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THE RELATIONSHIP BETWEEN KNEE INTEGRITY AND FUNCTION POST TOTAL KNEE REPLACEMENT

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Physiotherapy.

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DECLARATION

I, Candace Lally, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Physiotherapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signed: ……

This……day of……..2008

This effort is dedicated to my parents, Peter and Rosalie for their love, guidance, encouragement and the belief they had in me, and to my husband, Regan, for his love, support and patience.

ABSTRACT

The purpose of this study was to determine if there is a relationship between knee integrity and function in patients who have had a total knee replacement. Twenty-two patients were selected at the arthroplasty clinics at the Johannesburg Hospital and Chris Hani Baragwaneth Hospital. This occurred at six weeks following a primary total knee replacement. Twenty-two subjects who participated in the study underwent two tests. The first test measured the patients' functional ability using the Iowa Level of Assistance (ILOA) Scale. Knee integrity was measured using the Knee Society Knee Score. The two examiners were blinded to each other's results. The results indicate that there is no relationship between knee integrity measured using the Knee Society Knee Score and function measured using the ILOA Scale (p= 0.19).

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CHAPTER 1

1. Introduction

Osteoarthritis is a leading cause of pain and disability affecting joints (March et al 1999). Progressive loss of the articular cartilage can result in joints that are painful and inflamed. The joint becomes stiffer and there is less stability in the joint (Parmet et al 2003). These factors affect the function of the joint which ultimately impacts on patients' functional ability and their quality of life (March et al 1999). Treatment may be conservative or surgical.

Conservative treatment aims to bring pain relief to the patient, which may include medication, exercise or education. When all forms of conservative treatment have failed, total joint replacement is considered. This procedure is used for patients with intractable pain, end stage joint deterioration, and gross functional impairment (Ethgen et al 2004).

Total joint replacement has revolutionised the management of osteoarthritis. It is done for pain relief (McAuley et al 2002), the restoration of function (Hawker et al 1998), and the improvement of the patient's social interaction (Zavadak et al 1995).

In the past, the success of surgical interventions was assessed through measures of mortality, morbidity and post-operative complications. Complications following total knee replacement such as infection, bleeding,

component loosening, and compartment syndrome, can impact on the effectiveness of the joint replacement (Ritter et al 1995). Impairments could result in quadriceps weakness, limited range of motion, instability and malalignment. Surgical techniques have been highly refined over the past twenty years resulting in higher success and survival rates. With the improvement of surgical procedures, there is a shift to outcome measures which focus on improvement of quality of life of individuals (Rissanen et al 1996), and the restoration of function (Hawker et al 1998).

It is necessary to identify objectively which medical interventions are effective and necessary in improving function and quality of life of patients (Ritter et al 1995). A wide variety of questionnaires and other measurement tools have been designed to measure outcomes such as pain, strength, range of motion, mobility and activities of daily living. They have been designed to measure joint integrity or the patient's functional ability. Limited information is available as to whether there is a relationship between knee integrity and the patient's functional ability following total knee replacements. Knee integrity post total knee replacement, can be assessed as a measure of range of movement, stability and pain (Insall et al, 1989). One can hypothesise that improved knee integrity (range of motion, stability and pain) will result in improved knee function. This in turn should improve the patient's general function.

Post operative physiotherapy aims to minimise the complications following total knee replacements and to rehabilitate the patient to full functional recovery. Techniques such as cryotherapy, strengthening and stretching

exercises are used (Zavadak et al 1995). Physiotherapy in hospital also includes functional techniques such as bed mobility, transfers, ambulation and stair climbing. An assumption can be made that if there is a relationship between knee integrity and function, physiotherapists may decide to only work on improving function, or only work on improving knee integrity (improving knee range of motion, reducing swelling, reducing pain and improving muscle strength). Time could then be better utilised on one aspect of rehabilitation.

Two measuring tools will be used in this study, namely the Knee Society Knee Score, and the Iowa Level of Assistance Scale. Knee integrity will be measured using the Knee Society Knee Score. The Knee Society Knee Score measuring tool was developed by the Knee Society in 1989 (Insall et al 1989). The validity and reliability of this rating system has already been shown by Insall et al (1989). The Iowa Level of Assistance (ILOA) Scale is a measure of function, first described by Shields et al (1995). It was shown to be both reliable and valid in their study. A significant correlation between the Harris Hip Rating Scale which measures function and the ILOA Scale were found ($p<.0001$). The ILOA Scale had moderate to good inter-tester reliability and good to excellent intra-tester reliability (Shields et al 1995).

Problem Statement:

Post-operative physiotherapy aims at improving knee integrity i.e. reducing pain, improving range of motion and improving stability of the knee. Physiotherapists also work on the patient's functional activities. There is a gap

in the body of knowledge as to whether there is a relationship between knee integrity (pain, range of motion and stability) and function following total knee replacements.

Research Question:

Is there a relationship between knee integrity and function following total knee replacements?

Aim:

To establish whether there is a relationship between knee integrity and function post total knee replacement.

Objectives:

1. To assess the functional ability of patients post total knee replacement using the Iowa Level of Assistance (ILOA) Scale.

2. To assess knee integrity of patients post total knee replacement using the Knee Society Knee Score.

3. To compare the scores of the ILOA Scale and the Knee Society Knee Score to establish whether there is a relationship between knee integrity and function.

CHAPTER 2

2. Literature Review

2.1 Introduction

This chapter includes a discussion on the following:

2.2 Osteoarthritis – how signs and symptoms affect function.

2.3 Indications for total knee replacement (TKR).

2.4 Complications of TKR.

2.5 Impairments following TKR.

2.6 The role of physiotherapy post operation.

2.7 Measurement requirements.

2.8 Outcome measurements.

2.9 International Classification and Functioning (ICF).

The literature data bases reviewed by the researcher were Pubmed and PEDRO. There were no limitations made with regard to time. Some of the key words used included osteoarthritis, complications, total knee replacement, arthroplasty, arthrofibrosis, stiffness, Knee Society Knee Score, outcome measures, function, Iowa Level of Assistance Scale, International Classification and Functioning.

2.2 Osteoarthritis – how signs and symptoms affect function

Osteoarthritis is a degenerative condition that affects the articular surfaces of joints which results in pain, stiffness and joint instability (Parmet et al 2003). Osteoarthritis results from disparity of stress applied to the articular cartilage and the ability of the cartilage to withstand stress (Apley and Solomon 1988). There is progressive loss of cartilage accompanied by new bone formation and capsular fibrosis (Parmet et al 2003). Over time the disease gets progressively worse.

There are four features of osteoarthritis and they include progressive cartilage destruction, subchondral cyst formation, remodelling of the bone with osteophyte formation and capsular fibrosis (Apley and Solomon 1988). Patients diagnosed with osteoarthritis present with the following on MRI: defects of the cartilage, bone marrow oedema, osteophytes, subchondral cysts, sclerosis, meniscal or ligamentous tears, joint effusion, synovial cysts and synovitis (Hayes et al 2005).

The clinical features of the condition are that it affects middle-aged people and increases in frequency with age. Pain starts insidiously and increases slowly over years and is aggravated by exertion and relieved by rest. Stiffness is caused by capsular fibrosis and narrowing of the joint space. Swelling is caused by joint effusion. In many cases muscle wasting, local tenderness and instability due to ligament laxity affect the joint. The muscles surrounding the knee get weaker which affects the stability of the knee. An osteoarthritic knee

is painful, inflamed, weak and stiff. These symptoms affect the functional ability of the individual (March et al 1999).

A study by Kornaat et al (2006) evaluated the association between clinical features and structural abnormalities found on magnetic resonance (MR) imaging in patients with osteoarthritis of the knee. A large sample size of 205 patients was used. The results of the study indicate that only two associations exist between clinical symptoms and structural finding found on MR imaging. These include joint effusions, which are associated with pain and stiffness, and osteophytes in the patellofemoral compartment, which are associated with pain. All other imaging findings such as subchondral cysts, bone marrow oedema, subluxation and meniscal tears are not associated with symptoms.

Osteoarthritis may lead to impairments in function and structures of the knee. These impairments may lead to limitations of physical activities and restrictions in participation (Stucki et al 2004).

A third of people 63 to 94 years of age have osteoarthritis of the knee (Deyle et al 2000). In an aging population with longer life expectancy, more people experience pain and dysfunction due to arthritic disease (Zavadak et al 1995). Osteoarthritis limits ambulation, the ability to climb stairs and stand comfortably (Deyle et al 2000). Surgical techniques and prosthetic developments have been highly refined over the last 20 years resulting in high success and survival rates. Clinicians have concluded that TKR contribute to the individual's improved functional status and overall well-being (Ritter et al

1995). Over the years the demand for joint replacement has increased due to prolonged life expectancy. This rising demand for surgery and post-operative rehabilitation has increased the cost to the state (Zavadak et al 1995).

2.3 Indications for total knee replacements

Total knee replacement has revolutionised the management of osteoarthritis. It is done for the relief of pain, the restoration of function (Weiss et al 2002) and the improvement of the individual's social interaction (Zavadak et al 1995).

Prior to the patient undergoing total joint replacement, the patient must have undergone conservative management. Conservative treatment includes the prescription of non-steroidal inflammatory medication and analgesics, as well as rest and a modification of the patient's activity levels. Load reduction can be achieved by the use of assistive appliances such as a walking stick or weight reduction by obese patients (Apley and Solomon 1988). Better joint mobility can be achieved with a physiotherapy exercise programme. This includes stretching exercises to the quadriceps, hamstrings and calf muscles, as well as strengthening exercises of the same muscles using isometric and resisted exercises which include the use of theraband and weights (Zavadak et al 1995).

Total joint replacement is indicated for patients with intractable pain and substantial functional disabilities who have not had acceptable relief and

functional improvement after conservative treatment and who are not candidates for reconstructive procedures such as arthroscopy. Patients with end stage joint deterioration due to osteoarthritis that are medically fit to be operated on, are considered for this procedure (Ethgen et al 2004). Physicians consider radiographs, range of motion (ROM) of the knee, joint stability, pain and function to determine if surgery is indicated (Ritter et al 1995).

2.4 Complications of total knee replacement

Life threatening complications may occur during or following knee replacement. These include cardiac arrest, tachyarrhythmia, pulmonary oedema, congestive heart failure, myocardial infarct, pulmonary embolism, acute renal failure, stroke, phlebitis, haematogenous infection, bowel obstruction or a pneumothorax (Ritter et al 1995). Arthrofibrosis and infection will be discussed in more detail.

2.4.1 Arthrofibrosis

Arthrofibrosis is one of the most common complications after total knee replacement. It is defined as painful stiffness with scarring and soft tissue proliferation. This may be accompanied by synovial hyperplasia, excessive proliferation of collagen and fibroblasts and inflammation. Early intensive physiotherapy with sufficient analgesia constitutes basic therapy. This may be followed by manipulation of the knee, arthrolysis or revision arthroplasty

(Gollwitzer et al 2006). Stiffness may be caused by infection, mechanical mal-alignment or loosening of the implant (Jerosch and Aldawoudy 2007). Stiffness is uncommon but is a disabling problem after total knee replacement. The prevalence of stiffness has not been well defined in the literature (Nelson et al 2005). Yercan et al (2006) indicted in a study including 1188 patients that about 5% of the patients presented with stiffness at 31 months. Half the patients had a manipulation post operation and their mean ROM improved from 67 degrees to 117 degrees. Early manipulation gave better results than those done at a later stage and arthrolysis should be done between three to six months post replacement.

2.4.2 Infection

Infection is a complication that might be caused via the site of the wound due to unsterile techniques or due to haematogenous spread from another site of infection. Symptoms include fever, pain, swelling and pus formation at the wound site. Early discovery of the infection is vital so that treatment can begin quickly. Treatment includes intravenous antibiotics and, or a debridement. This could prolong the patient's stay in hospital resulting in delayed functional recovery. The incidence of infection has declined since 1986 due to the introduction of prophylactic antibiotics (Blom et al 2004).

2.5 Limitation of joint range following total knee replacement

Limitation of motion after total knee replacement can be the result of a multiplicity of factors. These may include mal-positioning of components, over-sizing of the tibio-femoral joint space, retaining of osteophytes and a tight posterior cruciate ligament (Bong and Di Cesare 2004). Factors such as pain, obesity and deformities of the adjacent joints may also limit motion (Laskin and Beksac 2004). Intra-operative factors, which can result in joint stiffness, include improper flexion-extension gap, mal-positioning of the components or the creation of an anterior tibial slope. Post-operative factors include poor patient motivation, arthrofibrosis, infection and heterotrophic ossification (Bong and Di Cesare 2004; Laskin and Beksac 2004).

Stiffness is an uncommon but disabling problem after total knee replacement (Bong and Di Cesare 2004). A stiff knee is defined as either having a flexion contracture of 15-degrees and / or having a flexion arc of less than 75-degrees. The prevalence of stiffness is 1.3% at 32-months post operation (Nelson et al 2005). Patients present with less ROM post total knee replacement.

The first steps in treating stiffness include mobilising the patient and instituting physiotherapy. If these interventions fail, manipulation or revision arthroplasty can be done. Manipulation is most successful when done within the first three months post operation. Lysis of the adhesions is usually done three months after the operation (Bong and Di Cesare 2004).

Revision arthroplasty is usually done when stiffness is caused by malpositioning or over-sized components (Bong and Di Cesare 2004). Nelson et al (2005) studied the outcome of revision surgery for a stiff knee following arthroplasty. A total of 1000 patients with primary total knee replacements were assessed. The Knee Society Score was used to assess knee integrity. The total scores improved from 38.5 points to 86.7 points at 32-months post operation. The mean flexion contracture decreased from 11.3 degrees to 3.2 degrees and the mean pain score was reduced from 15 (moderate pain) to 45 (mild or occasional pain) points. The mean arc of movement improved from 54.6 degrees to 82.2 degrees. Functional range of knee flexion is between 45º and 105º (Miner et al 2003). Although the results of this study indicate that revision surgery is a satisfactory treatment option for stiffness when done within three to six months after the initial replacement, the benefits are modest as the arc of movement is less than the knee's functional ROM. A study by Miner et al (2003) indicates that patients with less that 95º of knee flexion present with low functional scores when assessed using the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) ($p < .0001$).

2.6 The role of physiotherapy post operation

Success of total knee replacement depends on the surgical procedure and the subsequent rehabilitation (Zavadak et al 1995). Physiotherapy aims to prevent or limit the impairments following total knee replacement through appropriate treatment techniques and to improve the patient's functional outcomes. The physiotherapist performs anti-inflammatory modalities on the patient which

include ultrasound, interferential therapy, pulsed short wave diathermy, transcutaneous electrical nerve stimulation (TENS), laser, acutouch and heat or cryotherapy. Joint mobilisation modalities, which include Maitland mobilisations and Mulligan techniques are also done. These techniques are performed to improve physiological joint mobility. Myofascial release, continuous passive mobilisation exercises, stretching, strengthening exercises, gait re-training, massage, patient education and an exercise programme are also prescribed.

The aim of physiotherapy is to restore the patient to full functional recovery by maintaining range of motion of the joint, preventing weakness in the muscles around the joint which reduces stability of the joint, to reduce pain and to maintain functional integrity of the knee (Zavadak et al 1995). Different treatment modalities which are routinely used by the physiotherapist to reduce impairments post TKR will now be discussed.

2.6.1 Cryotherapy

A systematic review by Hubbard and Deneger (2004) of 55-randomised control trials, using ice, were studied. None of the studies blinded the therapists and only one study blinded the subjects. Seventeen of the studies examined patients recovering with arthroplasties. Some studies showed that ice had no effect on pain, swelling or ROM. Other studies showed that ice was effective in terms of pain after minor surgery but there were no differences for ROM or girth. The time period when cryotherapy was applied, ranged from

immediately to one to three days post surgery. Continuous cryotherapy results in greater decrease in pain and girth following surgery than intermittent cryotherapy. Ice with simultaneous exercise is more effective than heat with exercise with regard to reducing swelling. Eight studies showed that ice and compression are more effective than ice alone in decreasing pain. Actual surface temperatures of the cooling devices were not provided.

The results of the review showed that the quality of the available evidence is of concern. More high-quality studies are required to create evidence-based guidelines on the use of cryotherapy. They must focus on developing modes, durations, and frequency of ice applications to optimise outcomes after injury or operations (Hubbard and Denegar 2004).

2.6.2 Continuous Passive Motion (CPM)

There are various treatment modalities that are used to reduce stiffness in the knee following total knee replacement. One such modality is continuous passive motion (CPM). Denis et al (2006) studied three in-hospital rehabilitation programmes using 81 subjects who had undergone total knee replacement due to osteoarthritis. The results of this study indicate that there is no benefit in using CPM with regards to knee ROM or function when using the WOMAC score. There was no reduction to knee impairments or disability. The quality of the study was not good as the exact physiotherapy interventions received by the subjects were not clearly defined due to the write up. The examiners were not blinded to the type of intervention received by the

subjects, which could result in their being biased. The settings of the CPM machine were also not described.

In a study by Pope et al (1997), the benefits of CPM in patients following TKR were studied. Fifty-three patients were randomly assigned to three groups. Each group received an identical physiotherapy regime. Group one received no CPM. Group two received CPM at 0-40 degrees and group three received CPM at 0-70 degrees for 48-hours. Patients were assessed preoperatively one-week post operation and at one year post operation. The results indicate that at one-week post operation, there was increased mean flexion in the groups who had CPM compared to the group who had no CPM. At one-year post operation there was no advantage in terms of improved function or ROM. There were no further interventions after one week. This indicates that the benefits of CPM are short lived and once the treatment stops there is no long-term benefit. The settings of the CPM machine were also not at a functional setting i.e 45º - 105º and this could also be the reason why there was no improvement in function.

A meta-analysis of the effectiveness of CPM following TKR indicates that CPM combined with physiotherapy results in improved ROM, decreased swelling and length of hospital stay and a reduction in the need for manipulation following TKR, compared to physiotherapy alone. However there is not enough data available regarding the number of hours of application of CPM and there is no consensus regarding the best ROM setting on the CPM machine. (Brosseau et al 2004).

McInnes et al (1992) also found that CPM combined with physiotherapy resulted in increased active flexion and decreased swelling, but did not affect pain, active extension or length of stay in hospital. Colwell and Morris (1992) indicated that when CPM management is compared to a post operation splint, the results indicate that there is decreased analgesic use and decreased length of hospital stay for patients who were assigned to CPM. More studies are required to create evidence-based guidelines on the use of CPM focusing on optimal duration and frequency.

2.6.3 Transcutaneous Electrical Nerve Stimulation (TENS)

The use of CPM and its effect on pain management was assessed on patients who had unilateral total knee arthroplasties. Pain medication consumption was less for the group who received CPM with ($p<0.5$). In the same study the use of CPM with transcutaneous electrical nerve stimulation (TENS) was assessed with patients following total knee replacement. The findings indicate that there was no difference in in-hospital pain medication consumption when patients used CPM with TENS and when patients used CPM without TENS (Walker et al 1991). In this study TENS was not an effective method of pain reduction.

Jensen et al (1985) assessed the use of TENS on patients with post-operative knee pain. The results indicated that TENS caused a decrease in pain in 93% of the patients. This group regained their isokinetic power in flexion and extension one month sooner that the group who received no TENS ($p<0.05$).

There was an improvement in ROM ($p<0.02$) and a reduction in swelling ($p<0.05$). The only complication was skin irritation at the electrode site.

2.6.4 Interferential Therapy

Jarit et al (2003) conducted a study, which assessed the effects of interferential therapy on post operative pain, ROM and oedema. Eighty-seven subjects all received interferential machines. A randomised double-blinded study was conducted. The results indicate that interferential therapy reduces swelling, pain and pain medication consumption. ROM increased significantly post operatively in the treatment group. The results could indicate a quicker return to activities of daily living and athletic activity in patients who have had anterior crutiate reconstruction, menisectomy or knee chondroplasty. The duration of the treatment and the exact settings on the machine were not clearly defined in the methodology. More studies are required to create evidence-based guidelines for the use of Interferential Therapy.

2.6.5 Quadriceps strengthening

A study by Mizner et al (2005) assessed if there was a better correlation between quadriceps strength and functional performance compared to knee flexion, ROM or pain and functional performance following total knee replacement. Forty subjects were assessed at one, two, three and six months after surgery. The results indicate that quadriceps strength was the most highly correlated measure associated with functional performance at all

testing sessions. This suggests that quadriceps strengthening could be important to enhance the benefits of total knee arthroscopy.

Surgical intervention has improved drastically in the last 20 years, which has resulted in a high success and survival rate. It is necessary to identify which medical intervention is necessary and effective in improving the quality of life of individuals (Ritter et al 1995). All the interventions discussed have in some way been shown to be effective in treating pain, swelling, stiffness or muscle weakness.

2.7 Measurement requirements

Measurements are needed to assess the effectiveness of any intervention. (Shields et al 1995). Orthopaedic surgeons rely on measurements obtained from the patient's history, physical signs, x-rays and objective measures. The measurements need to be reliable or reproducible and they need to be valid. Unreliable measures can arise from three sources namely:

- the patient
- the clinician
- the procedure

Using consistent, standard test conditions can reduce patient variability. Using the same bony landmark, using the same equipment and grading such as slight, moderate and severe can reduce clinician variability. Procedural

variability can be improved by using simple or identical equipment and the method used needs to be described in such a way as to allow for replication (Wright and Feinstein 1992).

Reliability is concerned with whether an instrument is consistent or reproducible. Cronbach's alpha and test-retest reliability results of 0.7 to 0.9 estimates are recommended for instruments (Garratt et al 2004). Validity is concerned with whether an instrument measures what it is designed to measure. Responsiveness is concerned with whether an instrument is sensitive to changes in health that may occur during a period. The measurement changes when the patient's status changes and remains stable when the patient's health is stable (Garratt et al 2004; Kreibich et al 1996). All of the above criteria need to be taken into consideration when choosing a measuring instrument. Unreliable measurements decrease the efficiency of clinical trials.

2.8 Outcome Measures

2.8.1 Iowa Level of Assistance (ILOA) Scale

The ILOA scale is a measure of function, which was first described by Shields et al (1995). It was shown to be valid, reliable and highly responsive in the same study. It was used on patients post total hip and total knee replacement to determine the readiness of the patient to be discharged from hospital. This

functional measurement tool assesses a patient's ability to perform five functional tasks, which include:

- Supine to sitting on the edge of the bed.
- Sitting on the edge of the bed to standing.
- Walking 4.57 metres (15ft)
- Climbing up and down three stairs.
- Walking speed over 13.4 metres (44ft).

Each task is graded according to the level of assistance provided by the therapist and the assistive device used to perform the task. An ordinal scale is used ranging from zero to six for the level of assistance required. A five point ordinal scale is used for the assistive device used. The sum of the tasks indicates the overall total score and an indication of the patient's functional ability. A total out of 50 indicates the functional ability of the patient.

The speed at which the patient could walk 13.4 metres (44-ft) was selected because of the extensive oxygen uptake data with established metabolic equivalent levels available for walking this distance. A close relationship was found between walking speed over this distance and function (Shields et al 1995).

The Harris Hip Rating Scale measures functional ability in patients following total hip and knee replacements. Pain, ambulation, stair climbing, activities of daily living, range of movement and muscle strength are assessed. This scale

ranges from one to a hundred, with a hundred indicating the highest function. Weighted Kappa statistics were used to correlate the Hip Harris Rating Scale and the ILOA Scale. The results indicate a Pearson Product-moment of 0.82 and a correlation coefficient of 0.89 indicating a significant relationship between the Hip Harris Rating scale and the ILOA Scale ($p<0.0001$). This indicates good validity (Shields et al 1995).

The inter-rater reliability was measured and revealed to be good and the intra-rater reliability was considered to be excellent with weighted Kappa values of 0.90.

The ILOA Scale is responsive to change in the patient's functional status and a change of seven points on the functional scale is seen as clinically important.

Zavadak et al (1995) stressed how attaining the above milestones is vital for normal functioning following TKR. The transfer activities used in the ILOA Scale are important aspects of mobility. Patients will find it necessary to transfer from sitting to standing when getting in and out of bed, on and off a toilet and in and out of a chair. Patients who are not independent in these transfers will always be reliant on others to assist them with these movements and may be confined to a bed or a chair or unable to use a toilet without assistance. A lack of independence may require hiring help, entering a nursing home or rehabilitation facility resulting in increased costs.

If patients are unable to walk independently, patients may socially isolate themselves leading to socio-psychological problems. There may be a risk of increased bone loss and muscle mass as well as the development of pressure sores and increased risk of infection (Zavadak et al 1995). Walking and stair climbing are important for mobility inside and outside the home.

2.8.2 Knee Society Knee Score

The American Knee Society Clinical Rating System is an orthopaedic tool developed by Insall et al (1989), to measure components of the knee following knee replacements. This dual rating system has two components: a knee score which considers pain, stability and range of motion and a functional score which utilises walking distance and stair climbing as the main parameters (Liow et al 2000). Lingard et al (2001) concluded that the knee score was valid and responsive when comparing it to the WOMAC and SF-36 scores. They found that the Knee Score had good convergent and construct validity. The functional component was less responsive. It is for this reason that the functional component has not been used in this study. Only the knee score will be used in this study and is referred to as the Knee Society Knee Score. This rating system was developed to measure knee integrity (pain, stability and range of motion) and was developed by the Knee Society (Insall et al 1989). One hundred points is awarded to a well-aligned knee with no pain, negligible instability and range of motion of 125 degrees. Points are deducted for flexion contracture, extension lag and malalignment.

Liow et al (2000) determined the inter-observer and intra-observer reliability of the American Knee Society Score. Twenty-nine subjects with knee replacements were evaluated by six observers. A 95% reference interval obtains a score of 16 points for the interobserver reference and the intraobserver reference intervals were 11 points. The intra-observer variances were smaller than the inter-observer variances. Reliability is better with repeated measures with one observer compared to multiple observers. Thus an experienced observer who is familiar with how to assess patients using the American Knee Score will produce a more reliable score than someone who is not familiar with this score. Observer experience influences the consistency of scoring. Less experienced observers have larger intra-observer variations. Familiarity in examination of patients is necessary for better scoring accuracy.

Kreibich et al (1996) measured the Knee Society Knee Score's responsiveness or its sensitivity to change. A paired t-test was used ($t = 14.3$) and ($p<. 001$). The results indicated that it was the most responsive to change when compared to six other scoring systems namely the Western Ontario and McMaster Universities osteoarthritis index, the six minute walk, the thirty-second stair climb test, the Short Form-36 and the time trade off test. Liow et al (2000) reported a high inter-rater reliability with trained individuals using standardised measurement procedures.

Some knee scores are divided into categories such as excellent, good, fair or poor. Wright and Feinstein (1990) stated that a single reading with the Knee

Society Score could span two categories due to error if the categories have narrow intervals.

The Knee Score was used in a study by Jerosch and Aldawudy (2007) to establish the effect of arthroscopic management in patients' with knee stiffness after TKR. The results indicate that following arthroscopy of the knee patients presented with increased knee flexion, a decrease in extension lag and reduced pain. There was no change to knee alignment or stability. Range of movement, pain and extension lag were the components that caused improved knee scores. This indicates that arthroscopy is an effective method of treatment. Some of the components of the Knee Society Knee Score including measuring ROM and pain will now be discussed in detail.

2.8.3 Goniometry as a tool for measuring range of movement

Goniometry is a measuring tool used to assess the range of motion of a joint. It can be used as an initial assessment and it evaluate the patient's progress (Rothstein et al 1983). Rothstein et al (1983) assessed goniometric reliability and which goniometer size was the most reliable in a clinical setting. The results of the study indicated that when using the Pearson product-moment, intra- and inter-tester reliability for passive knee flexion and extension was high (r=0.9 to 0.99). The size of the goniometers did not impact on the high degree of intra-rater reliability. These findings agreed with previous studies done by Boone et al (1978) that tested intratester and intertester variability and reliability outside a clinical setting. Techniques used to improve reliability

would be to use the same tester as intratester reliability is better than intertester reliability (0.92 and 0.99 respectively). (Rothstein et al 1983). The clinician should use the same starting position, the same bony landmarks and the same equipment, which also improves reliability (Wright and Feinstein 1992).

2.8.4 Measurement of pain

One of the goals of any intervention is pain relief. We need to know if treatment influences pain as well as the ability to work, perform social functions, be independent, the need for aids, appliances and drugs. Pain is subjective and can only be measured by the person feeling it. Three systems can be used to describe pain severity: descriptions, numbers and visual analogue scales (Huskisson 1982).

Descriptive scale: Words such as slight moderate and severe are used. Most people choose moderate when describing their pain. The problem with this scale is that not enough descriptive words are available for patients to accurately portray their pain (Huskisson 1982).

Numerical scales are favoured more than descriptive scales as patients have a larger variety to choose from. However children tend to select certain preferred numbers, which upsets the distribution of results. The Knee Society Knee Score uses a descriptive scale of pain, however more detail is given. Pain is assessed in two dimensions namely severity and frequency. The

patient is able to say whether their pain is continuous or occasional or if they have pain with walking and stairs, or when doing stairs only.

The visual analogue is a ten-centimetre line which has a defined beginning and ending and represents the extremes of pain (zero indicates no pain and ten indicates the most excruciating pain). The patient selects a distance between the ends and this indicates the patient's severity of pain. This method of pain assessment is reproducible (reliable). The results of the visual analogue scale are valid as they correlate well with other pain measuring tools. It is applicable to all ages over five years of age regardless of language. This is one of the better pain assessment tools (Huskisson 1982).
Salo et al (2003) assessed the reliability of the visual analogue scale. The results indicate that patients are able to use and read the scale accurately. It showed that 95% of patients' were within two millimetres of the physician's reading and thus it is reproducible and a suitable tool for assessing pain.

2.9 International Classification and Functioning (ICF)

In 1980 the World Health Organisation introduced the International Classification of Impairment, Disability and Handicap (ICIDH). It provided a framework for understanding the dimensions of disablement and functioning at three different levels: the body, the person and society. In 2000 a revised draft was brought forward at the World Health Assembly and it was renamed the International Classification of Functioning, Disability and Health (ICF) (Weigl et al 2004).

Body functions are physiological functions of body systems. Body structures are anatomical parts of the body such as organs and limbs. An example of a body structure in this study would be the knee. Impairments are problems in body function or structure. In the case of this study, this would be the pain, stiffness and dysfunction caused by osteoarthritis. Activity is the execution of a task or action by an individual, an example of this would be walking up stairs, or walking long distances. Participation is involvement in life situations for example going shopping (Stucki et al 2004).

The ICF was developed to provide a common framework for health outcome resources (Weigl et al 2004). Physiotherapists aim to maximise the person's capacity to perform activities of daily living. It is therefore essential to evaluate outcomes of treatment modalities and predicting management costs (Ustun et al 2003). Surgeons need valid and reliable data to make informed decisions about patients needing TKR and who would benefit the most from this procedure.

Conclusion

In summary the important points of this review are:

- Total knee replacement has revolutionised the management of osteoarthritis. It is done for the relief of pain, the restoration of function and the improvement of the patient's quality of life.

- Post operative complications can affect the success of the operation.

- Physiotherapy rehabilitation plays a role in facilitating the successful outcome of the surgical procedure. It aims to prevent or reduce impairments and restore the patient to better functional recovery by amongst other things maintaining ROM of the knee, preventing weakness of the muscles around the knee and reducing pain. Therapists also work on achieving functional milestones such as walking and climbing stairs so that the patient is more independent.

- The Iowa Level of Assistance (ILOA) Scale measures functional ability. It is valid, reliable and highly responsive.

- The Knee Society Knee Score is an orthopaedic tool that measures knee integrity (pain, ROM and stability). It is valid and responsive and reliable.

- Expectation of improvement following TRK is increasing with advanced techniques. These days longevity and the return to previous or improved activities of daily living are expected. Assessment tools measuring higher function and recreational activities need to be developed.

CHAPTER 3

3. Method

3.1 Introduction

The procedure that was followed to ascertain the relationship between knee integrity and function in patients post total knee replacement is highlighted in this chapter. The method in which patients were selected, the assessment tools used to collect the data, the data collection process and the statistical tests used for the analysis of the results are described.

3.2 Study Design

This was a correlational study.

3.3 Subjects

This study was conducted at the arthroplasty clinics at the Johannesburg Hospital and Chris Hani Baragwaneth Hospital. Patients who had a primary knee replacement and who presented at their first follow-up session which was around six to eight weeks post operation were asked if they would like to participate in the study. Patients were given an information sheet about the study and those who met the inclusion criteria and from whom informed consent was obtained, were considered eligible for this study.

3.3.1 Ethical considerations

Ethical clearance was applied for, to the human research ethics committee (medical), University of the Witwatersrand. Protocol number M06108. (See Appendix A).

Permission to carry out the research at the arthroplasty clinic at the Johannesburg Hospital and Baragwaneth Hospital was applied for and permission was obtained. (See Appendix C and Appendix D).

3.3.2 Inclusion Criteria

- Male or female patients who have had a primary total knee replacement and who presented to the first follow-up session. This was around six to eight weeks post operation.
- Patients between the ages of 40 to 80 years of age
- Patients who gave informed consent

3.3.4 Exclusion Criteria

- Any additional trauma to the lower limbs
- Any inability to participate in the assessment from a physical and a cognitive point of view such as dementia, confusion or an inability to understand commands.
- Unwillingness to participate in the assessments

- Inability of the patients to walk prior to the total knee replacement (with or without the aid of an assistive devise).
- Patients suffering with rheumatoid arthritis.

(See Appendix B the change of title of the research, Appendix E for the patient assessment sheet and Appendix F for the consent form).

3.3.5 Sample Size

The sample size was calculated using a standard deviation of 6.9 and an error of 1.5 of which a clinically important change on the ILOA Scale was suggested as seven (Shields et al 1995; Jesudason and Stiller, 2002). The following formula was used:

$$\frac{\sigma^2}{e^2}$$

where σ is the standard deviation and e is the required size of the standard error. Thus n= 22.

3.4 Measuring Tools

3.4.1 Functional outcome measure

The patients' functional ability was assessed using the Iowa Level of Assistance (ILOA) Scale, which was first described by Shields et al (1995). (See ILOA Scale in Appendix G). It was shown to be reliable and valid. The ILOA Scale has two components. The first component evaluates the patient's ability to perform five functional tasks and the level of assistance required by the therapist. Each task is scored using an ordinal scale ranging from zero to six. Zero indicates that the patient performed the activity independently and six indicates that the task was not even attempted by the patient due to safety or medical reasons. This means that the patient needs more assistance from the physiotherapist as one moves from zero to six.

The second component measures the assistive device used by the patient to perform the task. An ordinal scale is also used where zero indicates that no device is used and five represents the most supportive device used. The scores given for each task for the amount of assistance required by the therapist and the score given for the assistive device used are added together to give an overall score which represents the patient's functional ability.

The five functional tasks include:

1. Moving from supine to sitting over the edge of the bed.
2. Sitting on the edge of the bed to standing.
3. Walking 4.57 metres.
4. Climbing up and down three steps.
5. Walking speed over 13.4 metres.

The walking speed over 1.4 metres was measured using a stopwatch and ranked using an ordinal scale from zero to six. The following table indicates which score the patient obtained when compared to the speed they walked.

Walking Speed Score

Score	Speed
0	Walks 13.4 m in ≤ 20 seconds
1	Walks 13.4 m in 21- 30 seconds
2	Walks 13.4 m in 31- 40 seconds
3	Walks 13.4 m in 41- 50 seconds
4	Walks 13.4 m in 51- 60 seconds
5	Walks 13.4 m in 61- 70 seconds
6	Walks 13.4 m in >70 seconds

The best overall result the patient is able to achieve with this scale is zero. This indicates that the patient was able to perform all five tasks independently without the use of any assistive device. The worst overall score that could be

achieved is fifty which indicates that the patient was unable to perform the tasks due to medical and safety reasons and the assistive device used for standing or mobilising was a walking frame.

3.4.2 Knee Integrity Measure

This rating system was developed in 1989 by the American Knee Society to provide an evaluation form for knee integrity (Insall et al, 1989). (See Knee Society Knee Score in Appendix H). The knee assessment has three parameters which measure pain, stability and range of motion. The knee is given a score out of a hundred. A well-aligned knee with no pain, negligible instability and range of motion of 125 degrees scores a hundred points. The points are divided up as follows: fifty points are allocated for pain, twenty-five points are allocated for range of motion and twenty five points are allocated for stability. There are point deductions for flexion contractions, extension lags and for misalignment, which are measured using patients X-rays.

Pain measurement

The patient was asked if they had pain in the operated knee. If they said “No” 50 points were awarded. If they said “Yes”, the researcher asked them if the pain was mild, moderate or severe. If they said mild, they were asked if it occurred only with stairs or with stairs and walking. If they said moderate, they were asked if the pain was occasional or continual. Points were given accordingly.

Range of motion

The patient was asked to lie down on the plinth with their head resting on a pillow. A universal goniometer was used. To standardise the goniometric measurements anatomical reference points were used according to the guidelines described by the American Academy of Orthopaedic Surgeons (1965). The goniometer axis was placed on the lateral condyle of the femur. The stationary arm pointed towards the greater trochanter. The movable arm pointed towards the lateral malleolus. The initial measurement was noted. Passive knee ROM with over pressure to the point of onset of pain was measured with a goniometer. The range was noted. Every five degrees represents one point. The patient was asked to inform the therapist if any pain occurred during the movement. The range was then recorded on the data sheet.

Stability

Anteroposterior stability:

The patient was asked to lie in a supine position on the plinth with the knee in slight flexion. The therapist stabilised the femur with one hand and placed the other hand around the back of the proximal part of the tibia. A posterior-anterior force was applied through the tibia. The movement felt was measured in millimetres and recorded on the data sheet.

Mediolateral stability:

The patient was asked to lie in a supine position with the knee extended. The therapist grasped the distal femur with one hand and the ankle with the other

hand. A lateral force directed medially was applied over the knee. This was recorded as medial stability. A medial force directed laterally over the knee was applied and this movement was recorded as the lateral stability.

Extension lag

The patient was asked to lie in a supine position near the end of the plinth with the knees hanging down. A towel was placed under the distal femur. The patient was asked to actively extend the knee. The active range of movement was measured with a goniometer. The difference between the active and the passive movement was recorded as the extension lag (Stillman 2004).

Alignment

Measurement calculated by the surgeon using x-rays and a computerised programme that measures the varus and valgus angulations of the knee was used to get the alignment score.

3.5 Procedure:

Two therapists were required for this study, the researcher and an assistant. They were blinded to the results of each other. The researcher conducted the ILOA Scale, which measured the patient's functional ability. The assistant therapist collected data using the Knee Society Knee Score, which measured knee integrity. The assistant was trained in how to assess patients using the Knee Society Knee Score.

A sample of convenience (patients who attended the arthroplasty clinic) was selected. The researcher introduced herself to the patient and explained the purpose of the study. Patients who fitted into the inclusion criteria and who were willing to participate in the study were given an information sheet to read (see Appendix E). If the patients agreed to participate, they were asked to sign the consent form (See Appendix F). Each patient was assigned a code, which was put on the consent form as well as the score sheet. The patients' names were not put on the score sheet to ensure confidentiality. The patient was introduced to the assistant therapist and taken to a room containing a plinth. The assistant first measured knee integrity using the Knee Society Knee Score. This was then followed by the researcher who measured the patient's functional ability using the ILOA Scale.

3.6 Statistical Analysis:

The relationship between knee integrity and function was assessed using the Pearson Correlation Coefficient. The results of the ILOA Scale were inverted so that the higher the score the better the function (in reality the lower the score the better the function). This then coincided with the Knee Society Knee Score where the higher the score, the better the knee integrity. This was necessary to see the relationship between the Knee Society Knee Score and the ILOA Scale when plotted on a graph. Descriptive statistics were used to analyse the demographic data where data was presented in the form of tables and graphs. Continuous data was presented as means and standard deviations.

CHAPTER 4

4. Results

Introduction

In this chapter the patients' demographic data and the relationship between the ILOA Scale and the Knee Society Knee Score are described in the form of tables and a graph.

4.1 Demographic data

The demographic data for the subjects are presented in Table 4.1

Table 4.1 Gender and age of the patients

Demographics	Frequency (n=22)	Percent (%)
Gender		
Males	2	9.1
Females	20	90.9
Age (mean ± SD)	63 (±5)	

Twenty patients (90.9 %) were females. The average age of the patients was 63-years of age.

4.2 Results of the Knee Society Knee Score

The components of this score are represented in Tables 4.2 – 4.8. (See Appendix-H for the Knee Society Knee Score).

Table 4.2 Pain experienced by the patients

Pain score	Frequency (n=22)	Percentage (%)	Cumulative (%)
50	2	9.1	9.1
45	9	40.9	50.0
40	1	4.6	54.6
30	3	13.6	68.2
20	4	18.9	86.4
10	1	4.6	90.9
0	2	9.1	100.0
Total	22	100.0	

Two patients (9.1%) had no pain. Nine patients (40.9%) presented with mild or occasional pain.

Table 4.3 Knee range of movement

ROM (º)	Frequency (n=22)	Percentage (%)	Cumulative (%)
40	1	4.6	4.6
55	1	4.6	9.1
70	2	9.1	18.2
75	3	13.6	31.8
80	3	13.6	45.5
85	2	9.1	54.6
90	5	22.7	77.3
95	1	4.6	81.8
100	2	9.1	90.9
110	1	4.6	95.5
125	1	4.6	100.0

Twelve patients (54.6%) presented with a flexion arc of less than ninety degrees.

Table 4.4 AP (Anterio-posterior) stability of the knee

AP stability	Frequency (n=22)	Percentage (%)	Cumulative (%)
5-10mm	4	18.2	18.2
<5mm	18	81.8	100.0
Total	22	100.00	

Eighteen patients (81.8%) were within normal limits of the antero-posterior translation.

Table 4.5 ML (Medio-lateral) stability of the knee

ML Stability	Frequency (n=22)	Percentage (%)	Cumulative (%)
6º-9º	3	13.6	13.6
<6º	19	86.4	100.0

Nineteen patients (86.4%) had normal varus and valgus stress tests

Table 4.6 Flexion contracture of the knee

Flexion contracture (degrees)	Frequency (n=22)	Percentage (%)	Cumulative (%)
>20	1	4.6	4.6
10-15	1	4.6	9.1
5-10	12	54.6	63.7
0	8	36.4	100.0

Fourteen patients (63.7%) had some degree of flexion contracture.

Table 4.7 Extension lag

Extension lag (degrees)	Frequency (n=22)	Percentage (%)	Cumulative (%)
15	1	4.6	4.6
10	7	31.8	36.4
5	9	40.9	77.3
0	5	22.7	100.00
Total	22	100.00	

Seventeen patients (77.3%) had some degree of extension lag.

Table 4.8 Alignment

Alignment (degrees)	Frequency (n=22)	Percentage (%)	Cumulative (%)
5-10	19	86.4	86.4
0-4	1	4.6	90.9
11-15	1	4.6	95.5
Other	1	4.6	100.0
Total	22	100.00	

Nineteen patients (86.4%) had normal alignment.

4.3 Results of the ILOA Score

The components of this score are represented in Tables 4.9 - 4.13. (See Appendix G for the ILOA Score).

Table 4.9 Supine to sitting

Supine to sitting	Frequency (n=22)	Percentage (%)	Cumulative (%)
0	22	100.0	100.0
Total	22	100.0	

All patients were able to perform this task independently.

Table 4.10 Sitting to standing

Sitting to standing	Frequency (n=22)	Percentage (%)	Cumulative (%)
0	17	77.3	77.3
1	3	13.6	90.9
5	1	4.6	95.5
6	1	4.6	100.0
Total	22	100.0	

Seventeen patients (77.3%) were able to perform this task independently.

Table 4.11 Walking

Walking	Frequency (n=22)	Percentage (%)	Cumulative (%)
1	10	45.5	45.5
3	10	45.5	90.9
5	1	4.6	95.5
7	1	4.5	100.0
Total	22	100.0	

Twenty patients (90.9%) were able to walk with minimal assistance.

Table 4.12 Stairs

Stairs	Frequency (n=22)	Percentage (%)	Cumulative (%)
1	8	36.4	36.6
2	1	4.6	40.9
3	8	36.4	77.3
4	3	13.6	90.9
8	1	4.6	95.5
9	1	4.6	100.0
Total	22	100.0	

None of the patients were able to climb up and down three stairs without any assistance or assistive devices but seventeen patients (77.3%) had little difficulty performing the task.

Table 4.13 Walking speed

Walking speed	Frequency (n=22)	Percentage (%)	Cumulative (%)
1	9	40.9	40.9
3	9	40.9	81.8
4	2	9.1	90.9
8	1	4.6	9.5
9	1	4.6	100.0
Total	22	100.0	

None of the patients were able to walk 13.4 metres independently without any assistive device but eighteen patients (81.8%) had little difficulty performing the task.

4.4 Relationship between the Knee Society Knee Score and the ILOA Score.

This is represented in Figure 4.1.

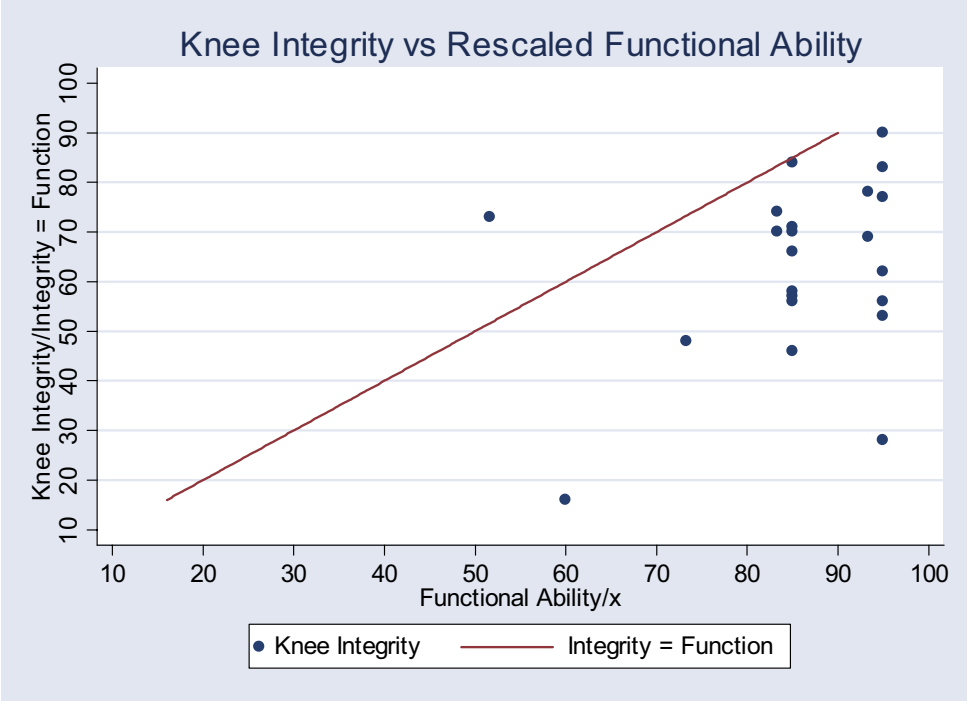

Figure 4.1 Knee integrity vs. Rescaled functional ability

In order to make the slope of the graph tilt to the right, the ILOA scores were inverted. This would indicate that the higher the score the better the function. (In reality, the lower the score the better the function). The results of the score were converted into percentages. Rescaled ILOA Score = (50 – Score/ 50 as percentage).

The Pearson's Correlation Coefficient was used to ascertain whether there was a relationship between the Knee Society Knee Score and the ILOA Scale. The results are r=0.29 and p=0.19. This indicates that there is no correlation between the two scales.

Conclusion

- The components that mainly affected the Knee Society Knee Score were pain, ROM, flexion contractures and extension lag.

- The components that mainly affected the ILOA Scale were walking and stair climbing.

- There was no correlation between the Knee Society Knee Score and the ILOA Score.

CHAPTER 5

5. Discussion

5.1Introduction

This chapter discusses the results of this study and interprets the findings of Chapter 4. It looks at the relationship between knee integrity, measured using the Knee Society Knee Score, and functional ability established using the ILOA Scale.

5.2 Results of the Knee Society Knee Score

5.2.1 Pain

Fifty percent of the patients had virtually no pain at six weeks post operation. The other fifty percent had pain that ranged from occasional to severe pain (Table 4.3). Two patients (9%) had severe pain. This indicates that the patients' pain is not being managed well. They are perhaps not given enough analgesic medication or the medication that they are receiving in government hospitals is not adequate, as they are given either Panado or Brufen tablets.

At the hospitals where this study was conducted, some patients received no physiotherapy and some patients received minimal intervention by a physiotherapist after the patient was discharged from hospital. In Chapter 2 of this report, various physiotherapy treatment modalities were discussed which

are shown to reduce pain. To reiterate various authors have done studies using different treatment modalities which are shown to reduce pain. Continuous cryotherapy has been shown to reduce pain and girth. Cryotherapy and simultaneous exercise is more effective in reducing pain than icing alone. Icing and compression also helps to reduce pain in patients post surgery. Transcutaneous Electrical Nerve Stimulation (TENS) causes a reduction of pain in 93% of patients who undergo surgery and the TENS group of patients consumed less pain medication. Interferential therapy has been shown to reduce pain in patients at intervals of 24-hours, 48-hours, 72-hours and at one to eight weeks post operation (Hubbard and Denegar 2004; Jensen et al 1985; Jarit et al 2003).

5.2.2 Range of motion

People normally require knee flexion of 45º to 105º during various activities of daily living. To demonstrate a normal gait pattern, 65º of flexion is required. To ascend and descend stairs, 90º of flexion is needed and to go from sitting to standing, 105º of flexion is required (Miner et al 2003). From the results of the range of movement shown in Chapter 4 (Table 4.4), one can assume that 91% of the patients (twenty patients) would not be able to go from sitting to standing as they only had knee flexion of 100º. However, from our sample of 22-patients, 17-patients (77%) who had less than 95º of knee flexion were able to go from sitting to standing independently without any assistance or assistive devices (Table 4.11). The reason why these patients were able to perform this transfer is because they put most of their weight on the unaffected leg while keeping the knee that had the TKR, in some degree of

extension. The patient compensates by using more hip and ankle flexion (Miner et al 2003). Two patients required a walking frame to perform this task at six weeks after the operation and used their arms to push themselves up from the sitting position into standing and compensated while performing this task.

Similarly a study by Miner et al (2003) indicated only a modest correlation between knee ROM and the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) with correlation coefficients of 0.34 or less. In their study, patients compensated for a stiff knee by increasing their ankle and hip range, or by applying more pressure on the joints of the other leg. The long term effect of this could be increased pain and discomfort to the normal joints, which could then result in additional pain and discomfort. Their study also showed that patients with pathology in the contralateral knee had less range of flexion than patients who had a normal contralateral knee. Pathology in the ipsilateral hip was associated with significantly less range of flexion in the operated knee. Pathology in the contralateral hip did not significantly affect the range of flexion in the operated knee. Patients with less than 95º of knee flexion had worse WOMAC functional scores ($p<.0001$). Only patients with a very stiff knee will have function that is really affected by ROM. Their study identified 95º of knee flexion as a clinically meaningful cut-off point above which ROM does not limit a patient's normal activities after TKR. However the long-term effects of this limitation of ROM could be detrimental to the normal joints, because of the patients over compensation when performing activities of daily living.

5.2.3 Stability and alignment of the knee

The results of Table 4.5 and 4.6 indicate that the majority of the patients had normal stability and alignment. This indicates that the total score of the Knee Society Knee Score in this sample is not really affected by the components of stability and alignment, but mainly by pain and ROM. Malalignment of the prosthesis could result in stiffness which although uncommon is a disabling problem (Jerosh and Aldawoudy 2007). Treatment of malalignment could include manipulation or revision arthroplasty (Bong and Di Cesare 2004), which has been shown to be successful in terms of post-operative function (Miner et al 2003).

5.2.4 Flexion contracture and extension lag of the knee

A large percentage of the patients in this study had some degree of a flexion contracture (Table 4.7) and some degree of an extension lag at six weeks post operation. This could indicate that attaining full knee extension and flexion is not that important when it comes to functional activities such as going from sitting to standing, walking and stair climbing, as these same patients performed well when assessed using the ILOA Scale. Functional range of motion is between 45º and 105º (Miner et al 2003). As long as the extension lag and the flexion contracture do not interfere with this range of motion, the patient should manage functionally. Patients also compensate when performing activities by using the other leg or their arms to assist with transfers. The quality of the movement being performed is not important to the patient, what is of importance is completing the movement by any means possible. The long term effect of poor ROM and poor quality of movement is

that the normal joints take excess strain and over a prolonged period, there is an increased risk of developing pain and discomfort in the normal joints due to osteoarthritis.

5.3 Results of the ILOA Score

The results of Tables 4.10 - 4.12 indicate that most of the patients were able to go from lying to sitting, sitting to standing and walking 4.57 meters independently, with minimal assistance. The patients scored very well in these three categories. This indicates that the ILOA Scale is not a sensitive enough functional measuring tool when used at six weeks post operation. It measures basic functional ability, not higher function. It was developed to determine whether patients who had had total hip and knee replacements were ready to be discharged from hospital (Shield et al 1995). It is the role of physiotherapists in the hospital to ensure that patients are able to perform basic transfers so that they will be independent at home, after they are discharged from hospital. None of the patients in this study were able to climb up and down three steps without any assistance or assistive devices (Table 4.13). This limits the patients' independence at home and at train stations or taxi ranks or even when they go to shopping centres.

Only one patient did not use an assistive device to perform the five functional tasks. She did however require nearby supervision for the walking, stairs and the speed test. Two patients used a walking frame at six weeks after the operation. Only one patient was unable to climb the stairs even with maximal

assistance. For example, a large percentage of South Africans using the services of government hospitals, live in informal settlements. It would be in the best interest of the patient to learn how to do transfers independently and correctly, and to mobilise without the use of the walking frame while still in hospital. This would improve the patient's independence. The size of their living quarters is small and this space is often shared with other family members. A walking frame takes up a lot of space. There is no proper toileting system in these areas. If the patients are not independently mobile, this could pose a big problem for them. Patients need good hip and knee flexion to use a long-drop or bucket toileting system.

5.5 Relationship between the Knee Society Knee Score and ILOA Scale

The results of the study have shown that there is no correlation between knee integrity which was measured using the Knee Society Knee Score and function which was measured using the ILOA Score (r=0.29). The patients had low scores when using the ILOA Scale, which indicates that they had good functional ability. The patients had above average knee integrity at six weeks post operation. The component of the Knee Society Knee Score that greatly affected the total score was ROM. Deductions were made for flexion contractures and extension lag. Patient scores were rarely affected by alignment, pain or knee stability. The component that influenced the ILOA Scale scores the most was the stair climbing.

The poor correlation between the two measuring tools in this study indicates that patients that presented with good function did not present with good knee integrity. No correlation also indicates that a therapist cannot only work on improving the functional ability of the patient, but must also work on improving the integrity of the knee (reducing pain, improving ROM of the knee and the strength around the knee). Improved ROM allows the patient more freedom of the joints when performing activities of daily living. The patient will be less likely to overuse or strain the ipsilateral and contralateral joints.

Patients attending these two government hospitals do not receive any physiotherapy once they are discharged from hospital. These patients see the doctor two weeks after the operation to have their stitches removed and then again at six weeks after the operation. Doctors should encourage patients to attend follow-up physiotherapy sessions so that the physiotherapist can assess the patient's transfers, encourage better movement and discourage any poor movement habits of the patient. Physiotherapy rehabilitation should include working on improving the integrity of the knee which means improving knee ROM to at least 105º, reducing the patients' pain and reducing the flexion and extension lags. The second part of the rehabilitation after being discharged from hospital should be to improve the quality of the transfers and to prevent bad habits from forming. These patients are compensating by over-using the unaffected leg, which strains the other knee joint (Apley and Solomon 1988).

Perhaps one of the reasons why there is no correlation between the Knee Society Knee Score and the ILOA Score is that the ILOA Score was developed to assess the patient's readiness to be discharged from hospital (Jesudason and Stiller, 2002; Shields et al, 1995). It may not be a sensitive enough functional tool to be used at six weeks after the operation. The ILOA Scale was used in this study because it is a valid and reliable functional tool (Shields et al 1995). It is inexpensive, practical, assessable and easy to administer. We need a tool that looks at higher functional ability. This is a potentially useful finding of this study that the ILOA Scale is not quite the tool needed to assess function at this stage. Possible reasons are that it is the goal of the physiotherapist in the hospital to rehabilitate the patient's functional milestones, and to ensure that the patient is able to manage with minimal assistance at home once discharged, however higher functions are needed at a later stage.

The ILOA Score does not look at the quality of the movement being performed. For example, although the patient successfully completed the task of going from sitting to standing, points should be deducted when they put all their weight on the unaffected leg, hardly using the operated leg because of limited range of movement. The quality of the movement needs to be assessed so that movement that is potentially harmful to the unaffected knee due to the increased load can be corrected while the patient is still in hospital so as to avoid the development of bad movement habits. The implications of the poor method described above, is that over time, the patient will be straining and damaging the unaffected knee due to increased load and stress

applied to the articular cartilage, causing osteoarthritis of the knee. Osteoarthritis results from a disparity between the stresses applied to the cartilage and the ability of the cartilage to withstand that stress (Apley and Solomon 1988). This could lead to huge financial implications to government hospitals as patients may require a second TKR on the other knee.

A patient's independence is limited if they are still using a walking frame at six weeks post operation. For example - In South Africa a person using public transport such as a taxi will struggle to get in an out of the taxi without any assistance. Taxi drivers are always in a hurry and may choose not to transport the patient. The patient might have to pay double the taxi fee because the walker takes up too much space. In South Africa most patients use public transport, which includes busses, taxis and trains. Getting to their transportation could also pose a problem, as they often need to walk long distances across rough terrain and up and down stairs. All the patients in this study needed assistance and an assistive device to ascend and descend stairs at six weeks post operation. Walking long distances using crutches or using a walking frame could be burdensome and tiring for patients. It is for this reason, that emphasis should be placed on attaining functional milestones before the patient is discharged from hospital (Zavadak et al 1995), or to recommend that follow-up physiotherapy sessions after discharge are needed.

Conclusion

There is no relationship between the Knee Society Knee Score and the ILOA Scale. At six weeks post-operation most of the patients performed well functionally but these patients did not have good knee integrity. Reasons for this could include that the ILOA Scale is not a sensitive enough assessment tool at six weeks post-operation as it does not assess higher function. The quality of the movement being performed is also not assessed, and deductions are not made for bad habits.

CHAPTER 6

6. Conclusion

The main finding of this study is that there is no correlation between knee integrity which was measured using the Knee Society Knee Score and function as measured using the ILOA Scale, six to eight weeks post surgery on total knee replacement.

Clinical Recommendations:

Following TKR, patients present with poor knee integrity. It is important to establish why patients have poor knee integrity. This would enable more appropriate rehabilitation to occur, thereby potentially reducing the risk of possible damage to the unaffected knee. Rehabilitation should focus on improving the quality of transfers, so that the patient does not over-stress the contralateral knee. Poor transfers increase the load on the good joints of the unaffected leg which in the long run may aggravate osteoarthritis and the patient may require a second TKR on the unaffected knee.

Research Recommendations:

A functional tool should be developed that assesses the attainment of higher functional milestones, as well as the quality of the movement. If a more sensitive functional assessment tool was used, one that looked at higher functional levels, a more accurate functional evaluation of the knee replacement could be determined.

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Appendix A: Ethical clearance certificate

Appendix B: Approval of change of title

Appendix C: Hospital clearance at Johannesburg Hospital

Appendix D: Hospital clearance at Baragwaneth Hospital

Appendix E: Patient information sheet

Appendix F: Consent Form

Appendix G: Iowa Level of Assistance (ILOA) Scale

Appendix H: Knee Society Knee Score

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Lally

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER MO61108**
PROJECT	A correlational study of knee integrity and function in patients post total knee replacement
INVESTIGATORS	Ms C Lally
DEPARTMENT	Physiotherapy
DATE CONSIDERED	06.11.24
DECISION OF THE COMMITTEE*	APPROVED UNCONDITIONALLY

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 07.01.10 **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Mrs W Wood

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2075/6

Reference: Ms Tania Van Leeve
E-mail: tania.vanleeve@wits.ac.za
30 November 2007
Person No: 9805474W
PAG

Ms CQC Lally
95 Dan Pienaar Ave
Florida Hills
Ext 2
Roodepoort
1709
South Africa

Dear Ms Lally

Master of Science in Physiotherapy: Approval of Title

We have pleasure in advising that your proposal entitled "*The relationship between knee integrity and function in patients post total knee replacement*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
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Reference: Ms Tania Van Leeve
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30 November 2007
Person No: 9805474W
TAA

Ms CQC Lally
95 Dan Pienaar Ave
Florida Hills
Ext 2
Roodepoort
1709
South Africa

Dear Ms Lally

Master of Science in Physiotherapy: Change of title of research

I am pleased to inform you that the following change in the title of your Research Report for the degree of has been approved:

From:	**A correlation study of knee integrity and function in patients post total knee replacement**
To	**The relationship between knee integrity and function in patients post total knee replacement**

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

GAUTENG PROVINCIAL GOVERNMENT

DEPARTMENT OF HEALTH

DATE: 06/11/06

NAME OF RESEARCH WORKER: CANDACE LALLY

TITLE OF RESEARCH PROJECT: A CORRELATIONAL STUDY OF KNEE INTEGRITY AND FUNCTION IN PATIENTS POST TOTAL KNEE REPLACEMENT

OBJECTIVES OF STUDY (briefly or include a protocol):

1. TO ASSESS THE FUNCTIONAL ABILITY OF PATIENTS WHO HAVE HAD A TOTAL KNEE REPLACEMENT USING THE IOWA LEVEL OF ASSISTANCE SCALE, AT AN INTERVENTION OF SIX TO TWELVE WEEKS POST OPERATION
2. TO ASSESS KNEE INTEGRITY USING THE KNEE SOCIETY CLINICAL RATING SYSTEM SCORE WITH OUTCOME MEASURES BEING PAIN, RANGE OF MOVEMENT AND KNEE STABILITY.
3. TO COMPARE THE SCORES OF THE IOA SCALE AND THE KNEE SCORE TO ESTABLISH WHETHER THERE IS A CORRELATION BETWEEN KNEE INTEGRITY AND FUNCTION.

METHODOLOGY (briefly or include a protocol):

CONFIDENTIALITY OF PATIENTS MAINTAINED: YES: EACH PATIENT WILL BE ALLOCATED A CODE WHICH WILL BE PUT ON EACH SCORE SHEET AND NOT THE PATIENT'S NAME.

COSTS TO THE HOSPITAL: NONE

APPROVAL OF HEAD OF DEPARTMENT: Prof A STEWART (PG co-ordinator)

APPROVAL OF CRHS OF WITS UNIVERSITY: Pending - application submitted

SUPERINTENDENT PERMISSION:

Signature: A. SCHEPERS date: 04/12/2006

Subject to any restrictions: Approved.

Gauteng Department of Health

PERMISSION FOR RESEARCH

DATE: 26/07/07

NAME OF RESEARCH WORKER: CANDACE LALLY

TITLE OF RESEARCH PROJECT THE RELATIONSHIP BETWEEN KNEE INTEGRITY AND FUNCTION IN PATIENTS POST TOTAL KNEE REPLACEMENT

OBJECTIVES OF STUDY (Briefly or include a protocol): 1) TO ASSESS FUNCTIONAL ABILITY OF PATIENTS FOLLOWING TOTAL KNEE REPLACEMENT. 2) TO ASSESS KNEE INTEGRITY OF THE PATIENTS. 3) TO COMPARE THE RESULTS OF THE TWO SCORES TO ESTABLISH WHETHER THERE IS A RELATIONSHIP BETWEEN KNEE INTEGRITY AND FUNCTION

METHODOLOGY (Briefly or include a protocol): INCLUDED IN THE PROTOCOL UNDER INSTRUMENTATION AND MEASURING PROCEDURES.

CONFIDENTIALITY OF PATIENTS MAINTAINED: YES: EACH PATIENT IS ASSIGNED A CODE

COSTS TO THE HOSPITAL: NONE

APPROVAL OF HEAD OF DEPARTMENT:

APPROVAL OF CRHS OF WITS UNIVERSITY: YES: PROTOCOL NO. M06108

SUPERINTENDENT PERMISSION:

Signature: DR E. OTHONNA Date: 7/7/07

Subject to any restrictions: None.

PATIENT INFORMATION SHEET

Good day. My name is Candace Lally. I am a qualified physiotherapist currently doing my masters degree in physiotherapy at the university of the Witwatersrand. The purpose of my study is to establish whether there is a relationship between how your knee has recovered from the operation and how you are managing to use your leg.

If you agree to participate in the study, you will be asked to participate in two tests related to the knee and how it works. The first test assesses knee integrity. I will ask you to rate your pain, measure the range of movement of your knee, and examine the stability of the joint. The second test measures your ability to do five tasks which include moving from lying to sitting on the edge of the bed, going from sitting to standing, walking, climbing up and down three stairs, and your walking speed. These tests will be administered by two different therapists and the results of the tests will be recorded. A few questions will be asked before the tests to make sure you are suitable for the study. Range of movement, swelling, strength and function will be tested. Each test will last for about 15 minutes.

Patient confidentiality will be assured as your name will not be used on any of the forms that we use. Participating in this study is voluntary and patients are free to withdraw from the study at any stage without consequence to future treatment.

There is no risk or side effects in participating in the study. If you have any queries or would like more information please contact me on 0827893342.

Thanking you for your time

Candace Lally
University of the Witwatersrand
Student number: 9805474w

CONSENT FORM

I, _____, agree to take part in this study being carried out by Candace Lally. I have read and understood the information sheet given to me. I understand that I can withdraw from the study if I choose to do so without being discriminated against.

Signature of patient:

Date:

Witness signature:

APPENDIX: IOWA LEVEL OF ASSISTANCE SCALE

TASKS

- Supine to sitting on the edge of the bed
- Sitting on the edge of the bed to standing
- Walking 4.57 metres
- Climbing up and down three steps
- Walking speed over 13.4 metres

ORDINAL SCALE AND DEFINITIONS FOR LEVEL OF ASSISTANCE

0 – independent	No assistance or supervision is necessary to safely perform the activity with or without assistive devices, aids or modifications
1 – standby	Nearby supervision is required for the safe performance of the activity; no contact is necessary
2 – minimal	One point of contact is necessary for the safe performance of the activity including helping with the application of the assistive device (part of ambulation), getting leg(s) on or off the leg rest and stabilising an assistive device
3 – moderate	Two points of contact are necessary (by one or two persons) for the safe performance of the activity
4 – maximal	Significant support is necessary at a total of three or more points of contact (by one or more people) for the safe performance of the activity
5 – failed	Attempted activity, but failed with maximal assistance
6 – not tested	Due to medical reasons or reasons of safety, test was not attempted
Contact	Any physical contact between the therapist and the patient or the assistive device (frame, crutches etc)

ORDINAL SCALE FOR ASSISTIVE DEVICE

0 – no assistive device

1 – one stick or crutch

2 – two sticks

3 – two elbow crutches

4 – two crutches

5 – frame (standard or rollator)

ORDINAL SCALE FOR AMBULATION VELOCITY

Time to walk 13.4 metres

0 – ≤ 20 seconds

1 – 21–30 seconds

2 – 31–40 seconds

3 – 41–50 seconds

4 – 51–60 seconds

5 – 61–70 seconds

6 – > 70seconds

RANGE OF SCORES

Minimal score: if the patient was independent in all five tasks (ie level of assistance score = 0) plus did not require an assistive device for the four tasks which involved standing or mobilising (ie assistive device score = 0), the total score = (5 × 0) for level of assistance score + (4 × 0) for assistive device score, which = 0.

Maximal score: if the patient was unable to attempt any of the five tasks because of medical reasons or reasons of safety (ie level of assistance score = 6) and the assistive device for the four tasks which involved standing or mobilising would have been a frame (ie assistive device score = 5), the total score = (5 × 6) for level of assistance score + (4 × 5) for assistive device score, which = 50.

KNEE SOCIETY KNEE SCORE

Pain		Points
None		50
Mild or occasional		45
Stairs only		40
Walking and stairs		30
Moderate		
Occasional		20
Continual		10
Severe		0
Range of Motion		**Points**
(5° = 1 point)		25
Stability		**Points**
Anteroposterior	<5mm	10
	5-10mm	5
	>10mm	0
Mediolateral	<6°	15
	6° - 9°	10
	10°- 14°	5
	15° or more	0
Subtotal		_____
Deductions (minus)		**Points subtracted**
Flexion contracture		
5 – 10		2
10 – 15		5
16 – 20		20
>20		15
Extension lag	<10	5
	10 – 20	10
	>20	15
Alignment	5 – 10	0
	0 – 4	3 points each degree
	11 – 15	3 points each degree
	Other	20
Total deductions		_____
Total Knee Score		_____