statement.** When a **clinical trial protocol** is being reported, the TIDieR checklist should be used in conjunction with the SPIRIT statement as an extension of **Item 11 of the SPIRIT 2013 Statement** (see www.spirit-statement.org). For alternate study designs, TIDieR can be used in conjunction with the appropriate checklist for that study design (see www.equator-network.org).

Appendix E: Robin Winkler Clinic Client Evaluation Questionnaire

For each statement below, please circle one response that best applies to you.

1. How would you rate the quality of the service you have received at the Robin Winkler Clinic?

Poor (1) Fair (2) Good (3) Excellent (4)

2. Did you receive the kind of service that you wanted?

Definitely not (1) Not really (2) Yes generally (3) Yes definitely (4)

3. To what extent has treatment met your needs?

Almost all needs were met (4) Most needs were met (3) Only a few of my needs were met (2) None of my needs were met (1)

4. How satisfied are you with the amount of help you received? (e.g., number of sessions provided, quality of treatment)

Very dissatisfied (1) Somewhat dissatisfied (2) Mostly satisfied (3) Very satisfied (4)

5. Since I first attended this clinic I have found the problems and/or symptoms targeted by treatment have become:

Much worse (1) No change (2) Better (3) Much better (4) Very much better (5)

6. I believe that my ability to cope with the problems and/or symptoms targeted by treatment has become:

Much worse (1) No change (2) Better (3) Much better (4) Very much better (5)

7. How much improvement in your symptoms do you think has occurred?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. How willing are you to use the strategies learned in treatment if you experience similar problems in the future?

Not at all willing (1) Willing (2) Very willing (3) Extremely willing (4)

9. If a friend were in need of similar help, how confident would you feel in recommending our clinic to him or her?

1 2 3 4 5 6 7 8 9 10

Not at all confident Somewhat confident Very confident

10. Generally, how satisfied are you with the service your received?

Very satisfied (5) Mostly satisfied (4) Indifferent (3) Mildly dissatisfied (2) Quite dissatisfied (1)

Please add any other comments or suggestions for improvement you wish to share:

_____
_____
_____
_____
_____

Appendix F: Instructions for taking photograph of knee for range of motion measurements

Instructions for taking a photograph of your knee

Photos will be used to measure your range of motion.

1. Sit on a couch/bed/floor where there is enough space for you to put your feet up on it.
2. Bend your knee as much as you can and rest it on the couch/bed/floor surface (**without** pulling your leg back with your hands or shifting your position).
3. Get someone else to take a photo, from the side on view of your legs. (Alternatively, you can use a camera stand, to have the photo taken using the timer function if no one else can take a photo for you).
4. Ensure that the photo is taken from the same level that your legs are at.
5. Ensure that you can see the ankle and hip as well.
   See example photos below.

Example photos:

Appendix G: Descriptive statistics from Chapter Five

Descriptive statistics of participant demographics

	Group	Range	Median/Mean	Standard Deviation
Gender	Control	Males = 11 Females = 11	-	-
	Intervention	Males = 9 Females = 13	-	-
Age	Control	Min. = 49 years Max. = 79 years	67.36 years	8.40 years
	Intervention	Min. = 51 years Max. = 78 years	65.41 years	6.05 years
Operated leg	Control	Bilateral = 2 Left = 7 Right = 13	-	-
	Intervention	Bilateral = 1 Left = 16 Right = 5	-	-
Education	Control	Middle School = 2 High School = 7 Certificate = 1 Diploma = 4 Bachelor = 5 Post Grad. Cert. = 0	Diploma	-

	Group	Range	Median/Mean	Standard Deviation
		Master = 2 Doctorate = 1		
	Intervention	Middle School = 1 High School = 7 Certificate = 2 Diploma = 4 Bachelor = 4 Post Grad. Cert. = 2 Master = 2 Doctorate = 0	Diploma	-
Comorbidities (excluding osteoarthritis)	Control	None = 3 1-2 diagnoses = 11 3-4 diagnoses = 6 5 or more = 2	1-2 diagnoses	-
	Intervention	None = 3 1-2 diagnoses = 13 3-4 diagnoses = 5 5 or more = 1	1-2 diagnoses	-

Descriptive statistics for ROM, KOOS, and FJS-12 over three time points

Measure	Group	Time 1 Mean (SD)	Time 2 Mean (SD)	Time 3 Mean (SD)
Range of Motion	Control	103.65 (9.99)	94.74 (12.16)	107.01 (9.46)
	Intervention	103.14 (12.46)	97.64 (8.48)	108.65 (6.21)
Pain (KOOS)	Control	47.16 (8.97)	61.18 (12.67)	80.37 (15.57)
	Intervention	47.82 (18.21)	60.36 (13.36)	79.85 (14.58)
Symptoms (KOOS)	Control	50.29 (13.00)	62.50 (11.32)	72.62 (13.40)
	Intervention	48.68 (19.25)	53.86 (12.36)	68.80 (19.57)
ADL (KOOS)	Control	50.38 (10.25)	73.14 (11.07)	81.99 (15.59)
	Intervention	52.95 (16.64)	69.56 (12.92)	80.53 (15.99)
QOL (KOOS)	Control	26.09 (13.47)	52.32 (16.09)	65.78 (20.29)
	Intervention	24.09 (17.43)	41.77 (15.61)	59.98 (21.31)
Awareness of knee (FJS-12)	Control	10.82 (8.27)	24.58 (19.10)	56.36 (32.01)
	Intervention	12.55 (13.84)	15.30 (15.85)	52.78 (28.61)

Descriptive statistics for NEO-FFI-3 and STAI

Measure	Group	Mean (SD)	Range
Neuroticism T-Score (NEO-FFI-3)	Control	40.05 (8.45)	Min = 26 Max = 60
	Intervention	43.55 (9.58)	Min = 26 Max = 65
Extraversion T-Score (NEO-FFI-3)	Control	54.00 (10.17)	Min = 32 Max = 74
	Intervention	53.59 (8.09)	Min = 37 Max = 66
Openness T-Score (NEO-FFI-3)	Control	50.77 (13.34)	Min = 25 Max = 72
	Intervention	56.41 (9.88)	Min = 30 Max = 74
Agreeableness T-Score (NEO-FFI-3)	Control	56.23 (9.65)	Min = 29 Max = 75
	Intervention	50.50 (8.92)	Min = 27 Max = 63
Conscientiousness T-Score (NEO-FFI-3)	Control	58.50 (10.20)	Min = 35 Max = 75
	Intervention	56.14 (6.51)	Min = 43 Max = 70
Trait Anxiety (STAI raw score)	Control	29.45 (6.05)	Min = 20 Max = 44
	Intervention	29.35 (6.63)	Min = 20 Max = 45

Appendix H: CONSORT checklist for pilot/feasibility trials

CONSORT 2010 checklist of information to include when reporting a pilot or feasibility trial*

Section/Topic	Item No	Checklist item	Reported on page No
Title and abstract			
	1a	Identification as a pilot or feasibility randomised trial in the title	129
	1b	Structured summary of pilot trial design, methods, results, and conclusions (for specific guidance see CONSORT abstract extension for pilot trials)	N/A no abstract for thesis chapter
Introduction			
Background and objectives	2a	Scientific background and explanation of rationale for future definitive trial, and reasons for randomised pilot trial	129-131
	2b	Specific objectives or research questions for pilot trial	131-132
Methods			
Trial design	3a	Description of pilot trial design (such as parallel, factorial) including allocation ratio	132
	3b	Important changes to methods after pilot trial commencement (such as eligibility criteria), with reasons	134-135
Participants	4a	Eligibility criteria for participants	134
	4b	Settings and locations where the data were collected	133-134
	4c	How participants were identified and consented	133
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	134-135
Outcomes	6a	Completely defined prespecified assessments or measurements to address each pilot trial objective specified in 2b, including how and when they were assessed	135-138
	6b	Any changes to pilot trial assessments or measurements after the pilot trial commenced, with reasons	N/A
	6c	If applicable, prespecified criteria used to judge whether, or how, to proceed with future definitive trial	N/A
Sample size	7a	Rationale for numbers in the pilot trial	134
	7b	When applicable, explanation of any interim analyses and stopping guidelines	N/A
Randomisation:			
Sequence generation	8a	Method used to generate the random allocation sequence	132

Section/Topic	Item No	Checklist item	Reported on page No
	8b	Type of randomisation(s); details of any restriction (such as blocking and block size)	132
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	133
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	133
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how	N/A
	11b	If relevant, description of the similarity of interventions	N/A
Statistical methods	12	Methods used to address each pilot trial objective whether qualitative or quantitative	139
Results			
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were approached and/or assessed for eligibility, randomly assigned, received intended treatment, and were assessed for each objective	140-142
	13b	For each group, losses and exclusions after randomisation, together with reasons	140-142
Recruitment	14a	Dates defining the periods of recruitment and follow-up	140
	14b	Why the pilot trial ended or was stopped	N/A
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Appendix G
Numbers analysed	16	For each objective, number of participants (denominator) included in each analysis. If relevant, these numbers should be by randomised group	141-143
Outcomes and estimation	17	For each objective, results including expressions of uncertainty (such as 95% confidence interval) for any estimates. If relevant, these results should be by randomised group	142-143
Ancillary analyses	18	Results of any other analyses performed that could be used to inform the future definitive trial	147
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	N/A
	19a	If relevant, other important unintended consequences	N/A

Section/Topic	Item No	Checklist item	Reported on page No
Discussion			
Limitations	20	Pilot trial limitations, addressing sources of potential bias and remaining uncertainty about feasibility	160-161
Generalisability	21	Generalisability (applicability) of pilot trial methods and findings to future definitive trial and other studies	160
Interpretation	22	Interpretation consistent with pilot trial objectives and findings, balancing potential benefits and harms, and considering other relevant evidence	149-153
	22a	Implications for progression from pilot to future definitive trial, including any proposed amendments	150-151, 153, 156-157
Other information			
Registration	23	Registration number for pilot trial and name of trial registry	140
Protocol	24	Where the pilot trial protocol can be accessed, if available	N/A
Funding	25	Sources of funding and other support (such as supply of drugs), role of funders	11
	26	Ethical approval or approval by research review committee, confirmed with reference number	140

Citation: Eldridge SM, Chan CL, Campbell MJ, Bond CM, Hopewell S, Thabane L, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. BMJ. 2016;355.

*We strongly recommend reading this statement in conjunction with the CONSORT 2010, extension to randomised pilot and feasibility trials, Explanation and Elaboration for important clarifications on all the items. If relevant, we also recommend reading CONSORT extensions for cluster randomised trials, non-inferiority and equivalence trials, non-pharmacological treatments, herbal interventions, and pragmatic trials. Additional extensions are forthcoming: for those and for up to date references relevant to this checklist, see www.consort-statement.org.