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Hip arthroscopy outcomes: a longitudinal study

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HIP ARTHROSCOPY OUTCOMES:

A LONGITUDINAL STUDY

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A dissertation submitted to the Faculty of Health Sciences, School of Therapeutic Sciences, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Master of Science in Physiotherapy.

Supervisors: Prof Witness Mudzi & Dr Corlia Brandt

Johannesburg 2020

Declaration

I, Samantha Jane Leeferink, student number 302876, declare that this Master's Dissertation is my work and that I contributed sufficiently towards research findings which are included in my dissertation. I have made no use of assistance, materials or sources, other than those which have been recognised in the text. This dissertation is being submitted for the Degree of Master of Science: Physiotherapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature of Student:…….....**Date**: 15 June 2020

Name of Primary Supervisor: Prof Witness Mudzi

Name of Primary Supervisor: Dr Corlia Brandt

Abstract

Introduction: Hip arthroscopy is not a new technology and thanks to improvements in surgical equipment and procedures, it is now a relatively well-utilised procedure in the management of hip disorders. Hip arthroscopy is used as a joint preservation measure. Although many hip disorders affect the younger population, these disorders are commonly associated with the older population. Insight into the recovery and return to an active or sporting lifestyle is important after hip arthroscopy. Research into this topic is scarce and there is no evidence of the outcomes after hip arthroscopic surgery in a South African context.

Aim of Study: The aim of the study was to establish the change in patient outcomes regarding perceived quality of life, hip functional performance and pain from baseline pre-operatively to six months post hip arthroscopic surgery.

Study Design: An observational, longitudinal study with a comparative age and gender matched control group was used.

Methods: Seventy-two participants were involved in this study. The surgical group (n=36) were consecutively sampled from a population of people undergoing hip arthroscopic surgery at Life Fourways Hospital. The control group (CG) (n=36) were an age and gender matched population who had never experienced hip pain. Ethical approval was sought from and granted by the Human Research Ethics Committee (HREC) of the University of the Witwatersrand. Three patient reported outcomes (PRO's) and one functional outcome were measured preoperatively (SG1) and six-months postoperatively (SG2). The PRO's included the International Hip Outcome Tool (iHOT33), Global Perceived Effect scale (GPE) and the Numeric Rating Scale for pain (NRS). The functional outcome was the single leg balance test (SLB). Descriptive and comparative statistics are reported for all outcomes. Stata version 14.2 was used for analysis.

Results: Age, height and weight were normally distributed in both groups and were similar on paired t-testing of age (p=0.3242), height (p=0.1047) and weight (p=0.3896). The iHOT33 scores showed a statistically significant improvement from baseline to follow-up

in the surgical group ($p<0.0001$). The GPE was rated as a “better” outcome by 28 participants ($n=36$) at SG2. A statistically significant improvement was noted in the NRS pain scores from baseline to follow up in the surgical group in the left ($p=0.0069$) and right ($p=0.0008$) hips. A statistically significant improvement was noted in the SLB tests from baseline to follow-up in the surgical group in the left ($p=0.0022$) and right ($p=0.0004$) hip. The surgical group showed significant improvement in all outcomes but was still significantly less than the outcomes of the control group. A moderate to strong negative correlation was found between the iHOT33 scores and pain in SG1 left hip and right hip and SG2 left hip and right hip.

Conclusion: There was a significant improvement in all measured outcomes at six months post hip arthroscopy. However, the outcomes had not improved to the level of the control group’s. Future research should investigate the time frame for the surgical group to regain a “normal” function as per the control group and the possibilities of improved physiotherapy rehabilitation to reach optimal function.

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LIST OF NOMENCLATURE AND ABBREVIATIONS

Acronym	Definition
ADL	Activity of Daily Living
BMI	Body Mass Index
CG	Control Group
ER	External Rotation
FAI	Femoroacetabular impingement
GPE	Global Perceived Effects Scale
HAGOS	Copenhagen Hip and Groin Outcome Score
HHS	Modified Harris Hip Score
Hip abd	Hip Abduction
Hip add	Hip Adduction
hip ext	Hip Extension
HOS	Hip Outcome Score
HOOS	Hip Disability and Osteoarthritis Outcome Score
HREC	Human Research Ethics Committee
ICC	Intraclass Correlation Coefficient
iHOT33	International Hip Outcome Tool
IR	Internal Rotation
LBP	Lower Back Pain
MCID	Minimal Clinically Important Difference
MDC	Minimal Detectable Change
MIC	Minimal Important Change

NAHS	Non-Arthritic Hip Score
NRS	Numeric Rating Scale
NSAIDS	Non-steroidal anti-inflammatory drugs
PI	Principal Investigator
POPIA	Protection of Personal Information Act
PRO	Patient-reported outcome questionnaire
QoL	Quality of Life
ROM	Range of Movement
SD	Standard Deviation
SEM	Standard Error of the Mean
SG1	Surgical group pre-operative assessment
SG2	Surgical group six-month postoperative assessment
SLB	Single Leg Balance test
TA	Transversus Abdominus
VAS	Visual Analogue Scale
°	Degrees
n	Sample size/ Frequency
p	p-value: level of marginal significance
r	Pearson's Correlation Coefficient
%	Percentage
r_s	Spearman's Rank Correlation Coefficient

CHAPTER 1. INTRODUCTION

1.1. Background and Need

Hip arthroscopy is not a new technology, however, thanks to improvements in surgical equipment and procedures, it is now a relatively well-utilised procedure in the management of hip disorders (Byrd, 2006; Philippon *et al.*, 2007). Burman initially described the hip arthroscopic procedure in 1931, but the procedure has evolved since then. Hip arthroscopy has become a common practice over the last decade and is a minimally invasive procedure performed through small incisions using camera-guided equipment to correct hip disorders (Nicholls, 2004; Kelly *et al.*, 2005). Advances in the surgical technique and an improved insight of the hip joint pathology is leading to an increased number of hip arthroscopies being performed (McCarthy *et al.*, 2011; Tijssen *et al.*, 2011; Bozic *et al.*, 2013). As with any innovative procedure, there comes a growing interest in the musculoskeletal-related disorders that pertain to the surgery (Martin *et al.*, 2006). This increased interest leads to the need for more outcome-related research.

There are several indications for hip arthroscopic surgery, which include: femoroacetabular impingement (FAI), degenerative conditions, loose bodies, synovitis, symptomatic labral tears and chondral defects of the hip joint (Byrd & Jones, 2010; Kelly *et al.*, 2005; Nicholls, 2004). The exact incidence of hip arthroscopy is unknown (Tijssen *et al.*, 2011).

While many hip disorders affect the younger population (Weiss & Ramachandran, 2006), the diagnosis and treatment of hip disorders are commonly associated with the aging population (Mella *et al.*, 2015). A substantial population of young and active patients (who experience limitations because of symptomatic hip disorders) exists. Athletes and the active younger population are susceptible to hip degenerative disease – especially if there is an underlying abnormality of the hip. Braly *et al.* (2006) stated that the hip plays a fundamental role in nearly all sports related activities. Normal hip function is an important factor in sport and activity participation because the hip is a key weight-bearing joint (Braly

et al., 2006). Insight into recovery and return to an active or sporting lifestyle is important after hip arthroscopy (Bennell *et al.*, 2014).

Treatment options (pre-operatively and postoperatively) include: physiotherapy, activity modification, assistive devices, non-steroidal anti-inflammatory drugs (NSAIDS), analgesics, and corticosteroid infiltrations or injections (Margo *et al.*, 2003). Sims (1999) stated that physiotherapy has an important role in the recognition and implementation of preventative and curative strategies in the painful hip. Rehabilitation protocols are constantly evolving as hip arthroscopy is still a relatively new procedure (Enseki *et al.*, 2006). Rehabilitation after hip arthroscopy aims to return the patient to a pre-injury level of function. Regaining a normal gait, strength and range of motion (ROM) are crucial for this (Stalzer *et al.*, 2006). A rising interest in the musculoskeletal-related disorders pertaining to the surgery has been noted (Martin *et al.*, 2006). Research regarding this topic could lead to improvements in the physiotherapeutic management of patients.

Patient-reported outcome questionnaires (PROs) give a suggestion of hip function from the viewpoint of the patient (Casartelli *et al.*, 2015). The PROs do not physically or objectively measure the functional performance of the hip (Casartelli *et al.*, 2015). Most of the research done to date has been based on the outcomes of these PROs alone (Thorborg *et al.*, 2015). Limitations in activities of daily living (ADLs), hip pain and poor athletic performance may result from dynamic forces that act across the hip when there is an underlying hip disorder (Kelly *et al.*, 2005). Therefore, an assessment of the functional abilities of the hip is imperative. Functional assessment can include single leg squat, hopping, single leg stance and other higher level functional tasks (Grimaldi, 2011). The measurement of functional performance consists of both quality and quantity of movement, both being important to examine (Engelen-van Melick *et al.*, 2013). The way the movement is performed is the quality of movement (Chmielewski *et al.*, 2007). ROM gives an indication of the quantity of movement (Ekegren *et al.*, 2009).

1.2. Problem Statement

After hip arthroscopic surgery, the hip joint is altered to correct the underlying pathology. This has an influence on function. There is limited evidence and information available on the functional performance and recovery following hip arthroscopy (Larson *et al.*, 2011; Hetaimish *et al.*, 2013; Casartelli *et al.*, 2015; Hegedus *et al.*, 2015). Research regarding this topic is scarce and there is no evidence of the outcomes after hip arthroscopic surgery in a South African context. In this study we will investigate how quality of life (QoL), hip functional performance and pain change at six months post hip arthroscopy.

1.3. Research Question

What are the patient outcomes with regards to perceived QoL, functional performance and pain following hip arthroscopy?

1.4. Aim of the Study

The aim of the study was to establish the change in patient outcomes (regarding perceived QoL, hip functional performance and pain) from baseline pre hip arthroscopic surgery to six months post hip arthroscopic surgery.

1.5. Objectives of the Study

1.5.1. Primary Objective

- To determine the change in the patient-perceived QoL from baseline to six months post hip arthroscopy.

1.5.2. Secondary Objectives

- To determine the change in the hip functional outcome using a single leg balance test from baseline to six months post hip arthroscopy.

- To determine the change in patient pain scores from baseline to six months post hip arthroscopy.
- To establish the demographic profile of patients undergoing hip arthroscopy at a private hospital in Johannesburg.
- To compare the perceived QoL, hip functional performance and pain outcomes post hip arthroscopy to an age- and gender-matched control group at six months postoperatively.
- To determine the association between the perceived QoL, hip functional performance and pain outcome variables.

1.6. Significance of the Research

To the researcher's knowledge, minimal research has been undertaken regarding hip arthroscopy in South Africa. It would be beneficial to determine patients' functional outcomes after hip arthroscopic surgery. If the outcomes are negative, then it would be prudent to consider physiotherapy rehabilitation protocols aimed at improving functional outcomes. This could pave the way for further research. Assessing the current status of hip arthroscopy would also give a guideline as to whether the rehabilitation protocols require further investigation or improvement. Functional outcomes are an objective and essential way of determining change experienced by patients. Valuable information can be obtained when functional outcomes are combined with the results of the PROs. The researcher hopes that the results from this study may add to the body of knowledge on the outcomes post hip arthroscopy. The results from the study could also be used to chart new areas of research needed to ensure better outcomes post hip arthroscopy.

1.7. Outline of the Research Dissertation

1.7.1. Chapter 2

This chapter discusses the pertinent literature relevant to the study. It outlines surgical procedure and reviews from current literature the indications for hip arthroscopy,

problems for physiotherapy, postoperative rehabilitation protocols, outcome measures, complications and gaps in the research.

1.7.2. Chapter 3

This chapter describes the methodology which was used to conduct this study.

1.7.3. Chapter 4

The results drawn from this study are presented in tables and figures and analysed for further discussion in Chapter 5.

1.7.4. Chapter 5

The results of the study are discussed and compared within the context of existing literature. Limitations of this study are highlighted in order to inform readers of recommendations for future research.

1.7.5. Chapter 6

This chapter concludes the dissertation. The new information derived from this study and the value of the results are discussed.

Finally, recommendations are proposed based on the new information and knowledge in this study as well as the current knowledge.

1.8. Conclusion

While hip arthroscopic procedure is becoming more popular, the outcomes after surgery and the implications for rehabilitation are not well understood. The next chapter will discuss the literature in further detail.

CHAPTER 2. LITERATURE REVIEW

2.1. Introduction

This literature review explores the hip arthroscopy surgical procedure, indications, incidences, complications, physiotherapy, rehabilitation and outcome measures. A literature search was done on the PubMed database via the University of the Witwatersrand's online library. The keywords used in this search were: hip arthroscopy, hip arthroscopic surgery, functional outcomes, physiotherapy and rehabilitation. The articles found spanned from 1995 to 2019 and the majority of the literature was from 2000 to 2019.

Hip arthroscopy is a rapidly expanding area of orthopaedic surgery (Glick *et al.*, 2014). In 1931, Michael Burman initially described the hip arthroscopic surgery when he conducted the first recorded procedures on cadaveric specimens. Burman perceived the procedure as unsuccessful. The first clinical application of the procedure was recorded by Kenji Takagi in 1939. The procedure has evolved substantially since then thanks to better understanding of hip pathologies and improvements in surgical equipment and procedures. In 1977, Richard Gross addressed hip arthroscopy's application in paediatric disorders. In the 1980s and '90s, James Glick and Thomas Sampson contributed significantly to the body of knowledge surrounding hip arthroscopy (including lateral positioning for the surgical procedure which will be discussed in the surgical procedure section below). In the mid-1990s, Thomas Byrd identified many modifications to the hip arthroscopic technique (Kandil & Safran, 2016).

2.2. Incidence and Prevalence of Hip Arthroscopy

Hip arthroscopy is now a well-utilised procedure in the management of hip disorders (Byrd, 2006; Philippon *et al.*, 2007). As with any innovative procedure, there comes a growing interest in the musculoskeletal-related disorders pertaining to the surgery (Martin *et al.*, 2006). Over the past decade, hip arthroscopic surgery has become a more common

practice and more surgeons are now performing the procedure with the aim of diagnostic and therapeutic results (Kelly *et al.*, 2005; Massa & Kavarthapu, 2019; Nicholls, 2004).

In a study conducted in the United States of America, 24 237 142 patients were investigated from the years 2007–2014 (Truntzer *et al.*, 2017). Of this number, 2581 hip arthroscopy surgeries were noted with an total incidence of 1.06 per 10 000 patients (Truntzer *et al.*, 2017). The hip arthroscopy was more frequently performed on the female population at 62.5% ($p < 0.001$) (Truntzer *et al.*, 2017). The age incidence of hip arthroscopy was highest between 15–24 years of age then between 35–44 years of age (Truntzer *et al.*, 2017).

There is a dearth of literature on the incidence and prevalence of the hip arthroscopic procedure in South Africa and Africa.

2.3. Hip Arthroscopy Surgical Procedure

Hip arthroscopy is a minimally invasive procedure to correct hip pathologies and is performed through small incisions using camera-guided equipment. Massa and Kavarthapu (2019) identify three regional groups when discussing the pathology of the hip, namely: the central articular compartment, the peripheral articular compartment and the periarticular compartment (Massa & Kavarthapu, 2019). The central compartment is visualised when traction is applied to the hip (Massa & Kavarthapu, 2019). Firstly, the cartilage is assessed, then the labrum is scrutinised for tears or detachments and, finally, the ligamentum teres is visualised and examined (Massa & Kavarthapu, 2019). Thereafter, traction is released. The peripheral compartment is typically visualised with the hip in 45° flexion or via the proximal anterolateral portal (Massa & Kavarthapu, 2019). This is where cam (camshaft) lesions are seen. A capsulotomy is sometimes indicated to further access the area of the femoral anterior head-neck junction (Massa & Kavarthapu, 2019). Dynamic reassessment needs to be done once the cam has been resolved. The periarticular compartment is visualised by a periacetabular synovectomy to visualise the acetabular overhang and thus treat the pincer bony deformity (Massa & Kavarthapu, 2019).

Hip arthroscopy can be performed in either a lateral or supine position (Byrd *et al.*, 1995; Glick, 2001). In the supine position, the patient's feet are placed into padded boots and the patient is positioned lying on their back on a traction table with a vertical post at the perineum (Byrd *et al.*, 1995). In the lateral position, the patient is placed side-lying (on the non-operated leg) on a radiolucent table with a horizontal post at the perineum (Glick, 2001).

Controlled traction is applied to the operative leg and continued under fluoroscopy to obtain the desired amount of joint distraction (Massa & Kavarthapu, 2019). The traction time must be kept as brief as possible to decrease the risk of traction-related complications such as nerve injuries (Simpson *et al.*, 2010). Traction is generally reduced while preparing for the operation. Once the surgeons are prepared, the traction is re-applied and the arthroscopy portals are established (Glick, 2001).

Four portals are commonly used in the hip arthroscopy procedure, namely: the anterolateral portal, the anterior portal, the proximal anterolateral portal and the distal anterolateral portal (Massa & Kavarthapu, 2019). A camera is usually placed in the anterolateral and anterior portals. The peripheral and central compartments can be visualised by the proximal anterolateral portal, while the lateral and anterolateral femoral neck can be visualised by the distal anterolateral portal.

There are advantages and disadvantages to performing hip arthroscopy using either the supine or lateral position (Marin-peña *et al.*, 2017). The positioning varies according to the system that is available in the theatre and the surgical skill and experience of the surgeon (Marin-peña *et al.*, 2017). More surgeons tend to use the supine position as it is a less complicated position from which to begin the surgery. However, this position is not ideal for use in obese patients as posterior access is challenging and often compromised (Smart *et al.*, 2007). The lateral position has the advantage of a better anatomical orientation for the procedure, but this setup requires more preparation to adapt the C-arm equipment and the traction system (Marin-peña *et al.*, 2017).

2.4. Complications Post Hip Arthroscopy

There is a low reported rate of complications following hip arthroscopic surgery which makes the procedure relatively safe. Enseki and Kohlrieser (2014) report this rate at 1.5% and note that several complications (though uncommon) have been described. Smart *et al.* (2007) report the complication rate between 0.5% and 6.4%. The use of traction generally brings about the most common complications seen, like articular surface injuries and neuropraxia (Belzile *et al.*, 2017; Glick *et al.*, 2014). Fluid management can also cause complications like fluid extravasation which can occur if the fluid outflow system becomes blocked or clogged. Other complication risks include: stress fracture or fracture of the femoral neck, avascular necrosis, deep vein thrombosis, excessive bleeding, heterotopic ossification, intra-articular adhesions, cartilage injury, injuries to the neurovascular structures, and over- or under-resection of the pathology (Enseki & Kohlrieser, 2014; Glick *et al.*, 2014). The three most common complications are expanded upon below.

2.4.1. Neuropraxia

Eight to 12 millimetres of traction is needed to perform the hip arthroscopic procedure (Smart *et al.*, 2007). This traction can be monitored using intraoperative fluoroscopy. If insufficient traction is observed, iatrogenic articular surface injuries are often noted (Glick *et al.*, 2014). The hip arthroscopic procedure more commonly notes transient neuropraxias of the pudendal and peroneal nerves rather than the sciatic nerve (as in hip arthroplasty) (Smart *et al.*, 2007). The pudendal nerve innervates the sphincters of the rectum and bladder and external genitalia. The pudendal nerve is both sensory and somatic and originates from the ventral rami of the second, third, and fourth sacral nerve roots. The anatomical pathway of the nerve runs between the piriformis and coccygeus muscles, exits through the greater sciatic foramen and enters the pelvis again through the lesser sciatic foramen. Neuropraxia is typically caused by compression of the nerve on the perineal post while traction is being applied (Smart *et al.*, 2007). The effect of the neuropraxia is generally pain, sexual dysfunction and continence or voiding cycle issues

in both the bladder and rectum (Possover & Forman, 2012). Nerve injury incidence was reported between 1.4% and 5% but has been noted to be as high as 13% (Kern *et al.*, 2018).

2.4.2. Fluid Management

Fluid management was developed for visualisation during hip arthroscopy. Initially, gravity flow systems were used, while more recently an automated pump system with both pressure and volume control has been used (Hsiao *et al.*, 2016). A clogged fluid outflow system generally leads to complications. The fluid escapes into surrounding tissues, such as the retroperitoneal space (Glick *et al.*, 2014). Fluid extravasation has been associated with serious complications such as atelectasis, hypothermia, abdominal compartment syndrome and cardiopulmonary arrest, although the risk is currently less than two percent (Hinzpeter *et al.*, 2015).

2.4.3. Stress Fracture or Fracture of the Femoral Neck

Cam impingement is treated by performing a femoral osteoplasty. Because of the removal of bone from the neck of the femur, this procedure causes risk of a stress fracture or femoral neck fracture (Glick *et al.*, 2014). Over-removal of bone must therefore be avoided. No more than 30% of the femoral neck's depth should be removed (Glick *et al.*, 2014). Stress fractures are a rare complication with an incidence rate of 0.1% as reported in a systematic review of 31 392 patients who underwent femoral osteoplasty (Horner *et al.*, 2017). If a fracture is a complication during the hip arthroscopy, weight bearing restrictions or ROM restrictions are applied as per the surgeon's orders. This complication can lengthen the recovery time frame.

2.5. Indications for Hip Arthroscopy

There are numerous intra-articular indications for hip arthroscopic surgery. These include any of the following individually or in combination: femoroacetabular impingement (FAI), symptomatic labral tears for debridement or repair, loose body removal, chondral defects,

synovectomy for synovitis, ligamentum teres repairs, capsular laxity treatment, and degenerative conditions of the hip joint (Bedi *et al.*, 2013; Byrd & Jones, 2010; Cheatham *et al.*, 2015; Kelly *et al.*, 2005; Nicholls, 2004). In addition to these intra-articular indications, there exists extra-articular indications that can be treated arthroscopically.These extra-articular indications can include but are not limited to: tight iliotibial band, irregularity of the iliopsoas tendon and bursa, tensor fascia lata muscle and trochanteric bursa, and tears of the hip abductor muscles (Kandil & Safran, 2016). Another indication for hip arthroscopic surgery can be to improve QoL and decrease pain (Tijssen *et al.*, 2011).

The exact prevalence and incidence of the hip arthroscopy are unknown (Tijssen *et al.*, 2011). However, the quantity of hip arthroscopies performed is increasing thanks to advances in the surgical technique and an improved knowledge of the associated pathology of the hip joint (Bozic *et al.*, 2013).

Ganz *et al.* (2001) discussed a theory of FAI which explains that at the end range of movements in the hip, structural abnormalities of the hip such as a deformed femoral head or a misshapen femoral neck will lead to irregular contact between the acetabular rim and the proximal femur. The labrum at the acetabular border is continuous with the cartilage on the joint surface. Damage is caused as a result of the repetitive, irregular contact of these structures due to the FAI. This abnormal, repetitive contact needs to be stopped early to prevent the progressive chondral damage which leads to osteoarthritis. This is where joint preservation by hip arthroscopic surgery plays an integral role.

Ganz *et al.* (2003) identified and explained three different types of FAI, namely a cam, pincer and combination type. A cam impingement is a bony prominence at the femoral head-neck junction. It is more noticeable with the movement of the hip into internal rotation with hip flexion. The shearing forces created by the changed biomechanics can eventually lead to a tear in the labrum at the affected site. A pincer impingement is where a deepening of the acetabular rim is observed due to an overhang of bone. This, in turn, leads to a decreased ROM before the femoral neck contacts with the acetabular rim.

Anatomically, this can be attributed to coxa profunda or acetabular retroversion. At the end of ROM, the labrum gets compressed between the acetabular rim and the femoral neck which can lead to degenerative changes in the cartilage or chondral surface. Damage by both cam and pincer impingement combinations is most commonly observed, but they can occur in isolation. FAI can be well managed arthroscopically. This is shown in the evidence when it is compared with the initial management strategy of open surgical dislocation (which had far more morbidities) (Ganz *et al.*, 2001; Kandil & Safran, 2016).

Many hip disorders affect the younger population (Weiss & Ramachandran, 2006), although the diagnosis and treatment of hip disorders are commonly associated with the aging population (Mella *et al.*, 2015). There is a substantial population of young, active patients who experience limitations because of symptomatic hip disorders. Athletes and the active, younger population are susceptible to hip degenerative disease – especially if there is an underlying abnormality of the hip. The idea that FAI could lead to joint degeneration is supported by histological evidence that the cartilage inflammation and degeneration at the site of impingement is similar to that seen in osteoarthritis (Chinzei *et al.*, 2016).

2.6. The Role of Physiotherapy Post Hip Arthroscopy

Braly *et al.* (2006) stated that the hip plays a fundamental role in nearly all normal functional activities as well as sports-related activities. Normal hip function is an important factor in sport and activity participation. This is because the hip is a key weight-bearing joint (Braly *et al.,* 2006). The recovery and return to an active lifestyle, which includes sporting function, is relevant after hip arthroscopy (Kivlan *et al.*, 2013).

Physiotherapy aims to restore normal hip function post-operatively. This includes addressing swelling and pain management, ROM restrictions, muscle imbalances and return to activity or sport (Kivlan & Martin, 2012). Similarly, Casartelli *et al.* (2015) stated that the objectives of hip arthroscopic surgery are to reduce hip pain, slow the degenerative changes of the hip joint, improve hip function and QoL and allow athletes to return to sporting activities.

Normal function was traditionally measured through objective measures such as radiographs, strength and ROM, but these are poor independent indicators of function without considering QoL (Mohtadi *et al*., 2012). It was established that the assessment of QoL was an integral part of determining normal function (Mohtadi *et al.*, 2012). Quality of life assessment has been an area of growing interest in the field of orthopaedics for many years (Naughton & Anderson, 1998). Physical and psychological health can be shown by a person's perception of pain and QoL (Walther *et al.*, 1999). Post-operative pain is generally temporary and it can be assumed that maximal pain levels tend to occur from the time of surgery until about day three post-operatively (Walther *et al.*, 1999). Pain levels are noted to decrease as the wound progressively heals (Walther *et al.*, 1999).

A study conducted in 2012 looked at a population of 612 patients after hip arthroscopic surgery (Malviya *et al.*, 2012). The study's sample consisted of 275 women and 355 men. The mean age at surgery was 36.7 years. A mean follow-up of 3.2 years showed that the mean QoL score improved significantly ($p<0.001$). Maliviya *et al.* (2012) found that men had a higher QoL score both pre-operatively and post-operatively when compared to women ($p<0.001$). It is, however, interesting to note that there was no statistically significant difference between the mean change in QoL score between women and men ($p=0.12$) (Malviya *et al*., 2012).

2.6.1. Hip Arthroscopy Post-Operative Rehabilitation Protocols

Treatment options for hip osteoarthritis and other hip pathologies include physiotherapy, activity modification, assistive devices, analgesics, non-steroidal anti-inflammatory drugs (NSAIDS) and corticosteroid injections (Margo *et al.*, 2003). Sims (1999) stated that physiotherapy has an important role in the recognition and implementation of preventative and curative strategies in the painful hip (Sims, 1999). Because hip arthroscopy is still a relatively new procedure, rehabilitation protocols are constantly evolving (Enseki *et al.*, 2006; Stalzer *et al.*, 2006; Enseki & Kohlrieser, 2014; Cheatham *et al.*, 2015; Kuhns *et*

al., 2017). Rehabilitation after hip arthroscopy aims to restore a pre-injury level of function for the patient. The restoration of normal ROM, strength and gait are vital to rehabilitation (Stalzer *et al.*, 2006).

In the past, post-operative hip rehabilitation protocols have not been well defined or understood. Athletes and the young, healthy population are generally eager to return to sport and competition as soon as possible and are known to push their limits to achieve this (Stalzer *et al.*, 2006). The basic principles and guidelines of post-operative rehabilitation need to be considered in each individual case. Stalzer, Wahoff and Scanlan (2006) stated that "[initially], soft tissue healing constraints must be considered while focusing on controlling swelling and pain, restoring ROM, and preventing muscle atrophy. As physiologic healing occurs, rehabilitation must address progressive lower extremity strengthening, proprioceptive retraining, and sports specific training" (Stalzer *et al.*, 2006).

As it currently stands, there is no unanimous decision on any one particular post-operative hip rehabilitation protocol. Protocols vary between surgeons, centres and physiotherapists. Although there are differences, most protocols relate to certain principles, namely: ROM and mobility, weight bearing restrictions or considerations, and muscular strengthening exercises (Enseki & Kohlrieser, 2014).

Early ROM activity is indicated to prevent post-operative stiffness and intra-articular adhesions (Enseki & Kohlrieser, 2014). Weight bearing restrictions differ depending on the procedures performed and the surgeon's protocol. Non-weight bearing gait is not commonly recommended. In the case of isolated labral debridement, a short period of partial weight bearing is generally recommended for two to three weeks post-operatively (Enseki & Kohlrieser, 2014). Extensive labral repairs may require a longer period of partial weight bearing (up to six weeks) (Enseki & Kohlrieser, 2014). In the case of microfracture of the cartilage or osteoplasty, this six-week extended gait protection period may be indicated (Enseki & Kohlrieser, 2014). Muscular strengthening guidelines also differ substantially between protocols and clinicians. Exercises should encourage movement in the available ROM and weight bearing restrictions. They should not reinforce abnormal movement patterns or increase pain and inflammation.

Cheatham *et al.* (2015) showed that based on the evidence, a four to five phase post-operative hip rehabilitation protocol was successful in the outcomes of basketball, football, soccer and ice hockey players. The authors believe that weight bearing should be restricted for a minimum period of four weeks in the case of microfractures and labral repair, progressing as tolerated to full weight bearing. Hip flexion, extension and external rotation should also be limited for four weeks. When there is no labral repair, weight bearing can be as tolerated and ROM as pain allows. Patients can be expected to recover full ROM after eight to ten weeks and safely engage in moderate impact activities after 12 weeks. Return to sport was noted to occur on average between 12 weeks and six months (Cheatham *et al.*, 2015).

Stalzer, Wahoff and Scanlan (2006) discussed the importance of protecting the surgically repaired tissue to allow for healing to occur and to avoid unnecessary stress on the repaired tissue. However, in mentioning that the repaired tissue needs to be protected, extended immobilisation is not ideal. Extended immobilisation could bring about several negative effects such as cartilage degeneration, muscle wasting or atrophy, adverse collagen formation, and loss of ligament strength (Stalzer *et al.*, 2006). Rehabilitation protocols should follow certain principles to be effective. Eight (8) basic rehabilitation principles were outlined, namely: "(1) consideration of soft tissue healing constraints, (2) control of swelling and pain to limit muscular inhibition and atrophy, (3) early ROM, (4) limitations on weight bearing, (5) early initiation of muscle activity and neuromuscular control, (6) progressive lower extremity strengthening and proprioceptive retraining, (7) cardiovascular training, and (8) sport specific training" (Stalzer *et al.*, 2006). In Stalzer *et al*'s article, post-operative hip rehabilitation protocols were divided into four phases (Table 2.1) (Stalzer *et al.*, 2006). In order to progress through each phase, certain clinical criteria or time frames need to be proven appropriate.

Table 2.1: Four phase rehabilitation outlines (Stalzer et al., 2006)

PHASE I – IMMEDIATE REHABILITATION (0-4 weeks)
Goals
Protect integrity of repaired tissue
Restore ROM within restrictions
Diminish pain and inflammation
Prevent muscular inhibition
Precautions
Do not push through hip flexor pain
Specific ROM restrictions (surgery dependent)
Weight-bearing restrictions
Criteria for Progression to Phase II
Minimal pain with all Phase I exercise
ROM ≥75% of the uninvolved side
Proper muscle firing patterns for initial exercises
Do not progress to Phase II until full weight bearing is allowed
PHASE II – INTERMEDIATE REHABILITATION (4-6 weeks)
Goals
Protect integrity of repaired tissue
Restore full ROM
Restore normal gait pattern
Progressively increase muscle strength
Precautions
No ballistic or forced stretching and no treadmill use
Avoid hip flexor/joint inflammation
Criteria for Progression to Phase III
Full ROM
Pain-free/normal gait pattern
Hip flexion strength >60% of the uninvolved side
Hip add, abd, ext, IR, ER strength >70% of the uninvolved side

PHASE III – ADVANCED (6-8 weeks)
Goals
Restoration of muscular endurance/strength
Restoration of cardiovascular endurance
Optimize neuromuscular control/balance/proprioception
Precautions
Avoid hip flexor/joint inflammation
No ballistic or forced stretching/strengthening
No treadmill use
No contact activities
Criteria for Progression to Phase IV
Hip flexion strength >70% of the uninvolved side
Hip add, abd, ext, IR, ER strength >80% of the uninvolved side
Cardiovascular fitness equal to preinjury level
Demonstration of initial agility drills with proper body mechanics
PHASE IV – SPORT-SPECIFIC TRAINING (8-16 weeks)
Criteria for Full Return to Competition
Full pain-free ROM
Hip strength >85% of the uninvolved side
Ability to perform sport-specific drills at full speed without pain
Completion of functional sports test

Kuhns *et al.* (2017) also reported using a four phase post-operative hip rehabilitation protocol (Table 2.2). This four phase rehabilitation protocol is more specific than that of Stalzer *et al.*, (2006). The time frames differ slightly and the ROM and exercises are well outlined for clinicians to follow.

*Table 2.2: Four phase rehabilitation outlines (*Kuhns *et al., 2017)*

PHASE I (week 1-6)

Goals

- Protect joint/ avoid irritation
- Symmetrical ROM by 6-8 weeks

Visit frequency: twice per week

Hip ROM restrictions

- 90° flexion for 2 weeks
- 30° abduction for 2 weeks
- 0° extension for 3 weeks
- 30° external rotation (ER) at 90° flexion for 3 weeks
- 20° internal rotation (IR) at 90° flexion for 3 weeks
- Flat foot partial weight bearing for 3 weeks
- No active lifting of the surgical lower extremity for 4 weeks

Techniques

- Manual therapy 20-30 minutes per session in weeks 1-6
- Supine soft tissue mobilisation with a focus on tensor fascia lata, iliopsoas, and quadratus lumborum
- Passive ROM including supine abduction, flexion, prone ER/IR, and supine circumduction in neutral, and 90° hip flexion
- Isometric exercises of quadriceps, adductors, gluteals, supine transversus abdominus (TA) for weeks 1-2
- Clams and reverse clams for weeks 1-3
- TA activation with bent knee fallouts for weeks 1-3
- Prone hip ER and IR and hamstring curls

PHASE II (week 3-10)

Goals

Non compensatory gait progression

Visit frequency: twice per week

Techniques

Begin aquatic therapy at week 3 if available and incisions are healed, exercises include heel raises, side steps, upper extremity exercises for core activation and mini squats

Continue manual therapy techniques

Standing weight shifts anterior/posterior and side to side for weeks 3-4

Backward and lateral walking for weeks 3-4

Standing double leg knee bends for weeks 3-4

Prone hip extension for weeks 3-5

Tall kneeling exercises for weeks 3-6

Begin elliptical forward and reverse with no resistance from week 6

Joint mobilisation for weeks 6-10

Forward step ups for weeks 6-10

Modified planks and side planks with oppositional movement for weeks 6-10

PHASE III (week 8-16)

Goals

Return to pre-injury level

Visit frequency: twice per week

Restrictions

Avoid agility drills until week 16 and avoid treadmill walking until week 12

Avoid weight bearing hip rotational activities until week 10

Techniques

Manual therapy as needed

Side steps and retro walks with resistance for weeks 8-16

Single leg balance – squat, trunk rotation for weeks 8-16

Planks and side planks for weeks 8-16 and single leg bridges for weeks 8-16

Weight bearing hip rotational activities for weeks 10-16

PHASE IV (week 16-32)
Goals
Return to sport
Visit frequency: twice per week
Restrictions
Assess functional strength and proximal control then advance to Phase IV
Techniques
Running – can start in alter G at 16 weeks, non-alter G at 20 weeks
Agility for weeks 20-32
Cutting for weeks 24-32
Plyometrics for weeks 24-32
Return to sport specific exercises for weeks 24-32

The criteria needed to advance to the next phase is outlined below in Table 2.3. These criteria guide clinicians to make an educated decision about advancing their patients to the next phase of rehabilitation when the patient is ready.

*Table 2.3: Criteria to advance (*Kuhns *et al., 2017)*

PHASE I: Strength and preparedness for ambulation without an assistive device, good pain control
PHASE II: Good proximal and distal control during exercises, no compensatory movements secondary to fatigue, minimal pain during therapy sessions (pain 1-2 points higher than baseline on a 1-10 scale)
PHASE III: Complete all phase III exercises without pain, maintain good proximal and distal control with running and functional activities
PHASE IV: Pass running assessment in Alter G or treadmill, pass return to sport functional test(s) as applicable

The standard post-operative protocol described by Philippon *et al*. (2009) uses a continuous passive movement machine for eight to 12 hours per day for four weeks. For ten days after the surgery, an anti-rotation brace can be used to prevent external rotation of the hip (Philippon *et al.*, 2009). Physiotherapy initially addresses passive movements

of the hip, thereafter active movements of the hip and then strengthening (Philippon *et al.*, 2009). The prevention of adhesion formation is addressed by including passive hip 'pendulums' or circumduction movements into the rehabilitation program (Philippon et al., 2009).

To ensure that post-operative hip rehabilitation protocols are patient specific but still consistent, functional testing and outcome measure reassessment are important (Enseki & Kohlrieser, 2014).

2.7. Outcomes Post Hip Arthroscopy

Using the hip arthroscopic surgery for the treatment of FAI has shown significant improvements in patient outcomes within two years post-operatively (Flores *et al.*, 2018). Flores *et al*. (2018) noted that the biggest improvement of outcomes was seen in the first three months post-operatively. However, some outcomes like QoL and pain continue to improve over a two year follow-up period (Flores *et al.*, 2018).

The findings of a systematic review (conducted in 2017) showed that over a three to six month period post hip arthroscopy, pain was reduced and function was improved. However, improvement in sports function was only seen between six months to one year postoperatively (Kierkegaard *et al.*, 2017). This improvement was maintained at a two to three year follow-up post hip arthroscopy (Kierkegaard *et al*., 2017).

Thorborg et al. (2018) found that not all patients achieved a full recovery or normal hip function scores post hip arthroscopy, which means that the expectation of return to normal function may need to be adjusted by patients and clinicians (Thorborg *et al.*, 2018). Studies have shown that at a two year follow-up post hip arthroscopy, outcomes scores are reduced when compared to those of a healthy control population (Thorborg *et al.*, 2018). Hetaimish *et al*. (2013) conducted a systematic review which found inconsistencies in the clinical and radiological outcome reporting post hip arthroscopy (Hetaimish *et al.*, 2013). The clinical outcomes included pain scores, patient satisfaction, range of motion, the Harris Hip Score (HHS) and the Non-Arthritic Hip Score (NAHS) (Hetaimish *et al.*,

2013). The radiological outcomes included degenerative changes, the head-neck offset and the alpha angle (Hetaimish *et al.*, 2013). There is a need for a more consistent way to report post hip arthroscopy outcomes in future studies (Hetaimish *et al.*, 2013).

2.7.1. Quality of Life Post Hip Arthroscopy

Some of the biggest expectations post hip arthroscopy are to have decreased pain, recover QoL and return to sport (Kierkegaard *et al.*, 2017). The World Health Organisation defines health-related QoL as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad-ranging concept affected in a complex way by the individual’s physical health, psychological state, level of independence, social relationships, and their relationships to salient features of their environment” (Vahedi, 2010). This recovery of QoL and sporting function seems to take longer to achieve post hip arthroscopy. This is because the first relevant clinical improvement is generally noted between three to six months post hip arthroscopy (Kierkegaard *et al.*, 2017). The improvement of QoL is not seen in the early stages post hip arthroscopy (Kierkegaard *et al*., 2017). Kierkegaard *et al*. (2017) found that most of the studies in previous systematic reviews looked at composite score outcomes such as the Harris Hip Score – which does not detect changes in domains such as QoL (Kierkegaard *et al.*, 2017). Outcome measures that measure domains with sub-scores are more specific to detect the changes in QoL (Kierkegaard *et al*., 2017).

In a sample of 612 patients at one year post hip arthroscopy, 76.6% reported an improvement in QoL scores, 14.4% remained unchanged and 9.0% had deteriorated (Malviya *et al.*, 2012). Malviya *et al.* (2012) reported that the QoL score improved at one year post hip arthroscopy (Malviya *et al.*, 2012). When comparing men and women, they found that the mean QoL score was significantly higher in men both pre-operatively and one year post hip arthroscopy (Malviya *et al.*, 2012). When looking at the mean change in the QoL score, there was no significant difference between men and women (Malviya *et al.*, 2012). Malviya *et al.* (2012) showed that the lower the pre-operative QoL score, the higher the improvement in QoL score post hip arthroscopy (Malviya *et al*., 2012).

Flores *et al.* (2018) found that the largest improvement in PRO scores happened between the pre-operative assessment and three months post hip arthroscopy, with smaller score improvements at the six month, one year, and two year follow ups (Flores *et al.*, 2018). However, outcomes such pain, QoL and return to sport can still improve over a two year follow up (Flores *et al.*, 2018). Lerch *et al.* (2013) found that at a three to six month follow-up, there was no significant, clinically relevant QoL improvement (Lerch *et al.*, 2013).

Forty-six healthy control individuals and 71 test individuals (who were 12 to 24 months post hip arthroscopy) were subjected to an investigation of the following: the Hip disability and Osteoarthritis Outcome Score (HOOS), iHOT33, EuroQol-5D and Hospital Anxiety and Depression Scale (Filbay *et al.*, 2016). The test individuals reported a worse hip-related QoL post hip arthroscopy than that of the healthy control's (Filbay *et al.*, 2016). Palmer *et al.* (2019) established QoL by using the EQ-5D-3L tool (Palmer *et al.*, 2019). Patients who received hip arthroscopy as a treatment for FAI had significantly higher QoL scores at an eight month follow-up than those of patients who had undergone only physiotherapy (Palmer et al., 2019).

Validated patient-reported outcome questionnaires (PROs), such as the International Hip Outcome Tool (iHOT33), must be used in future studies to draw more accurate conclusions from the data (Thorborg *et al.*, 2018). The iHOT33 PRO demonstrates the psychometric properties that must be used with confidence in a population of participants undergoing hip arthroscopic surgery (Kemp *et al.*, 2013). Identifying the particular areas of QoL impairment allows clinicians to implement a more specific rehabilitation program and support structure for patients undergoing hip arthroscopic surgery (Filbay *et al*., 2016).

2.7.2. Pain Post Hip Arthroscopy

Pain is a multimodal, unique experience to everyone. Pain is almost always experienced in some way after surgery. A systematic review looked at general uni-dimensional pain scales such as the numeric rating scale for pain (NRS) (Kierkegaard *et al.*, 2017). It showed a clinically significant pain reduction between six months to one year post hip

arthroscopy (Kierkegaard *et al.*, 2017). When assessing pain using pain sub-scores in disease-specific questionnaires, a clinically significant pain reduction was seen between three to six months post hip arthroscopy. This is much sooner than the six month to one year period reported when using uni-dimensional scales (Kierkegaard *et al*., 2017).

Several patients may experience residual hip pain post hip arthroscopy *(*Kierkegaard *et al*., 2017). This residual pain may be due to intra-articular causes (unaddressed impingement problems, scar tissue and cartilage lesions), extra-articular causes (soft tissue and muscles), or a combination (Kierkegaard *et al*., 2017).

Kemp *et al.* (2014) observed that most adults who had a hip arthroscopy for hip pain suffered with chondropathy at the time of surgery. At 12 months post hip arthroscopy, this led to minimal to no improvement in PRO scores (Kemp *et al.*, 2014).

Shin *et al*. (2018) reported that poor outcomes and ongoing pain are seen in some patients post hip arthroscopy. This refractory pain can be attributed to a failed hip arthroscopy (Shin *et al.*, 2018). The reasons for a failed surgery can include any one or a combination of the following: misdiagnosis, a new injury or complication, inadequate surgical procedure, no treatment of associated pathology, poor or slowed healing, and/or inadequate or incomplete physiotherapy rehabilitation (Shin *et al*., 2018).

Psychological factors, such as depression, can predict lower pre-operative PRO scores, the development of chronic pain post hip arthroscopy, and poor outcomes post hip arthroscopy (Clapp *et al.*, 2019). The Pain Catastrophizing Scale may therefore play a useful role in post hip arthroscopy rehabilitation strategies (Clapp *et al.*, 2019).

2.7.3. Function Post Hip Arthroscopy

FAI is a cause of dysfunction in the hip and hip pain (Sansone *et al.*, 2015). Pain has been found to improve soon after hip arthroscopy, but the progress in functional abilities does not improve to the same extent over a period of one year (Thorborg *et al.*, 2018). Kierkegaard *et al*. (2017) found that there are persisting muscle strength impairments post hip arthroscopy (Kierkegaard *et al*., 2017).

Excellent function and high patient satisfaction were reported post hip arthroscopy when the prescribed rehabilitation was followed (Philippon *et al.*, 2009). A study found an improvement from pre to post-operative outcome score of 50 to 71 when using the VAS to measure global hip function at a mean follow-up of 25.4 months (Sansone *et al.*, 2015). At a two year follow-up, 82% of a total of 289 patients were satisfied with the outcome of hip arthroscopic surgery (Sansone *et al.*, 2015).

Many studies have not reported hip function scores compared to those of a healthy control population (Kierkegaard *et al.*, 2017). Most of the outcome studies show short term results with less than a five year follow-up (Safran & Hariri, 2010). Long term outcomes are still awaited (Jamil *et al.*, 2018).

2.8. Outcome Measures Post Hip Arthroscopy

Outcome measures provide clinicians with important information regarding progress in terms of the rehabilitation process. Several outcome measures pertaining to the hip arthroscopy surgery have been described in the literature.

Philippon *et al*. (2009) conducted a study in 2005 which assessed participants pre-operatively and followed them up at a mean time of 2.3 years post hip arthroscopy. This study used a patient satisfaction outcome, the HHS, the NAHS and the Hip Outcome Score (HOS) (Philippon *et al.*, 2009). An improvement of 58 to 84 was seen on the HHS and patient satisfaction was 9 (where 1 is unsatisfied and 10 is very satisfied) (Philippon *et al.*, 2009). In 2007, a study found that at 3 years post hip arthroscopy, the HOS had a high correlation to function on a physical measure but a low correlation to mental health measures (Martin & Philippon, 2007). The HOS scores differed based on the participants' existing level of activity, age and surgical outcome (Martin & Philippon, 2007). A study conducted in 2008 noted an improvement at a mean follow-up of 9.9 months post hip arthroscopy for a positive impingement test (100% v 14%), the Short Form 12 (60.2 vs 77.7), the HHS (60.8 vs 82.7), and Visual Analogue Scale (VAS) for pain (6.74 vs 1.88 cm) (Larson & Giveans, 2008).

In a study conducted in 2013, five PROs were investigated, namely: the HOOS, HHS, HOS, iHOT33 and Copenhagen Hip and Groin Outcome Score (HAGOS) (Kemp *et al.*, 2013). An excellent test-retest reliability of 0.91-0.97 was noted with an MDC of <20%. Content validity was acceptable for the HOOS, HAGOS, and iHOT33 (Kemp *et al.*, 2013). All PROs could distinguish a change between the control and surgical groups (Kemp *et al.*, 2013).

PROs do not physically measure hip functional performance but rather give a suggestion of hip function from a patient's viewpoint (Casartelli *et al.*, 2015). PROs are indicators of pain and QoL (Mohtadi *et al.*, 2012). Most research done to date has been based on the outcomes of these PROs alone (Thorborg *et al.*, 2015; Tijssen *et al.*, 2011). Limitations in activities of daily living (ADL's), hip pain and poor athletic performance may result from dynamic forces that act across the hip when there is an underlying hip disorder (Kelly *et al.*, 2005). Therefore, an assessment of the hip's functional abilities is imperative. Functional assessment has included single leg squat, hopping, single leg stance, and other high level functional tasks (Grimaldi, 2011).

Three PROs and one functional test were used to conduct this study. The PROs and test are outlined below:

2.8.1. Measure of Perceived QoL: The International Hip Outcome Tool (iHOT33) (Appendix 1)

The iHOT33 tool is a self-administered 33-item questionnaire designed to measure the QoL in young and active patients who have symptomatic hip disease. QoL questionnaires were initially designed for patients undergoing total hip arthroplasty or those with hip fractures. However, these questionnaires had a ceiling effect and had limited use for the young, active population (Mohtadi *et al.*, 2012). A younger and more physically active population with non-arthritic hip pathology has different goals and expectations with regards to surgery and QoL. This needed to be addressed when formulating a new tool (Mohtadi *et al.*, 2012). A Numeric Rating Scale (NRS) scores each question with a response ranging from 0-10. These questions are divided into four categories, namely:

symptoms and functional limitations (16 questions); sports and recreational activities (6 questions); job-related concerns (4 questions); and social, emotional, and lifestyle concerns (7 questions) (Mohtadi *et al.*, 2012). The iHOT33 has good reliability with an internal consistency measure of Cronbach α of 0.99 and an intraclass correlation coefficient (ICC) of 0.78 (Mohtadi *et al.*, 2012). The iHOT33 was found to have good construct validity when compared to the NAHS with a correlation coefficient of 0.81 (Mohtadi *et al.*, 2012). The iHOT33 focuses on the subjective reported symptoms by the patient (Enseki & Kohlrieser, 2014). The minimal important change (MIC) reported is <11 points of a possible 100 points (Kemp *et al.*, 2013).

2.8.2. Measure of Pain: The Numeric Rating Scale (NRS) (Appendix 2)

Each participant rated the pain felt in the left and right hip on the NRS. Alghadir *et al.* (2018) stated that the NRS is preferred over the VAS because it is easy to understand and administer. This is why the NRS was chosen over the VAS for this study. The NRS is a one-dimensional measure for pain intensity in adults. It is an 11-item score which is a segmented version of the VAS. The NRS is a self-administered tool on which the respondent selects a whole number from 0 to 10 on a horizontal line, with 0 representing “no pain” and 10 representing “worst pain imaginable” (Hawker *et al.*, 2011). Patients are asked to select a number which most accurately depicts their level of pain. Both literate and illiterate patients showed a high test-retest reliability (r= 0.96 and 0.95 respectively) for the NRS (Hawker *et al.*, 2011). The NRS is highly correlated to the VAS in terms of construct validity in patients with rheumatic and other chronic pain conditions (0.86 to 0.95) (Hawker *et al.*, 2011). A decrease of 2 points or 30% on the NRS pain scores is clinically important (Hawker *et al.*, 2011). Good-to-excellent correlation of r=0.941 was found between the VAS and NRS, with an ICC of 0.95, a standard error of the mean (SEM) of 0.48, and a minimal detectable change (MDC) of 1.33 (Alghadir *et al.*, 2018).

2.8.3. Additional Measure of QoL: Global Perceived Effect Scale (GPE) (Appendix 3)

The GPE is another indicator of QoL. This scale has three options per criterion, namely: worse, almost the same, or better. If worse or better is selected, they are then broken down into seven options, namely: almost the same (hardly better/worse at all), a little better/worse, somewhat better/worse, moderately better/worse, a good deal better/worse, a great deal better/worse, a very great deal better/worse. The GPE scale has an intraclass correlation coefficient of 0.90-0.99 and can be replicated very well (Kamper *et al.*, 2010). Good correlation was seen between the GPE and change in scores on pain and disability measures (r=0.40-0.74) (Kamper *et al.*, 2010). However, post scores correlated better in most instances (r=0.58-0.84), while pre scores revealed weak association (r=0.00-0.28) (Kamper *et al.*, 2010). Due to this information, the GPE was tested at the six-month post-operative assessment for this study. The test-retest reliability of the GPE is excellent with an ICC of 0.998 at the first assessment and 0.925 at 12 months after chronic whiplash disorder, and 0.901 24 hours between assessments of lower back pain (Kamper *et al.*, 2010). The GPE scores are reported to improve over time (Kamper *et al.*, 2010). This means that the current status has a strong influence on the scores because current status improves over time.

2.8.4. Measure of Functional Performance: Single Leg Balance Test (Appendix 4)

The choice of incorporating balance testing has been informed by clinical practice guidelines for non-arthritic hip pain and research done on postoperative knee rehabilitation (Enseki *et al.*, 2014; Gustavsson *et al.*, 2006; Hegedus *et al.*, 2015; Kivlan & Martin, 2012; Stickler *et al.*, 2015; Tijssen *et al.*, 2015). The single leg balance test has a reported intra-rater reliability of 0.58 (Youdas *et al.*, 2007). Kivlan and Martin (2012) conducted a literature review which found that only the single leg balance and deep squat tests have validity in a population with non-arthritic hip pain and pathology. Therefore the single leg balance test was used as a functional measure to be assessed in this study.

2.9. Conclusion

To the author's knowledge, no research has been conducted on a South African population in terms of post-operative outcomes (functionally or self-reported). There are many musculoskeletal aspects that are still not known and a variety of different rehabilitation protocols used by various surgeons, institutions and physiotherapists. The information we currently have regarding the outcomes and physiotherapy rehabilitation required is insufficient. Therefore, this study uses three PROs and one functional test to look at the outcomes of a surgical group (baseline and six-months post-operatively) versus a control group (with no history of hip pain or surgery). The methodology that was used to achieve this is described in the following chapter.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter discusses the methodology used in this study. The methods chosen emanate from the literature and research aims discussed in Chapter 1 and 2. This chapter focuses on the study design, methodology and statistical analysis.

3.2. Study Design

An observational longitudinal or cohort study was used with a comparative control group. A cohort study looks at a sample of people (at intervals over time) who share a similar characteristic. In this case, they had undergone a hip arthroscopic surgical procedure. The cohort studied the participants at baseline pre-operatively and at six months post-operatively to establish the outcomes. The surgical group consisted of patients who had undergone a hip arthroscopy at Life Fourways Hospital under an orthopaedic surgeon who specialises in the hip joint. The control group consisted of an age and gender matched population who had never experienced hip pain. The control group was sourced from a population of physiotherapy patients who had never complained of hip pain or discomfort. They were contacted and invited to participate in the study.

Figure 3.1 below gives a graphic representation of the study design and shows how each group is assessed over time.

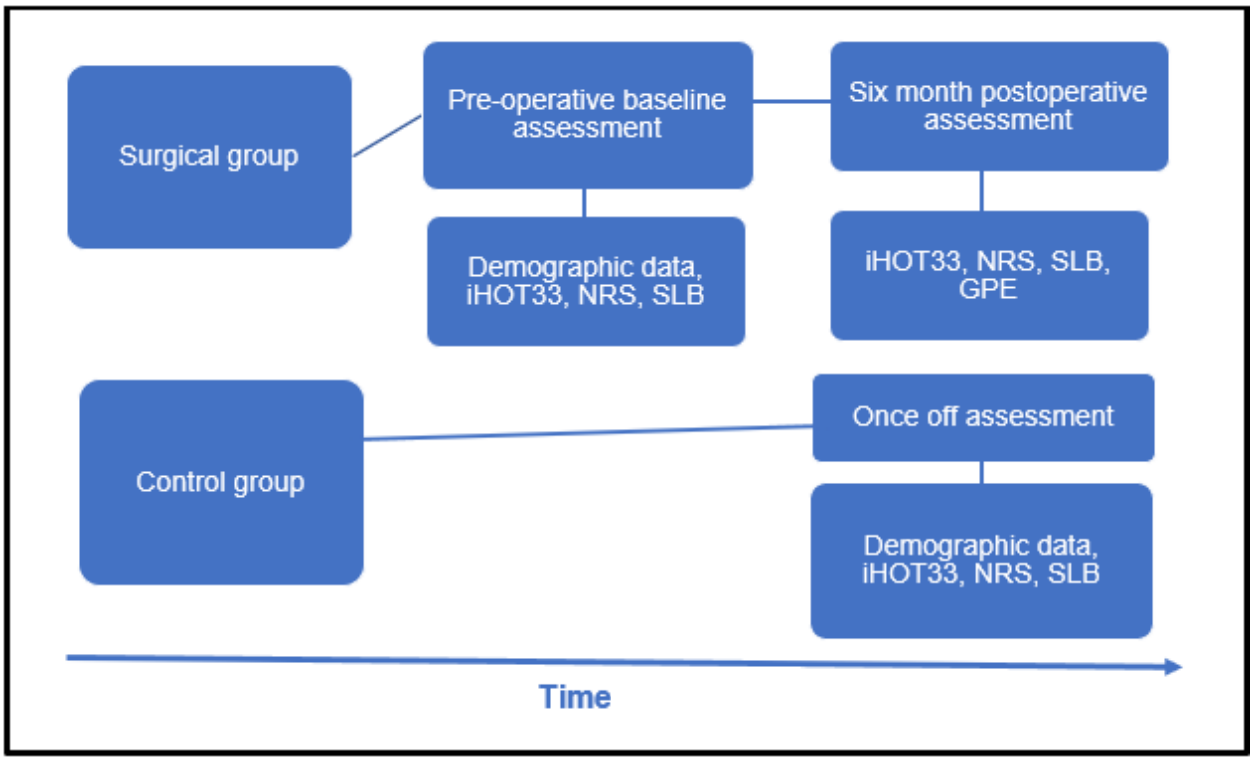


Figure 3.1: Flow diagram of the study design

3.3. Ethical Considerations

The study commenced once ethical clearance was obtained from the University of the Witwatersrand's Human Research Ethics Committee, ethical clearance number M170404 (Appendix 5). Each participant gave their permission and written consent (Appendix 6). Only participants who gave written, informed consent were involved in this study. The ethical requirements of the University of the Witwatersrand's Human Research Ethics Committee were strictly adhered to throughout the entire research process.

The Protection of Personal Information Act (POPIA) was not violated. The confidentiality of the data collected was maintained. The researcher allocated a folder to each participant which contained all their relevant information and completed assessments. The folders

were numbered and only the researcher knew the identity attached to each number. The researcher stored all electronic data on a password protected laptop.

Participation in the study was entirely voluntary and the participant had the right to withdraw from the study at any stage without any penalty being levied on them (Appendix 6, Appendix 7, Appendix 8).

The information obtained from this study was used for research purposes only. The participants had the right to access all research and information pertaining to them at any time during or after the study.

3.4. Research Setting

The study was conducted at Life Fourways Hospital, corner of Cedar Road and Cedar Avenue West, Fourways, Gauteng, South Africa (Appendix 9). The hospital, which is situated in Johannesburg, is a 194-bed facility with a 16-bed maternity ward, a neonatal intensive care unit, a paediatric ward, a 26-bed ICU and 10 theatres. Some of the specialist units include Cardiology and Orthopaedics. The hospital is a private healthcare facility that caters to the people of the greater Fourways area.

3.5. Study Participants

All patients who underwent hip arthroscopic surgery at the Life Fourways Hospital between 24 July 2017 and 14 December 2017 were contacted telephonically or via e-mail. They were invited to participate in a pre-hip arthroscopic assessment and a follow-up measurement at six-months post hip arthroscopy. An age and gender matched control group of participants without a history of hip pain was contacted telephonically or via e-mail to invite them to participate in a once off measurement.

3.5.1. Sample Selection and Size

This study uses a sample of convenience. A total sample size of 42 patients (21 per group) would have 95% power to detect a change of 6.1 when using the iHOT33 as the

main outcome measure, allowing for a 10% non-compliance and a 15% drop out. Significance was set at $p \leq 0.05$. It was decided to have a minimum of 40 participants per group for the study (a minimum total of 80 participants) to ensure that robust statistics can be used for data analyses.

3.5.2. Inclusion Criteria for the Control Group

Participants were included in the study if they had no history of hip pain or trauma in either hip, were either male or female and were aged between 18 and 60 years.

3.5.3. Inclusion Criteria for the Surgical Group

Participants were included in the study if they: had undergone either a left, right or bilateral hip arthroscopy, were male or female, and were aged between 18 and 60 years.

3.5.4. Exclusion Criteria for the Control Group

Participants were excluded if they: had a history of hip pain or trauma in either hip, had a lower limb neurological fallout or had any medical condition that may adversely affect balance i.e. vertigo.

3.5.5. Exclusion Criteria for the Surgical Group

Participants were excluded if they: had undergone a purely diagnostic hip arthroscopy, had a lower limb neurological fallout or had any medical condition that may adversely affect balance (i.e. vertigo).

3.5.6. Sampling

Consecutive sampling was used until the required number of participants for this study was reached. A sample of convenience was used for the age and gender matched control group. A population of physiotherapy patients who had never complained of hip pain or discomfort were contacted and invited to participate in the study.

3.6. Procedure of Data Collection

3.6.1. Pilot Study

A pilot study was undertaken to determine how long it took each patient to complete the PRO questionnaire, the pain scale, and the functional movement component. The pilot study familiarised the researcher with the instruments and tools used in the study. It was used to check if the data could be captured on the data-capturing spreadsheet designed for this study.

A total of eight (8) participants (10% of the main study population) was used for the pilot study, where four participants were in the control group and four participants were in the surgical group. These participants were asked to complete the PRO questionnaires and the functional outcome of balance and pain was assessed. Each participant went through the same procedure as the main study. The pilot study took place at Life Fourways Hospital (Appendix 9).

The pilot study showed that the data could be timeously collected on the data sheets designed for the study. No differences were noted in the data or outcomes of the iHOT33, NRS, GPE and SLB test for the eight participants, four in the surgical group and four in the control group between the pilot study and the main study. The pilot study results were therefore included in the final analysis.

3.6.2. Main Study

Data collection began after the University of the Witwatersrand's Human Research Ethics Committee granted permission. The researcher obtained a list (from the orthopaedic surgeon's offices) of patients who were due to undergo hip arthroscopic surgery. The POPI Act was not violated. Once identified, the eligible patients were verbally invited to participate in the study at their pre-operative information session. The researcher identified participants from a database of pre-existing physiotherapy patients who had visited the physiotherapy practice and were potentially eligible for the age and gender matched control group. The POPI Act was not violated. Each participant was given a copy

of the information sheet (Appendix 7, Appendix 8) and a consent form (Appendix 6). They were then informed that they had the right to refuse to participate in and drop out of the study at any time. The specific details of the assessment procedure were explained to each participant as they performed each component of the battery of tests.

As per Figure 3.2 below, each participant completed the demographic information sheet (Appendix 6), the PRO; the iHOT33 tool (Appendix 1) and the NRS (Appendix 2). The GPE (Appendix 3) was only assessed at six-months post-operatively in the surgical group. The participants were then assessed in terms of functional performance by means of a single leg balance test (Appendix 4). The SLB test is described in Appendix 4.

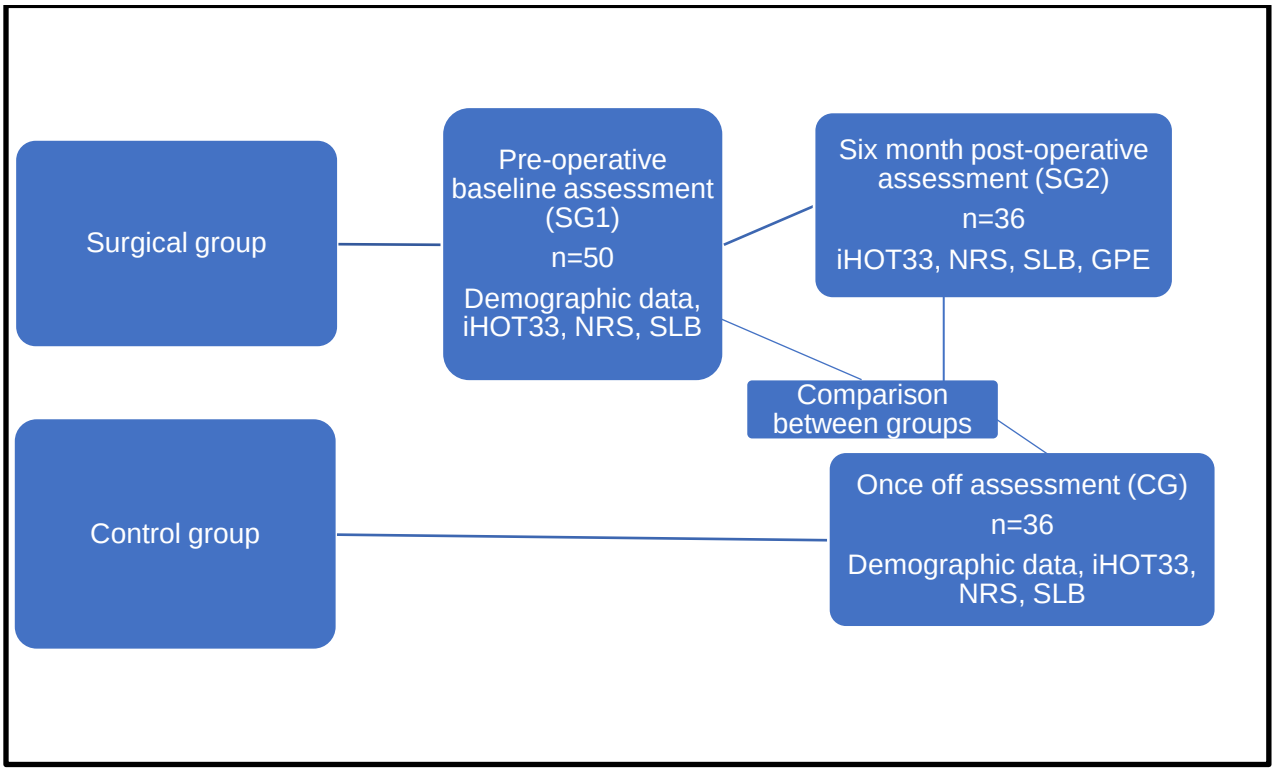


Figure 3.2: Flow diagram of the longitudinal assessment procedure

A single researcher conducted all of the assessments at the Life Fourways Hospital. The same procedure was performed on the surgical group as on the control group. If a participant missed an assessment, they were contacted telephonically to reschedule. The main study took place at Life Fourways Hospital.

3.7. Variables

The independent variables were hip pathologies, age, gender, height and weight.

The dependent variables were hip functional outcome (balance), patient perceived QoL (iHOT33 and GPE) and pain (NRS).

3.8. Outcome Measures

The primary objective of this study was to determine the change in the patient perceived QoL from baseline to six-months post hip arthroscopy in the surgical group.

The secondary objectives were: to determine the change in the hip functional outcome using a single leg balance test from baseline to six-months post hip arthroscopy, to determine the change in patient pain scores from baseline to six-months post hip arthroscopy, to establish the demographic profile of patients undergoing hip arthroscopy at a private hospital in Johannesburg, to compare the perceived QoL, hip functional performance and pain outcomes post hip arthroscopy to an age and gender matched control group at six months post-operatively, and to determine the association between the perceived QoL, hip functional performance and pain outcome variables.

In order to achieve these set objectives, three PROs were used, namely: the iHOT33, the NRS and the GPE for pain. To achieve the functional objective, the single leg balance test was used.

These outcome measures were discussed in detail in Chapter 2 under section 2.7.

3.9. Statistical Analysis

Demographic data were summarised using frequencies and percentages for categorical data. Means and standard deviations were used for continuous data that followed a normal distribution, while median and interquartile ranges were used for data that did not follow a normal distribution.

Data were captured on an Excel spreadsheet and analysed as discussed in Table 3.1. Data were summarised using descriptive statistics. Means and standard deviations were used for continuous data and frequency, while percentages and 95% confidence intervals were used for categorical data.

The surgical group was compared to the control group. This was done at baseline (pre-operatively) and at six-months post-operatively by using t-tests of perceived QoL, single leg balance and pain. A paired t-test analysis was used to assess the change from baseline to six-months post-operatively for the within group analysis (for both the surgical and control groups).

The associations between patient perceived QoL versus pain score were determined through Pearson correlation testing. Spearman's rank correlation testing was done to determine the association between patient perceived QoL versus functional outcome and pain score versus functional outcome.

Testing was done at the 0.05 level of significance.

Stata version 14.2 was used to analyse the data. Table 3.1 below outlines the data analysis as per the objectives.

Table 3.1: Data analysis according to the objectives

Objectives	**Type of Data**	**Variables**	**Data analysis Para/non-parametric**
Determine the change in the patient perceived QoL from baseline to six-months post hip arthroscopy in the surgical group.	Ordinal	Quantitative	Frequency, median & percentiles Paired t-tests
Determine the change in the hip functional outcome using a single leg balance test from baseline to six-months post hip arthroscopy.	Ratio	Quantitative	Frequency, median & percentiles Proportion tests
Determine the change in patient pain scores from baseline to six-months post hip arthroscopy.	Ordinal	Quantitative	Frequency, median & percentiles Paired t-tests
Establish the demographic profile of patients undergoing hip arthroscopy at a private hospital in Johannesburg.	Ratio Nominal Ordinal Continuous	Quantitative Quantitative Quantitative Quantitative	Frequency, mode, median & percentiles T-tests for age, height and weight
Compare the perceived QoL, hip functional performance and pain outcomes post hip arthroscopy to an age and gender matched control group at six months post-operatively.	Ordinal Ratio	Quantitative	T-tests
Determine the association between the perceived QoL, hip functional performance and pain outcome variables.	Ordinal Ratio	Quantitative	Pearson's correlation Spearman's correlation

3.10.Conclusion

Chapter 3 described the study's design and research methodology. The next chapter gives a detailed presentation of the change in scores in the surgical group from baseline to six months and compares this with the control group. Chapter 4 also presents other associations and relationships between variables to underpin the discussion of the data.

CHAPTER 4. RESULTS

4.1. Introduction

This study aimed to establish the change in patient outcomes from baseline pre-operatively to six months post hip arthroscopic surgery with regards to perceived QoL, hip functional performance, and pain. This main aim was further divided into primary and secondary objectives. The primary objective was to determine the change in the patient perceived QoL from baseline to six-months post hip arthroscopy. The secondary objectives were to determine the change in the hip functional outcome using the single leg balance test, QoL and patient pain scores from baseline to six-months post hip arthroscopy. The study aimed to establish the demographic profile of patients undergoing hip arthroscopy at a private hospital in Johannesburg. It aimed to compare the perceived QoL, hip functional performance and pain outcomes post hip arthroscopy to an age and gender matched control group at six months post-operatively. Finally, it aimed to determine the association between the perceived QoL, hip functional performance and pain outcome variables.

This chapter presents the results obtained in the surgical group at baseline and at the six-month follow up and the results of the control group comparison. The results were calculated within and between groups using t-tests and association tests between variables in Stata V14.2 as guided by a biostatistician.

A flow diagram of the study sample and loss to follow-up is presented in Figure 4.1 and discussed in the text to follow.

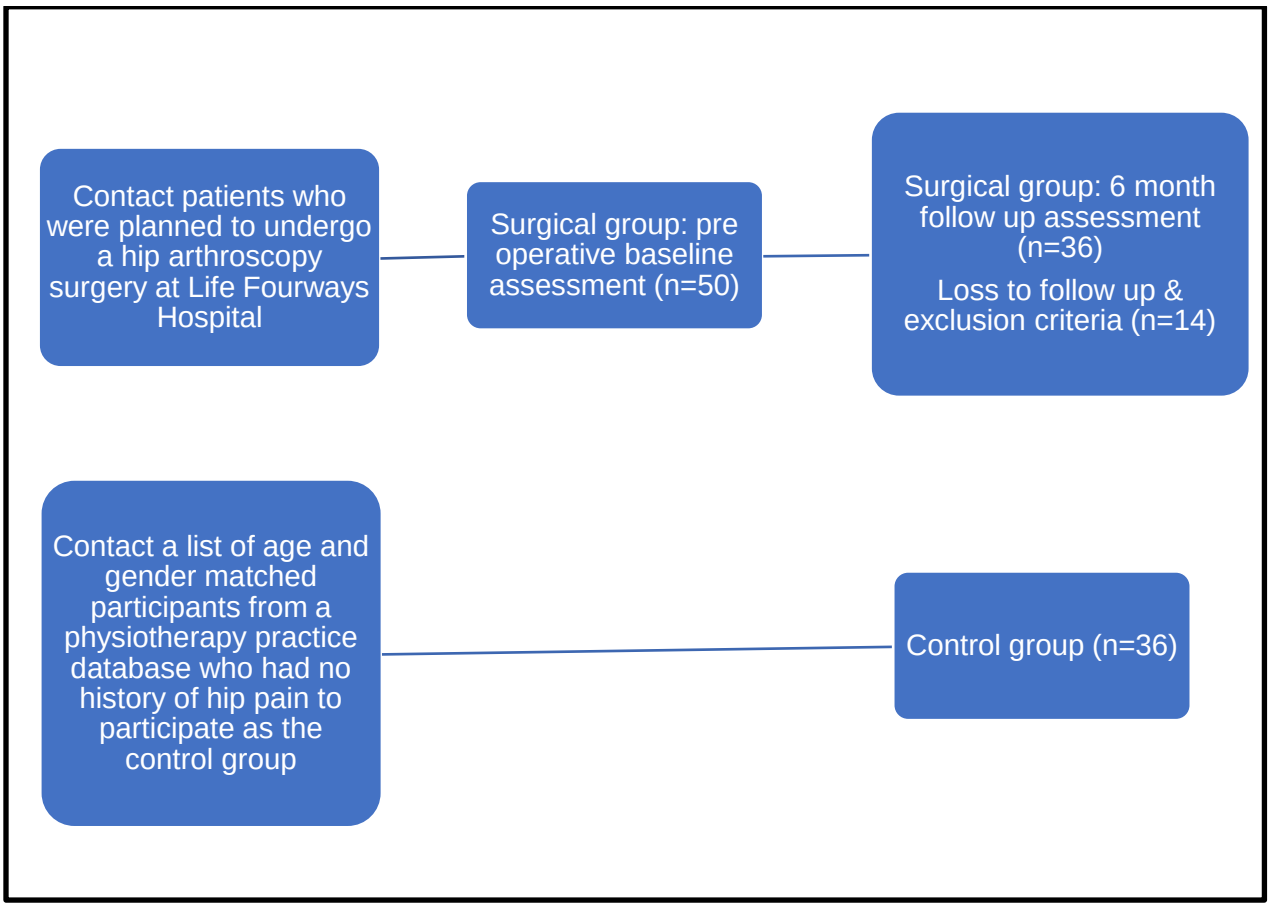


Figure 4.1: Flow diagram of the study

A total of 36 participants per group (a maximum total of 72) was the final sample size used for data analysis. This was due to the exclusion criteria for the surgical group and loss to follow up. There was a loss of 14 participants in the surgical group, of which three were due to the exclusion criteria (vertigo) and 11 were due to loss to follow up. This still allowed for robust statistics to be used in data analysis. The three exclusions for vertigo were assessed at baseline as none had active symptoms of vertigo at the time of assessment and it was deemed safe and no risk for adverse effects. However, at the six-month post-operative follow up, an assessment was not done for the safety of the participant due to the risk of developing complications owing to active symptoms of vertigo i.e. falling during balance testing.

The surgical group underwent two assessments: baseline pre-operative (n=50) and six-month post-operative follow-up (n=36). The control group (n=36) was age and gender matched to the participants in the surgical group who had continued to the point of follow-up. This data will be shown in section 4.2 below.

In the text, tables and figures to follow, the surgical group baseline pre-operative assessment will be referred to as SG1, while the surgical group six-month post-operative follow-up will be known as SG2 and the control group as CG.

4.2. Demographic Data

Demographic data for each group was collected as per Appendix 6. The profiles of both groups were relatively similar in all demographic aspects (Table 4.1).

Table 4.1: Demographic data of the study sample

General attributes		
Demographic detail	**Surgical Group (n=50)**	**Control Group (n=36)**
Gender	Male = 25 Female = 25	Male = 17 Female = 19
Employment status	Employed = 48 Unemployed = 2	Employed = 32 Unemployed = 4
Leg dominance	Both = 1 Right = 45 Left = 4	Right = 36
Smoker	No = 47 Yes = 3	No = 31 Yes = 5
Diabetes	No = 50	No = 36
Osteoporosis	No = 50	No = 35 Yes = 1
Vertigo	No = 47 Yes = 3	No = 36
Neurological fallout	No = 50	No = 36
History of hip pain	Yes = 45 No = 5	No = 36
History of hip pain: details	Both = 19 Left = 9 Right = 17 None = 5	n/a
Previous hip surgical history	Yes = 11 No = 39	No = 36
Chronic medication	Yes = 20 No = 30	Yes = 7 No = 29

Physical Attributes		
Demographic data	**Surgical Group: Mean (SD)**	**Control Group: Mean (SD)**
Age	39.1 (8.99)	39.58 (9.66)
Height	173.02 (10.7)	170.30 (8.65)
Weight	76.18 (17.15)	78.27 (12.35)

Age, weight and height data were normally distributed in both groups as shown below in Figure 4.2, Figure 4.3 and Figure 4.4. This allowed for t-tests to be done to compare the data. Similarities between the surgical and control groups were noted on t-tests of age (p=0.32), height (p=0.10) and weight (p=0.39).

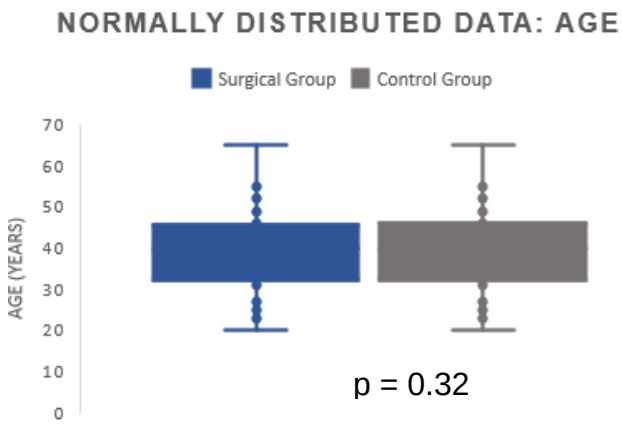


Figure 4.2: Normally distributed data – age (n=36)

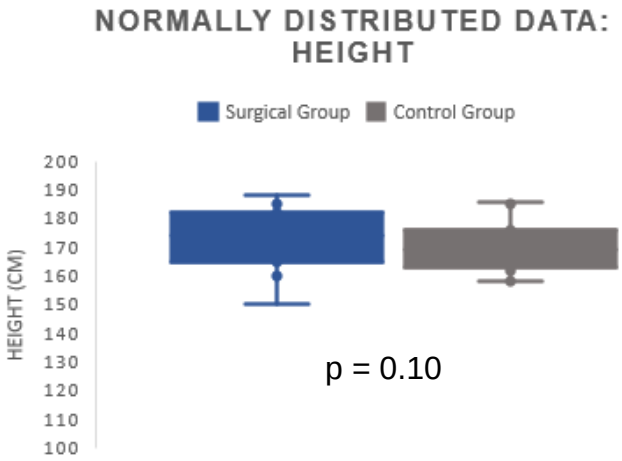


Figure 4.3: Normally distributed data – height (n=36)

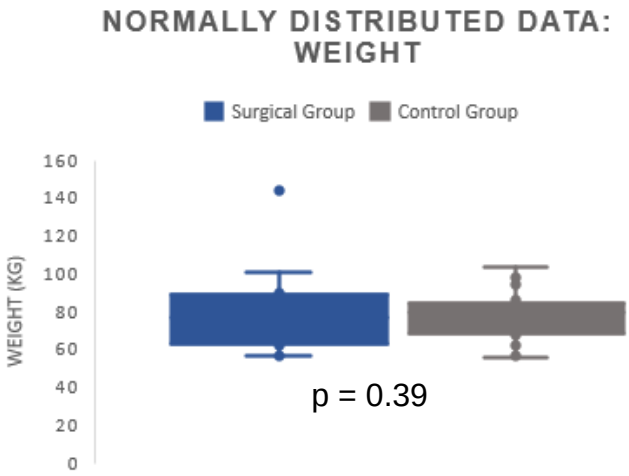


Figure 4.4: Normally distributed data – weight (n=36)

A variety of types of employment and occupations were noted in both groups (Table 4.2). Most employment and occupations involved sedentary or seated work.

Table 4.2: Employment details

Surgical Group	**Control Group**
an accountant, an actuary, an administrator, an athlete, an attorney, an attorney – legal counsel, an audit clerk, a business developer, a chemical engineer, two civil engineers, a commercial pilot, a copy writer, a dentist, a digital project manager, a director, a doctor, an educational psychologist, an educator, an engineer, a golfer/student, an information technology manager, an information technology specialist, an instructional designer, a legal counsel, a logistics manager, a maintenance superintendent, a management consultant, two managers, a marketer, a marketing executive, a mechanical engineer, a mother, an operations manager, a physiotherapist, a program manager, a project manager, a reptile breeder, a resources manager, a sales accountant manager, two sales managers, three self-employed individuals, a self-employed paralegal, a student, a student teacher and a teacher	an agriculturalist, an analyst, a banker, a marketing and branding representative, two in finance, two financial advisors, a financial manager, a general manager, a general practitioner, an information technology specialist, an insurance broker, two managers, three marketers, a mechanic, two paramedics, two physiotherapists, a project manager, a psychologist, a receptionist, a sales representative, a search engine optimisation manager, a security personnel, a self-employed individual, two stay at home mothers, two students and two teachers

Table 4.3 below outlines the participants' noted previous surgical history with regards to the hip joint. As can be seen in the control group, there is no history of previous hip surgical intervention.

Table 4.3: Previous hip surgical history

Surgical Group	**Control Group**
a right hip arthroscopy in 2000, a right hip arthroscopy in 2010, a left hip slipped capital femoral epiphysis surgery in 2011, a left hip arthroscopy in 2014, two left hip arthroscopies in 2015, three right hip arthroscopies in 2015, a left hip arthroscopy in 2016, a right hip arthroscopy in 2016, four left hip arthroscopies in 2017 and a right hip arthroscopy in 2017	n/a

Chronic medication used by the participants in the surgical group included: Arcoxia, Blood pressure medication, Brintelix, Calciferol, Celebrex, Cilift, Cymgen, Eezytrol, Eltroxin, Epilum, Epitec, Ezetol, Glucophage, Hormone replacement therapy, Lamatrigine, Lamectin, Lexamil, Nexium, Niralep, Pexola, Prepilin, Psychiatric medication, Qlaira, Serdep, Servastatin, Stilnox, Stormil, Symicord, Thyroid medication, Topomax Trazadone, Trepaline, Venlor, Wellbutrin and Zoloft. The usage of these medications can be seen in Table 4.4 below.

Table 4.4: Chronic medication usage in the surgical group

Medication	**%**
Arcoxia & Celebrex	2
Eltroxin	2
Eltroxin, Nexium & Pexola	2
Epilum & Prepilin	2
Hormone replacement therapy & blood pressure medication	2
Lamatrigine	2
Qlaira, Ezytol & Cilift	2
Symbicord	2
Wellbutrin, Epitec & Zoloft	2
Brintelix, Lexamil and Venlor	2
Ezytol & Stormil	2
Servastatin	2
Cymgen	2
Lamectin, Niralep & Calciferol	2
Serdep & Trazadone	2
Stilnox	2
Thyroid medication & Glucophage	2
Trepaline & Topomax	2
Psychiatric medication	2
No Medication	60

Chronic medication used by the participants in the control group included: anti-depressants, blood pressure medication, in vitro fertilisation medication, Lyrica, over the counter pain killers, Pritor and Puricos. The control group used notably less chronic medication when compared to the surgical group (Table 4.5).

Table 4.5: Chronic medication usage in the control group

Medication	**%**
Anti-depressants	2.78
Blood pressure medication	2.78
In vitro fertilisation medication	2.78
Lyrica	2.78
Over the counter pain killers	2.78
Pritor	2.78
Puricos	2.78
No medication	80.56

4.3. Patient Perceived Quality of Life

The iHOT33 self-reported questionnaire was used to ascertain the participants' perceived QoL in relation to their hip pain as detailed in Chapter 3.8 and Appendix 1. Table 4.6 represents the score of each of the 33 questions in the iHOT33 questionnaire with the mean and standard deviation (SD). Each score improved from baseline to follow-up in the surgical group. However, the follow-up scores of the surgical group did not improve to the point of the scores reported by the control group.

For the individual scores, a score closer to 10 indicates the best outcome. For the total score, a score closer to 100 indicates the best outcome.

Table 4.6: Separate item scores per group: iHOT33

iHOT33 item/question	**SG1: Baseline pre-operative (n=50)** **Mean (SD)**	**SG2: Six-month follow up (n=36)** **Mean (SD)**	**CG: Control Group (n=36)** **Mean (SD)**
1	3.26 (2.52)	6.88 (2.74)	9.86 (0.83)
2	4.16 (2.80)	6.72 (2.93)	9.88 (0.46)
3	4.88 (2.91)	7.58 (2.56)	9.88 (0.31)
4	4.76 (2.82)	7.80 (2.67)	9.88 (0.66)
5	5.14 (3.01)	7.38 (2.49)	9.80 (1.00)
6	5.6 (3.2)	7.63 (2.50)	9.88 (0.39)
7	5.82 (2.78)	7.77 (2.45)	9.97 (0.16)
8	5.22 (3.33)	7.58 (2.90)	9.97 (0.16)
9	5.84 (2.74)	8.02 (2.63)	9.91 (0.36)
10	5.84 (2.87)	8.25 (2.41)	9.88 (0.39)
11	5.7 (2.96)	8.30 (2.36)	9.91 (0.36)
12	5.64 (2.96)	7.69 (2.31)	9.91 (0.28)
13	5.86 (2.77)	8.25 (2.28)	9.86 (0.59)
14	3.97 (2.86)	7.61 (2.72)	9.97 (0.16)
15	5.7 (3.00)	8.16 (2.36)	9.97 (0.16)
16	4.06 (2.45)	7.27 (2.45)	9.88 (0.66)
17	1.82 (2.28)	5.91 (3.47)	9.75 (1.5)
18	3.12 (2.17)	6.55 (2.66)	9.80 (1.00)
19	1.46 (1.47)	5.08 (3.51)	9.83 (1.00)
20	2.86 (2.33)	5.38 (3.28)	9.91 (0.50)
21	3.64 (2.92)	5.00 (2.93)	9.84 (0.80)
22	2.32 (2.08)	4.86 (3.18)	9.80 (1.16)
Not working *	Not working = 0	Not working = 3	Not working = 0
23	5.46 (3.10)	6.43 (3.05)	9.72 (1.27)
24	3.89 (2.70)	6.57 (3.00)	9.86 (0.68)

25	6.36 (3.65)	7.93 (2.81)	9.77 (1.33)
26	6.42 (3.18)	8.45 (2.18)	9.88 (0.66)
27	1.68 (1.82)	5.38 (3.40)	9.80 (1.16)
28	5.48 (3.16)	7.28 (2.84)	9.97 (0.17)
29	3.34 (2.41)	6.55 (3.13)	9.86 (0.83)
30	4.14 (2.90)	6.61 (3.10)	9.88 (0.66)
31	3.62 (2.72)	6.66 (3.23)	9.88 (0.66)
32	5.25 (3.57)	7.81 (3.08)	9.88 (0.68)
33	2.5 (2.54)	6.30 (3.30)	9.80 (1.16)

*as defined in the questionnaire, see Appendix 1

Table 4.7 below shows the iHOT33 total score means and standard deviations. This shows that there is an improvement from baseline to follow-up in the surgical group. When looking at the follow-up surgical group compared to the control group, there was a markedly higher score for the control group with a lower SD.

Table 4.7: Total scores: iHOT33

	SG1: Baseline pre-operative (n=50)	**SG2: Six-month follow up (n=36)**	**CG: Control Group (n=36)**
Mean (SD)	43.65 (17.40)	69.39 (22.95)	98.76 (6.32)

Within group and between group t-testing was done with a confidence interval of 95%. Table 4.8 below shows the p value findings of the total iHOT33 scores. A statistically significant improvement of 27.88 points ($p<0.0001$) was noted from SG1 to SG2. The CG can be seen to have a larger iHOT33 score than SG1. The iHOT33 score difference between the SG2 and the CG was also large indicating a better score for the CG. The CG has higher scores when compared to both SG1 and SG2 (although the SG2 difference was notably less).

Table 4.8: Comparison of the iHOT33 scores – within and between group analysis

Group comparison	**p value**	**Correct hypothesis**	**mean (diff)**	**Group with the better score**
SG2 to SG1	p<0.0001*	Ha: mean(diff)>0	27.88	SG2
CG to SG1	p<0.0001*	Ha: mean(diff)>0	57.26	CG
CG to SG2	p<0.0001*	Ha: mean (diff)>0	29.37	CG

* statistically significant value, p<0.05

At the six-month surgical group SG2 follow-up assessment, the global perceived effects scale (GPE) was completed as another measure of perceived QoL (Table 4.9). A better outcome was reported by 28 (n=36) of the participants when compared to how they felt pre-operatively. Table 4.9 below summarises the number of participants who selected one of the first three outcomes of the GPE score, namely; “almost the same”, “better” or “worse” when compared to how they felt pre-operatively.

Table 4.9: Summary of the global perceived effects scale participant scores (n=36)

GPE	**%**	**N**
Almost the same	19.44	7
Better	77.78	28
Worse	2.78	1

The GPE scale is further divided into subcategories of “better” or “worse” as selected by each participant. These subcategories are: “a good deal better/worse”, “a great deal better/worse”, “a very great deal better/worse”, “moderately better/worse” (Table 4.10). One participant was reinjured post-operatively while playing a game of tennis and required further management and did not give a rating on the subscale of the GPE.

Table 4.10: Global perceived effect details (n=36)

GPE	**%**	**N**
A good deal better	20	6
A great deal better	30	9
A great deal worse	3.33	1
A very great deal better	30	9
Moderately better	13.33	4
Reinjured – no score	3.33	1

4.4. Functional Outcome

The functional outcome was determined by doing the SLB test as described in Chapter 3.6 and Appendix 4. The SLB test was conducted on the left hip and right hip as noted in Table 4.11 and Table 4.12 below.

Table 4.11: SLB percentiles and frequencies per group - Left hip

	SLB: SG1 Left hip (n=50) % (n)	**SLB: SG2 Left hip (n=36) % (n)**	**SLB: CG Left hip (n=36) % (n)**
30 seconds: able	80 (40)	100 (36)	100 (36)
30 seconds: unable	20 (10)	0 (0)	0 (0)
Pain during test: yes	38 (19)	19.44 (7)	0 (0)
Pain during test: no	62 (31)	80.56 (29)	100 (36)

Table 4.12: SLB percentiles and frequencies per group - Right hip

	SLB: SG1 Right hip (n=50) % (n)	**SLB: SG2 Right hip (n=36) % (n)**	**SLB: CG Right hip (n=36) % (n)**
30 seconds: able	68 (34)	97.23 (35)	100 (36)
30 seconds: unable	32 (16)	2.77 (1)	0 (0)
Pain during test: yes	48 (24)	5.56 (2)	2.78 (1)
Pain during test: no	52 (26)	94.44 (34)	97.22 (35)

Using proportion testing with a 95% confidence interval, the results can be seen in Table 4.13, Table 4.14, Table 4.15 and Table 4.16 below. The functional outcome had a significantly improved score from SG1 to SG2 (left hip p=0.0022, right hip p=0.0004). The outcome was similar in SG2 when compared to the CG.

SG2 had a notable similarity compared to the CG using the right hip. SG2 versus the CG in the left hip was the same for the SLB test, while the pain scores during the test were also similar.

Table 4.13: Left hip SLB: proportion test results

Group comparison	**p value**	**Correct hypothesis**	**mean (diff)**	**Group with the better score**
Left hip: SG2 to SG1	p=0.0022*	Ha: diff>0	0.2	SG2
Left hip: CG to SG1	p=0.0022*	Ha: diff>0	0.2	CG
Left hip: CG to SG2	No value	Ho: diff = 0	0	CG=SG2

* statistically significant value, p<0.05

Table 4.14: Left hip pain present during SLB test: proportion test results

Group comparison	p value	Correct hypothesis	mean (diff)	Group with the better score
Left hip pain: SG2 to SG1	p=0.0158*	Ha: diff<0	-0.21	SG2
Left hip pain: CG to SG1	p<0.0001*	Ha: diff<0	-0.38	CG
Left hip pain: CG to SG2	p=0.0053*	Ha: diff<0	-0.16	CG

* statistically significant value, p<0.05

Table 4.15: Right hip SLB: proportion test results

Group comparison	p value	Correct hypothesis	mean (diff)	Group with the better score
Right hip: SG2 to SG1	p=0.0004*	Ha: diff>0	0.29	SG2
Right hip: CG to SG1	p=0.0001*	Ha: diff>0	0.32	CG
Right hip: CG to SG2	p=0.3139	Ha: diff != 0	0.02	CG

* statistically significant value, p<0.05

Table 4.16: Right hip pain present during SLB test: proportion test results

Group comparison	p value	Correct hypothesis	mean (diff)	Group with the better score
Right hip pain: SG2 to SG1	p<0.0001*	Ha: diff<0	-0.42	SG2
Right hip pain: CG to SG1	p<0.0001*	Ha: diff<0	-0.45	CG
Right hip pain: CG to SG2	p=0.5553	Ha: diff != 0	-0.02	CG

* statistically significant value, p<0.05

4.5. Pain Scores

Each participant gave a score of their general, day-to-day experience of hip pain. The participants noted the pain scores by completing the NRS as defined in Chapter 3.8 and Appendix 2. The scores were reported for the left and the right hip as can be seen in Table 4.17 and Table 4.18 below. It is interesting to note that the most commonly reported score was 0 out of 10 in SG1, SG2 and the CG. Zero implies no pain while 10 implies the worst possible pain.

Table 4.17: NRS Left hip

NRS: Left hip	**Mean (SD)**	**Most commonly reported score (percentage per group)**
SG1	2.28 (3.16)	0 (44%)
SG2	1.91 (2.62)	0 (44.44%)
CG	0.11 (0.52)	0 (94.44%)

Table 4.18: NRS Right hip

NRS: Right hip	**Mean (SD)**	**Most commonly reported score (percentage per group)**
SG1	3.68 (3.18)	0 (30%)
SG2	2.13 (2.81)	0 (47.22%)
CG	0.13 (0.48)	0 (91.67%)

Within group and between group t-testing was done with a confidence interval of 95%. The results are reported in Table 4.19 and Table 4.20 below. A significant decrease in pain scores was observed from SG1 to SG2 in the left and right hips ($p=0.0069$, $p=0.0008$).

Table 4.19: Comparison of pain scores - Left hip

Group comparison	p value	Correct hypothesis	mean (diff)	Group with the better score
Left hip: SG2 to SG1	p=0.0069*	Ha: mean(diff)<0	-1.22	SG2
Left hip: CG to SG1	p<0.0001*	Ha: mean(diff)<0	-3.02	CG
Left hip: CG to SG2	p=0.0002*	Ha: mean(diff)<0	-1.80	CG

* statistically significant value, p<0.05

Table 4.20: Comparison of pain scores - Right hip

Group comparison	p value	Correct hypothesis	mean (diff)	Group with the better score
Right hip: SG2 to SG1	p=0.0008*	Ha: mean(diff)<0	-1.75	SG2
Right hip: CG to SG1	p<0.0001*	Ha: mean(diff)<0	-3.75	CG
Right hip: CG to SG2	p=0.0001*	Ha: mean(diff)<0	-2.00	CG

* statistically significant value, p<0.05

When comparing the left hip to the right hip in each group, it is interesting to note that the pain experienced was similar (Table 4.21).

Table 4.21: Within group comparison of left vs right hip pain scores

Same group comparison: left vs right	p value
SG1 left hip pain vs SG1 right hip pain	p=0.12
SG2 left hip pain vs SG2 right hip pain	p=0.71
CG left hip pain vs CG right hip pain	p=0.71

* statistically significant value, p<0.05

4.6. The Association between Perceived Quality of Life, Hip Functional Performance and Pain Outcome Variables

A correlation analysis was done using Pearson's correlation coefficient testing (r) and Spearman's rank correlation coefficient testing (r_s). These were used to explore the association between the variables to determine the strength of the relationships.

Pearson's correlation coefficient looks at continuous data, while Spearman's rank coefficient looks at continuous and/or ordinal data. A negative correlation indicates a relationship between two variables where the one increases as the other decreases or vice versa. A positive correlation indicates a relationship between two variables where the one variable increases as the other also increases, or the one variable decreases as the other also decreases.

The strength of association for the r and r_s values can be seen in Table 4.22 below.

Table 4.22: Strength of association for r and r_s values (Cohen, 1977)

Coefficient Value	**Strength of Association**
0.1<| r |<0.3	Minor correlation
0.3<| r |<0.5	Moderate correlation
| r |>0.5	Strong correlation

4.6.1. Patient Perceived Quality of Life versus Pain Score

Pearson correlation coefficients (r) were calculated to determine the association between patient perceived QoL versus pain score (Table 4.23 and Table 4.24). The r values are negative which means that there was a negative correlation. As the iHOT33 score increases, the pain score decreases. These scores have moderate to strong correlations.

In the baseline assessment of the surgical group, the correlation between the iHOT33 and the NRS in the left hip is moderately negative (Table 4.23). This means that as the

pain score decreases, the iHOT33 score increases. This finding is significant (p=0.0038). The correlation between the iHOT33 and NRS in the right hip is strongly negative. This means that as the pain score decreases, the iHOT33 score increases. This finding is significant (p<0.0001).

Table 4.23: SG1 Pearson Correlations for patient perceived quality of life (iHOT33) versus pain score (NRS) - Left hip & Right hip

		NRS Left Hip vs iHOT33	NRS Right Hip vs iHOT33
SG1	**Pearson's correlation**	-0.4024[b]	-0.5283[c]
	p value	0.0038*	0.0001*
	N	50	50

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

In the six month follow-up assessment of the surgical group shown below, the correlation between the iHOT33 and NRS in the left hip is strongly negative (Table 4.24). This means that as the pain score decreases, the iHOT33 score increases. This finding is significant (p<0.0001). The correlation between the iHOT33 and NRS in the right hip is moderately negative. This means that as the pain score decreases, the iHOT33 score increases. This finding is significant (p=0.0033).

Table 4.24: SG2 Pearson Correlations for patient perceived quality of life (iHOT33) versus pain score (NRS) - Left hip & Right hip

		NRS Left Hip vs iHOT33	NRS Right Hip vs iHOT33
SG2	**Pearson's correlation**	-0.6736[c]	-0.4767[b]
	p value	<0.0001*	0.0033*
	N	36	36

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

A Pearson's correlation was conducted to assess the relationship between the patient perceived QoL versus pain score. In the SG1 group's left hip, there was a moderate negative correlation r(48)= -0.4024, p=0.0038, with an increase in iHOT33 score which

explains 16% of the variation in pain score. In the SG1 group's right hip, there was a strong negative correlation r(48)= -0.5283, p=0.0001, with an increase in iHOT33 score which explains 28% of the variation in pain score. In the SG2 group's left hip, there was a strong negative correlation r(34)= -0.6736, p<0.0001, with an increase in iHOT33 score which explains 45% of the variation in pain score. In the SG2 group's right hip, there was a moderate negative correlation r(34)= -0.4767, p=0.0033, with an increase in iHOT33 score which explains 23% of the variation in pain score.

4.6.2. Patient Perceived Quality of Life versus Functional Outcome

Spearman's rank correlation coefficient (r_s) was conducted to determine the association between patient perceived QoL versus functional outcome (Table 4.25 and Table 4.26). The r_s values are positive which means that there was a positive correlation. As the iHOT33 score increases, the SLB score increases as well. These scores have minor to moderate correlations. The left hip association for the SG2 group could not be calculated because the results for the SLB were the same in the left hip.

Table 4.25: SG1 Spearman's Correlation for patient perceived quality of life (iHOT33) versus functional outcome (SLB)

		Left hip iHOT33 vs SLB	**Right hip iHOT33 vs SLB**
SG1	**Spearman's rho**	0.2668[a]	0.4516[b]
	p value	0.0611	0.0010*
	N	50	50

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

Table 4.26: SG2 Spearman's Correlation for patient perceived quality of life (iHOT33) versus functional outcome (SLB)

		Left hip iHOT33 vs SLB	Right hip iHOT33 vs SLB
SG2	**Spearman's rho**	.	0.2848[a]
	p value	.	0.0923
	N	36	36

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

A Spearman's correlation was conducted to assess the relationship between patient perceived QoL versus functional outcome. In the SG1 group's left hip, there was a minor positive correlation r_s= 0.2668, p=0.0611 which was not statistically significant. In the SG1 group's right hip, there was a moderate positive correlation r_s= 0.4516, p=0.0010 which was statistically significant. In the SG2 group's left hip, no correlation could be calculated. In the SG2 group's right hip, there was a minor positive correlation r_s= 0.2848, p=0.0923 which was not statistically significant.

4.6.3. Pain Score versus Functional Outcome

Spearman's rank correlation coefficient (r_s) was conducted to determine the association between the pain score versus the functional outcome (Table 4.27 and Table 4.28).

Table 4.27: SG1 Spearman's Correlation for the pain score (NRS) versus the functional outcome (SLB)

		Left hip: NRS pain vs SLB	Right hip: NRS pain vs SLB
SG1	**Spearman's rho**	-0.5730[c]	-0.4004[b]
	p value	<0.0001*	0.0040*
	n	50	50

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

Table 4.28: SG2 Spearman's Correlation for the pain score (NRS) versus the functional outcome (SLB)

		Left hip: NRS pain vs SLB	Right hip: NRS pain vs SLB
SG2	**Spearman's rho**	.	-0.3018[b]
	p value	.	0.0736
	n	36	36

[a] 0.1<| r |<0.3: minor correlation, [b] 0.3<| r |<0.5: moderate correlation, [c] | r |>0.5: strong correlation, * statistically significant value, p<0.05

The r_s values are negative which means that there was a negative correlation. As the pain score decreases, the SLB score increases. These scores have moderate to strong correlations. The left hip association for the SG2 group could not be calculated because the left hip SLB scores were the same.

A Spearman's correlation was conducted to assess the relationship between pain score versus the functional outcome. In the SG1 group's left hip, there was a strong negative correlation r_s= -0.5730, p<0.0001 which was statistically significant. In the SG1 group's right hip, there was a moderate negative correlation r_s= -0.4004, p=0.0040 which was statistically significant. In the SG2 group's left hip, no correlation could be calculated. In the SG2 group's right hip there was a moderate negative correlation r_s= -0.3018, p=0.0736 which was not statistically significant.

4.7. Summary of the Key Findings

Both groups' profiles were relatively similar in all demographic aspects. Age, weight and height data were normally distributed in both groups. Similarities between the surgical and control groups were noted on t-tests for age (p=0.3242), height (p=0.1047) and weight (p=0.3896).

In terms of patient perceived QoL, each score improved from baseline to follow-up in the surgical group. There was a significant improvement of 27.88 points (p<0.0001) from SG1 to SG2. However, the follow-up scores of the surgical group did not improve to the point

of the scores reported by the control group. GPE had a “better” outcome reported by 28 (n=36) of the participants when compared to how they felt pre-operatively.

The functional outcome had a significantly improved score from SG1 to SG2 (left hip p=0.0022, right hip p=0.0004). The outcome was similar in SG2 compared to that of the CG. SG2 had notable similarity to the CG when compared using the right hip. SG2 versus the CG in the left hip was the same for the SLB test, while the pain scores during the test were also similar in the left hip.

The most commonly reported pain score was 0 out of 10 in SG1, SG2 and the CG. Zero implies no pain while 10 implies the worst possible pain. A significant decrease in pain scores was observed from SG1 to SG2 in both the left and right hips (p=0.0069, p= 0.0008). When comparing left hip to right hip in each group, it was interesting to note that the pain experienced was similar (SG1 p=0.1186, SG2 p=0.7092, CG p=0.7111).

A Pearson’s correlation was conducted to assess the relationship between patient perceived QoL versus pain score. There were moderate to strong negative correlations between the outcomes in each hip at baseline and at follow-up in the surgical group.

A Spearman’s correlation was conducted to assess the relationship between patient perceived QoL versus functional outcome. There were minor to moderate negative correlations between the outcomes in each hip at baseline and at follow-up in the surgical group.

The relationship between pain score versus the functional outcome was assessed by conducting a Spearman’s correlation. There were moderate to strong negative correlations between the outcomes in each hip at baseline and at follow-up in the surgical group.

Chapter 4 described the results of the study, while Chapter 5 gives a detailed discussion of the findings.

CHAPTER 5. DISCUSSION

5.1. Introduction

The hip arthroscopic surgical procedure is a growing area of interest in the field of orthopaedics. The patient outcomes with regards to perceived QoL, functional performance and pain following hip arthroscopy remain relatively unclear, especially in the South African context. Establishing these outcomes facilitates a better insight into the impact of hip arthroscopic surgery and helps improve the physiotherapy rehabilitative protocols and support implemented after the surgery.

As mentioned in Chapter 4, the primary objective was to determine the change in the patient perceived QoL from baseline to six months post hip arthroscopy. The secondary objectives were: to determine the change in the hip functional outcome using the single leg balance test from baseline to six-months post hip arthroscopy, to determine the change in patient pain scores from baseline to six-months post hip arthroscopy, to establish the demographic profile of patients undergoing hip arthroscopy at a private hospital in Johannesburg, to compare the perceived QoL, hip functional performance and pain outcomes post hip arthroscopy to an age and gender matched control group at six months postoperatively, and, finally, to determine the association between the perceived QoL, hip functional performance and pain outcome variables. Associations were determined to provide a better understanding of how the variables may interact with one another.

This chapter discusses each of the objectives regarding this study's results and compare them to existing literature.

5.2. Demographic Profile

A demographic profile was established of patients undergoing hip arthroscopy at a private hospital in Johannesburg. The surgical group of participants consisted of 25 females and 25 males (n=50) at the baseline assessment. The mean age was 39.1 (SD±8.99) years

with a mean height of 173.02 (SD±10.7) centimetres (cm) and a mean weight of 76.18 (SD± 17.15) kilograms (kg).

The population observed in this dissertation was very similar to the populations mentioned in other studies. A study conducted in 2018 looked at 203 patients post hip arthroscopy of which 114 (56%) were female. The mean age was 40 years (SD±11) with a mean BMI of 26 (SD±4) (Stephan *et al.*, 2018). A study in 2015 assessed a total of 37 patients of which 21 (56%) were male with a mean age of 40.5 years (Tijssen *et al.*, 2015). Malviya *et al.* (2012) had a sample of 630 participants of which 275 (42%) were female and 355 (58%) were male. The mean age at surgery was 36.7 years (Malviya *et al.*, 2012). The mean age of 39.1 years found in our study is indicative of the younger population with hip pathologies seeking corrective surgery to prevent further degeneration and osteoarthritis (and therefore a deterioration in QoL, physical and work-related activities) from developing.

Most participants in both groups were employed in a variety of occupations. Occupation can play a role in recovery after surgery because of the physical implications that may be part of a specific occupation. An occupation that requires substantial physical input (or a sedentary occupation) is not ideal in the rehabilitation and recovery process. A physically demanding occupation may require up to six months of rehabilitation post hip arthroscopy before returning to activities such as heavy lifting (Edelstein *et al.*, 2012). A participant with a sedentary occupation, such as a desk job, may usually return to work between week one and two post hip arthroscopy. However, sitting for prolonged periods is not advised. Therefore, regular movement, stretches and exercise during the day is recommended (Edelstein *et al.*, 2012). Our study found that sedentary occupations were more prominent. This means that most of the participants were able to get back to work by roughly two weeks post-operatively. The exact time frame for return to work was not a part of the research.

In the clinical setting, leg dominance is relatively important. This is because it can influence recovery and rehabilitation. Leg dominance has been a point of discussion for some time in both healthy and injured populations (Velotta *et al.*, 2011). There is no one

way of determining leg dominance and the literature has no consensus. This is because in the lower limb, the functions of the legs in tasks like stability and mobility are different for each leg (Velotta *et al.*, 2011). A study conducted in 2010 compared the overall stability index of single leg stance of the dominant and non-dominant sides. This study found that there was a significant difference noted (p=0.019) with the non-dominant side being more stable (Rein *et al.*, 2010). Leg dominance can be established through a sequence of weight-bearing and manipulative performance tests (Spry *et al.*, 1993). Asking which leg would be used to kick a ball is one way to establish leg dominance in healthy adults (van Melick *et al.*, 2017). Using this question, leg dominance in our study was reported as predominantly the right side.

None of the control group had a history of hip pain or previous surgery, while 90% of the surgical group had experienced hip pain and 22% had had previous hip surgery. The fact that 22% of the surgical group had previous hip surgery could affect the interpretation of the results. This is because the participants may have already been experiencing a chronic pain or not have fully rehabilitated physically after the previous surgeries. Many people struggle with pain post-operatively and some may develop chronic pain which could result from poorly treated acute post-operative pain (Fletcher *et al.*, 2015). Pain is one of the most influential variables when recovering from surgery. Post-operative pain is often caused by the surgery and the surgical incision (Pogatzki-Zahn *et al.*, 2017). The pain experienced post-operatively should be controlled and eased quickly to promote the healing process, reduce distress, reduce complications and encourage comfortable rehabilitation (Pogatzki-Zahn *et al.*, 2017).

Pain control is more necessary in the surgical group compared to the control group as can be noted in the chronic medication usage. This pain medication could have been used for reasons other than hip pain. Chronic medication was used by 40% of the surgical group and only 19.4% of the control group. The use of chronic medication does not necessarily link with the use of pain medication in these groups. Further research is needed to identify why certain medications are more commonly used in these populations. The difference in medication usage and the management of any other co-morbidities were not identified for the purposes of this dissertation.

Co-morbidities play an important role in the likeliness of making a full recovery post-operatively. In terms of co-morbidities, none of the participants had diabetes or neurological fallout and the majority were not smokers. Only one participant in the control group had a history of osteoporosis and 6% of the surgical group were excluded due to issues with vertigo. Smoking is known to influence healing time (Patel *et al.*, 2013). A systematic review conducted in 2013 found that smoking does have a negative effect on bone healing. This is due to delayed union (and non-union) time (Patel *et al.*, 2013). Balance requires the integration and use of several systems such as vision, proprioception, muscle strength, reaction time, and vestibular activity (Sturnieks *et al.*, 2008). Vertigo, diabetes and neurological fallout could affect the results of the outcomes. This is because balance would be impaired for reasons other than the surgery. Diabetes mellitus can cause a loss of peripheral sensation as well as visual changes which then affect balance (Sturnieks *et al.*, 2008). Vertigo affects the vestibular support of postural control and thus disturbs balance (Sturnieks *et al.*, 2008).

5.3. Patient Perceived Quality of Life

Because it is a validated tool, the iHOT33 PRO has been suggested for other studies (Thorborg *et al.*, 2018). The results indicate that there was a significant improvement in patient perceived QoL in the surgical group at the six-month follow-up when using the iHOT33 questionnaire. The minimal clinically important difference (MCID) for the iHOT33 is 6.1 points (Mohtadi *et al.*, 2012).

The total score improved by an average of 27.88 points from SG1 to SG2 which shows more than the MCID. However, there was a significant difference of 29.37 points noted between the SG2 and CG. This indicates that the two groups were not as similar as the authors hoped. Few studies have investigated outcomes post hip arthroscopic surgery when comparing surgery to a healthy control population. This information implies that perhaps a better post-operative physiotherapy rehabilitation program might be needed. Thorborg *et al.* (2018) found that studies following up with patient at one to two years post hip arthroscopy displayed reduced outcome scores when compared to a healthy control population (Thorborg *et al.*, 2018). No other evidence could be found with which to

compare this finding. No other studies have looked at a surgical population comparison with an age and gender matched control group who have never had hip pain.

It is important to explore the subjective nature of recovery after surgery. The patient needs to feel like there is an improvement in their symptoms and, typically, this subjective or self-reported outcome can be looked at using PRO's. When looking at the results of the iHOT33 questionnaire, it is important to note that there is a focus on the patient's subjective reported symptoms (Enseki & Kohlrieser, 2014). Most research done to date has focused on the results of PROs alone (Thorborg *et al.*, 2015; Tijssen *et al.*, 2015). The outcomes of our research study showed that there was an improvement of 27.88 points out of 100 which was comparable to a successful outcome when using the iHOT33 PRO. This improved score outcome is similar to a study done in 2018 where the HOS was used as a PRO (Stephan *et al.*, 2018). They defined a positive outcome as a HOS-ADL score of over 80% or an improvement of 23%. No control group comparison was made. Although a different PRO was used, the successful outcome was noted with an improvement of over 23%. Similarly, a study done in 2017 used the HHS and HOS pre-operatively and at six-months post-operatively. This study's population was an active duty military population. The HHS showed a mean improvement of 34.28 points and the HOS showed an improvement of 34.16 points (Shaw *et al.*, 2017). Our research population was a young, active population whose physical activity levels differ from those of an active duty military population. However, from their results, it can be deduced that the improvement in score on the iHOT33 of 27.88 points is comparable to the mean improvement of the 34.28 points improvement noted on the HHS and 34.16 points on the HOS. The recovery after hip arthroscopy can be similar in populations with both hip pathology, existing co-morbidities or other sites of pain and in populations with only hip pathology. In 2015, a study was conducted using the iHOT33 and the HOS-ADL which were measured before hip arthroscopic surgery, six months after surgery and 12 months after surgery to determine the effects of lower back pain (LBP) on self-reported function post-operatively (Becker *et al.*, 2015). It was found that 44.2% of participants with LBP achieved MCID as per the iHOT33 compared to 41.0% of those without LBP at the six-month follow-up. At 12 months post-operatively as per the iHOT33, 42.9% of participants

with LBP achieved MCID at one year compared to 43.6% without LBP (Becker *et al.*, 2015). The population in our study did not mention LBP.

The GPE demonstrated a “better” outcome as reported by 28 (n=36) of the participants in our study. This indicates that the participants felt an improvement in their condition at six months after the surgery. Only one participant felt “worse” after the surgery and this was due to re-injury while playing tennis. Seven of the participants reported feeling “almost the same” which indicates neither the failure nor the success of the surgery. This “better” outcome could be thanks to the rehabilitation process after hip arthroscopy or thanks to the natural healing phases and timeframes. Current status has a strong influence on the scores because, as noted by Kamper *et al.* (2010), the scores seem to improve as time passes. It would be interesting to see future research follow-up on participants for an extended period to determine how the GPE scores improve over time. QoL and pain do continue to improve over time post hip arthroscopy. This finding of improving outcomes with time agrees with the findings of Tijseen *et al.* (2015), who found that 81% of the participants in their study had minor to full recovery over a mean follow-up time of 2.3 years. This is comparable to the 86% improvement found in a 2014 study (Ha *et al.*, 2014).

5.4. Functional Outcome

The hip functional outcome scores significantly improved from baseline to follow-up in the surgical group in the left hip (p=0.0022) and the right hip (p=0.0004). When comparing SG2 to CG, the left hip had the same results in both groups while the right hip was very similar between groups (p=0.3139). Our results show the change in the left and right lower limbs while the outcomes of a study done in 2015 compared operated and non-operated lower limbs. Multiple functional tests in 37 recreational athletes were investigated. These tests included single leg balance. It was found that there was no significant difference between the operated and non-operated lower limbs (Tijssen *et al.*, 2015). This implies that there could be some level of compensation in the non-operated limb which affects balance.

There was a significant improvement in pain scores during the test from baseline to follow-up in the SG in the left hip ($p=0.0158$) and in the right hip which showed a marked improvement ($p<0.0001$). The pain improvement may be attributed to a number of factors such as healing time, pain management with medication, and the rehabilitation process. A study done in 2012 found that aggravation of pain during a single leg balance test of 30-seconds had 100% sensitivity and 97.3 % specificity in identifying gluteus medius and minimus tendinopathy (Kivlan & Martin, 2012). As the pain scores reduced, the likeliness of participants in this study having developed a gluteal tendinopathy is low.

The results of our study show that six-months of recovery does bring about an improvement in the functional outcome of participants after a hip arthroscopic surgery. Physiotherapy and rehabilitation after hip arthroscopy should focus on functional positions. Further research would be beneficial to see which aspects of the recovery contribute to the improvement.

5.5. Pain Scores

From baseline to follow-up in the SG, a decrease in NRS pain score of 1.22 points was seen in the left hip, while there was a decrease of 1.75 points in the right hip. While the differences noted are statistically significant ($p=0.0069$ and $p=0.0008$), these differences do not show clinically important change according to Hawker *et al.* (2011). A decrease of 2 points or 30% on the NRS pain scores is clinically important (Hawker *et al.*, 2011). The pain score may not have improved as much as anticipated due to pain medication management and the potential differences in the rehabilitation process. The six-month follow-up in this study could be too soon to determine pain outcomes. This is because it has been noted in literature that, when using the NRS, improvements are seen between six months to one year post hip arthroscopy (Kierkegaard *et al.*, 2017).

In the left hip the SG2 had a higher NRS pain score of 1.80 points when compared to the CG, while in the right hip the SG2 had a higher score of 2.00 points. These results show that although the SG2 group has improved post-operatively, the improvement does not match up to the results of the control group. This could be attributed to several different

factors such as differences in rehabilitation, complications, possible demographic or biopsychosocial issues. However, the interpretation and effect of such variables on the findings were beyond the scope of this study. Our study made use of an NRS score where zero represents the worst score and 10 represents the best score. In a study conducted by Tijssen *et al.* (2015), a VAS was used to measure pain (where zero represents the worst score and 100 represents the best score). This study found a VAS score of 35.0 which could be inferred to be a score of 3.50. Our study found a score of 2.28 in the left hip and 3.68 in the right hip upon initial baseline assessment – which is similar to that of Tijssen *et al.* (2015).

It is interesting to learn that the most reported pain score was 0 out of ten. This could be attributed to participants having to report on pain in both the left and right limbs – the limb undergoing surgery was not taken into account when rating pain. Another reason for the low pain scores could be that pain control was used more often in the surgical group than in the control group – especially considering the medication usage recorded was for chronic use only.

5.6. The Association between Perceived Quality of Life, Hip Functional Performance and Pain Outcome Variables

The relationship between patient perceived QoL versus pain score shows a moderate to strong negative correlation with statistically significant relationships between the variables. As the iHOT33 score increases, the participants' perception of pain decreases. This could be attributed to a change in perception of the hip problem after having a surgery to repair it, the rehabilitation and education of the patient, and the fact that they are able to do more on a day-to-day basis (Pogatzki-Zahn *et al.*, 2017).

Gan (2017) reported that poorly controlled pain in the post-operative period has many consequences. The consequences can be an impairment of function, poor reported QoL, increased morbidity, prolonged recovery, long-term usage of opioid pain killers, and increased health care costs (Gan, 2017). Persistent pain needs to be prevented with adequate acute pain management during surgery and in the post-operative recovery. If

the incidence of persistent pain can be reduced, the likeliness of developing a chronic pain condition is minimised (Gan, 2017). While it was not recorded for our study, the participants who had undergone a previous surgery could have developed persistent or chronic pain which can lead to altered perception of their own capabilities and function post-operatively due to previous experience.

The relationship between pain score versus the functional outcome shows moderate to strong negative correlation with statistically significant relationships between the variables in the SG1 group's left and right hips. In the SG2 group's right hip, there was a moderate negative correlation with no statistically significant relationship between the variables. This indicates that as the pain score decreases, the SLB outcome improves. This enforces the relationship between a decreased perception of pain and an improved functional outcome. Musculoskeletal pain has been shown to impair stability and postural control (Hirata *et al.*, 2011). Pain is often a major stressor for any person. Feeling worried about the pain or causing damage to the structures due to this pain could affect a person's balance (Hirata *et al.*, 2011). As the structures heal post-operatively, the pain decreases and the balance improves.

The relationship between patient perceived QoL versus functional outcome shows mixed results. No statistically significant relationship was found between the variables for the SG1 group's left hip or SG2 group's left or right hip. However, in the SG1 group's right hip, there was a statistically significant relationship between the variables and a moderate positive correlation. This indicated that as the iHOT33 scores increase, so too do the SLB outcomes. This could be as a result of the right leg being the most dominant side reported by the participants. However, in the literature, the non-dominant side is noted to be more stable while the dominant side is more mobile (Rein *et al.*, 2010). The positive correlation balance findings could be due to the SG1 measures being reported pre-operatively.

5.7. Limitations

This study has some potential limitations. The generalisability of the results is limited by the relatively small sample size. The sample was big enough for robust statistics to be

calculated. However, it was not representative of the greater South African population. Consecutive sampling was used for our study. A lack of probability sampling was a limitation because participants could not be randomly sampled from a larger population. Participants in this study were consecutively sampled for convenience because of the limited time frame for data collection. Another limitation of the generalisability of the results is the fact that the data were collected from one surgeon's patients in a hospital in an affluent area in Johannesburg, South Africa.

Five of the participants in the surgical group had reported previous hip surgery in the same year as data collection which could impact the results. Three of the five participants were lost to follow up at the six-month timeline.

A limitation of this study was not considering the limb undergoing surgery when rating pain.

There was limited previous research on the topic which impacts the comparative value to similar research in the field. However, this also emphasises the importance and need for this study.

The post-operative physiotherapy and rehabilitative programs were not looked at per participant. This information could have been beneficial in ascertaining why certain results did not improve as hypothesised.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The patient outcomes regarding perceived QoL, functional performance and pain following hip arthroscopy were explored for this study. This was investigated by using three PROs (iHOT33, GPE and NRS) and one functional test (SLB).

The profiles of both groups were relatively similar in all demographic aspects. Age, weight and height data were normally distributed and very similar. The surgical group consisted of 50 participants. These participants were consecutively sampled from a list of patients receiving hip arthroscopic surgery at a private hospital in Johannesburg. The participants were assessed at baseline pre-operatively and at six-months post-operatively. At the six-month follow-up, 36 were assessed due to exclusion criteria and loss to follow up. An age and gender matched control group population of participants (n=36) was selected from people who had never experienced hip pain or undergone hip surgery.

The iHOT33 scores improved significantly from baseline to follow-up in the SG. This shows that patient perceived QoL improves post-operatively. However, the score did not match the CG score. This indicates that improved physiotherapy rehabilitation should be considered. GPE had a “better” outcome reported by 28 (n=36) of the participants when compared to how they felt pre-operatively.

The SLB functional outcome improved significantly from baseline to follow-up in the SG. The outcome was similar when SG2 was compared to the CG. This shows that the improvement seen after hip arthroscopic surgery helps the participants regain an almost normal function.

The most commonly reported NRS pain score was 0 out of 10 in SG1, SG2 and the CG. Zero indicates no pain while 10 indicates the worst possible pain. A significant decrease in pain scores was observed from baseline to follow-up in the SG in the left and the right hips. A decrease in pain indicates that the participants feel better.

A moderate to strong negative correlation was observed when comparing patient perceived QoL (iHOT33) to pain scores. This supports the assumption that as perceived QoL improves, pain decreases (or vice versa).

A minor to moderate positive correlation was observed when comparing the relationship between patient perceived QoL (iHOT33) and SLB functional outcome. This supports the assumption that as the perceived QoL improves, the balance improves. The only statistically significant relationship was found in SG1's right hip.

A moderate to strong negative correlation was observed when comparing the relationship between pain scores and the SLB functional outcome. The findings in the SG2 group were not statistically significant. This means that as the pain score decreases, the function increases but not significantly.

Ultimately, the findings from this study show that there was a significant improvement in all measured outcomes at six-months post hip arthroscopy. However, the outcomes are not improved to the control group's level. Future research should investigate the time it takes for the surgical group to regain a "normal" function as per the control group. Future research should also look at the possibilities of improved physiotherapy rehabilitation to reach optimal function.

6.2 Recommendations

Further research into the effects of different post-operative physiotherapy and rehabilitative programs would be largely beneficial. Further research could potentially compare surgical versus conservative management for hip pathologies in the South African context. Future studies could investigate the comparison between three subcategories namely dominant versus non-dominant lower limb, left versus right lower limb and operated versus non-operated lower limb. The comparative value of research could greatly benefit from studies with an age and gender matched control group population without hip pain.

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APPENDIX 1 THE INTERNATIONAL HIP OUTCOME TOOL (IHOT33)

INTERNATIONAL Hip Outcome Tool IHOT33

Quality of Life Questionnaire for Young, Active Patients with Hip Problems

Instructions:
These questions ask about the problems you may be experiencing in your hip, how these problems affect your life, and the emotions you may feel because of these problems.
Please answer each question with respect to the current status, function, circumstances and beliefs related to your hip.
Consider the last **month**.
The questions are formatted so that you can indicate the severity of the problem by circling a number below the question.

Please note:
Please circle the number which most closely represents your situation.

If you circle a number on the far **left,** it means that you **feel you are significantly impaired**. *For example:*
0------1-------2------3------4------5------6------7------8------9------10
Significantly Impaired No Problems At All

If you circle a number on the far **right**, it means that you **do not think that you have any problems** with your hip.
For example:
0------1-------2------3------4------5------6------7------8------9------10
Significantly Impaired No Problems At All

If a number is circled in the middle of the line, this indicates that you are moderately disabled, or in other words, between the extremes of 'significantly impaired' and 'no problems at all'. It is important to circle a number at the appropriate end of the line if the extreme descriptions accurately reflect your situation.

If the question asks about something that you do not experience, please mark the option:
- **I do not do this action in my activities**, where this is appropriate.

I: SYMPTOMS AND FUNCTIONAL LIMITATIONS

The following questions ask about symptoms that you may experience in your **hip** and about the function of your **hip** with respect to daily activities. Please think about how you have felt most of the time over the past **month** and answer accordingly.

1. How often does your hip/groin ache?
0------1-------2------3------4------5------6------7------8------9------10
Constantly Never

2. How stiff is your hip as a result of sitting/resting during the day?
0------1-------2------3------4------5------6------7------8------9------10
Extremely Stiff Not Stiff At All

3. How difficult is it for you to walk long distances?
0------1-------2------3------4------5------6------7------8------9------10
Extremely Difficult Not Difficult At All

4. How much pain do you have in your hip while sitting?
0------1-------2------3------4------5------6------7------8------9------10
Extreme Pain No Pain At All

5. How much trouble do you have standing on your feet for long period of time?
0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble No Trouble At All

6. How difficult is it for you to get up and down off the floor/ground?
0------1-------2------3------4------5------6------7------8------9------10
Extremely Difficult Not Difficult At All

7. How difficult is it for you to walk on uneven surfaces?
0------1-------2------3------4------5------6------7------8------9------10
Extremely Difficult Not Difficult At All

8. How difficult is it for you to lie on your affected hip side?
0------1-------2------3------4------5------6------7------8------9------10
Extremely Difficult Not Difficult At All

9. How much trouble do you have with stepping over obstacles?
0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble No Trouble At All

10. How much trouble do you have climbing up/downstairs?
0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble No Trouble At All

11. How much trouble do you have with rising from a sitting position?
0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble No Trouble At All

12. How much discomfort do you have with taking long strides?
0------1-------2------3------4------5------6------7------8------9------10
Extreme Discomfort No Discomfort At All

13. How much difficulty do you have with getting into and/or out of a car?

0 ------1-------2------3------4------5------6------7------8------9------10

Extreme Difficulty No Difficulty At All

14. How much trouble do you have with grinding, catching, or clicking in your hip?

0------1-------2------3------4------5------6------7------8------9------10

Severe Trouble No Trouble At All

15. How much difficulty do you have with putting on/taking off socks, stockings, or shoes?

0------1-------2------3------4------5------6------7------8------9------10

Extreme Difficulty No Difficulty At All

14. Overall, how much pain do you have in your hip/groin?

0------1-------2------3------4------5------6------7------8------9------10

Extreme Pain No Pain At All

II: SPORTS AND RECREATIONAL ACTIVITIES

The following questions ask about your **hip** when you participate in sports and recreational activities. Please think about how you have felt most of the time over the past **month** and answer accordingly.

17. How concerned are you about your ability to maintain your desired fitness level?

0------1-------2------3------4------5------6------7------8------9------10

Extremely Concerned Not Concerned At All

18. How much pain do you experience in your hip after activity?

0------1-------2------3------4------5------6------7------8------9------10

Extreme Pain No Pain At All

19. How concerned are you that the pain in your hip will increase if you participate in sports or recreational activities?

0------1-------2------3------4------5------6------7------8------9------10

Extremely Concerned Not Concerned At All

20. How much was your quality of life deteriorated because you cannot participate in sport/recreational activities?

0------1-------2------3------4------5------6------7------8------9------10
Extremely Deteriorated **Not Deteriorated At All**

21. How concerned are you about cutting/changing directions during your sports or recreational activities?

- **I do not do this action in my activities.**

0------1-------2------3------4------5------6------7------8------9------10
Extremely Concerned **Not Concerned At All**

22. How much has your performance level decreased in your sport or recreational activities?

0------1-------2------3------4------5------6------7------8------9------10
Extremely Decreased **Not Decreased At All**

III: JOB RELATED CONCERNS

The following questions relate to your **hip** with respect to your work or occupational activities. Please think about how you have felt most of the time over the past **month** and answer accordingly.

- **I am retired** (please skip section)
- **I do not work for reasons other than my hip condition** (please skip section)

23. How much trouble do you have pushing, pulling, lifting, or carrying heavy objects at work?

- **I do not do these actions in my work.**

0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble **No Trouble At All**

24. How much trouble do you have with crouching/squatting?

0------1-------2------3------4------5------6------7------8------9------10
Severe Trouble **No Trouble At All**

25. How concerned are you that your job will make your hip worse?

0------1-------2------3------4------5------6------7------8------9------10
Extremely Concerned **Not Concerned At All**

26. How much trouble do you have at work because of reduced hip mobility?

0------1-------2------3------4------5------6------7------8------9------10
Extreme Difficulty **No Difficulty At All**

IV: SOCIAL, EMOTIONAL AND LIFESTYLE CONCERNS

The following questions ask about social, emotional and lifestyle concerns that you may feel with respect to your **hip** problem. Please think about how you have felt most of the time over the past **month** and answer accordingly.

27. How frustrated are you because of your hip problem?

0------1-------2------3------4------5------6------7------8------9------10

Extremely Frustrated **Not Frustrated At All**

28. How much trouble do you have with sexual activity because of your hip?

- **This is not relevant to me.**

0------1-------2------3------4------5------6------7------8------9------10

Severe Trouble **No Trouble At All**

29. How much of a distraction is your hip problem?

0------1-------2------3------4------5------6------7------8------9------10

Extreme Distraction **No Distraction At All**

30. How difficult is it for you to release tension and stress because of your hip problem?

0------1-------2------3------4------5------6------7------8------9------10

Extremely Difficult **Not Difficult At All**

31. How discouraged are you because of your hip problem?

0------1-------2------3------4------5------6------7------8------9------10

Extremely Discouraged **Not Discouraged At All**

32. How concerned are you about picking up or carrying children because of your hip?

- **I do not do this action in my activities.**

0------1-------2------3------4------5------6------7------8------9------10

Extremely Concerned **Not Concerned At All**

33. How much of the time are you aware of the disability in your hip?

0------1-------2------3------4------5------6------7------8------9------10

Constantly Aware **Not Aware At All**

QUESTIONNAIRE COMPLETE!
THANK YOU!

APPENDIX 2 THE NUMERIC RATING SCALE (NRS)

Please select an answer from 0 to 10 for your level of hip pain NOW

0 = No pain and 10 = Worst possible pain

Left hip

0 1 2 3 4 5 6 7 8 9 10

Right hip

0 1 2 3 4 5 6 7 8 9 10

APPENDIX 3 GLOBAL PERCEIVED EFFECT SCALE (GPE)

How does your hip pain feel now compared to before you had the surgery?

Worse / Almost the same / Better

If your answer was **Worse**, please select one of the following:
almost the same (hardly worse at all) / a little worse / somewhat worse / moderately worse / a good deal worse / a great deal worse / a very great deal worse

If your answer was **Better**, please select one of the following:
almost the same (hardly better at all) / a little better / somewhat better / moderately better / a good deal better / a great deal better / a very great deal better

APPENDIX 4 SINGLE LEG BALANCE TEST (SLB)

Test executions of functional performance tests:

Test	Test execution
Single leg balance test	Participant stands on one leg for 30s with an upright posture and the non-stance leg lifted in 30º of hip flexion. Arms placed where comfortable – no support. Must be able to balance for 30 seconds without pain. **Practice attempt: 10s per leg.**

(Tijssen *et al.*, 2015)

APPENDIX 5 ETHICAL CLEARANCE CERTIFICATE

R14/49 Miss Samantha Leeferink

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M170404

NAME: (Principal Investigator)	Miss Samantha Leeferink
DEPARTMENT:	Physiotherapy Life Fourways Hospital
PROJECT TITLE:	Hip Arthroscopy Outcomes: A Longitudinal Study
DATE CONSIDERED:	05/05/2017
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Witness Mudzi
APPROVED BY:	Prof P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	10/07/2017

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in April and will therefore be due in the month of April each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

11/07/2017
Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 6 CONSENT FORM

Consent to Participate in a Research Study

Title of study: **Hip arthroscopy outcomes: a longitudinal study**

I ……..... (full name and surname) voluntarily agree to take part in this study. I choose to take part in this study knowing that I am at liberty to withdraw at any time. I am not giving up any of my legal rights by signing this form. My signature below indicates that I have read and understood the information sheet and the researcher has explained the entire research information sheet, including the risks and benefits, and have had all of my questions answered.

_____ _____

Signature of Participant Printed Name of Participant

_____

Date

_____ _____

Cellphone contact number e-mail address

_____

Signature of Researcher

APPENDIX 7 INFORMATION SHEET – SURGICAL GROUP

Research Information Sheet

Dear Sir / Madam

Thank you for taking the time to consider participating in this research study.
My name is Samantha Leeferink, I am a physiotherapist currently enrolled to obtain my Master of Science degree at the University of the Witwatersrand. The study that I intend to conduct is looking at functional outcomes after hip arthroscopy to measure recovery in different spheres following surgery.

Title of Study: Hip arthroscopy outcomes: a longitudinal study.

Purpose:
You are being asked to participate in a research study looking at the functional outcomes after hip arthroscopic surgery because you have undergone a hip arthroscopic surgery with Dr Cakic. This study is being conducted at Life Fourways Hospital, Suite A12b.

Study Procedures:
If you decide to take part in this study, you will be required to attend an assessment before surgery as well as one follow up assessment (six-months after surgery) at a date and time that will best accommodate you as well as the researcher conducting the study. You will be required to wear a pair of shorts that allow your knees to be visible and shoes that can be removed as the functional tests will be done barefoot. You will be asked to complete 2 short questionnaires where after you will be asked to complete a functional movement test for balance.

Benefits
As a participant in this research study, there may well be no direct benefit to you; however, information from this study will help improve the way in which recovery following hip arthroscopy can be measured.

Risks

Participation in this study has no known risks.

Confidentiality

- All information collected about you during the course of this study will be kept without any identifiers.
- You will be identified in the research records by a code name or number.
- Only the researcher, research supervisors and research assistants may see the information collected about you during the course of the study.
- All electronic data will be stored on a password protected laptop by the researcher.

Voluntary Participation/Withdrawal

Taking part in this study is completely voluntary. You may choose not to participate in this study. If you decide to participate, you can change your mind later and withdraw from the study. You are free to not answer any questions or to withdraw at any time. No penalty or loss of benefits will be involved if you make that decision.

Questions:

If you have any questions about this study now or in the future, please feel free to contact Samantha Leeferink at the following phone number 084 270 0833 or 011 875 1827 or samanthajane.physio@gmail.com

Alternatively you may contact:

- Prof Witness Mudzi on 011 717 3716 or witness.mudzi@wits.ac.za
- Ms Zanele Ndlovu on 011 717 1252 or zanele.ndlovu@wits.ac.za (Research Administrator for the Human Research Ethics Committee)

Kind Regards

Principal Investigator (PI): Samantha Leeferink
Life Fourways Hospital – 011 875 1827

APPENDIX 8 INFORMATION SHEET – CONTROL GROUP

Research Information Sheet

Dear Sir / Madam

Thank you for taking the time to consider participating in this research study.
My name is Samantha Leeferink, I am a physiotherapist currently enrolled to obtain my Master of Science degree at the University of the Witwatersrand. The study that I intend to conduct is looking at functional outcomes after hip arthroscopy to measure recovery in different spheres following surgery.

Title of Study: Hip arthroscopy outcomes: a longitudinal study.

Purpose:
You are being asked to participate in a research study looking at the functional outcomes after hip arthroscopic surgery. You will form part of the control group who have no history of hip pain. This study is being conducted at Life Fourways Hospital, Suite A12b.

Study Procedures:
If you decide to take part in this study, you will be required to attend a once off assessment at a date and time that will best accommodate you as well as the researcher conducting the study. You will be required to wear a pair of shorts that allow your knees to be visible and shoes that can be removed as the functional tests will be done barefoot. You will be asked to complete 2 short questionnaires where after you will be asked to complete a functional movement test for balance.

Benefits
As a participant in this research study, there may well be no direct benefit to you; however, information from this study will help improve the way in which recovery following hip arthroscopy can be measured.

Risks

Participation in this study has no known risks.

Confidentiality

- All information collected about you during the course of this study will be kept without any identifiers.
- You will be identified in the research records by a code name or number.
- Only the researcher, research supervisors and research assistants may see the information collected about you during the course of the study.
- All electronic data will be stored on a password protected laptop by the researcher.

Voluntary Participation/Withdrawal

Taking part in this study is completely voluntary. You may choose not to participate in this study. If you decide to participate, you can change your mind later and withdraw from the study. You are free to not answer any questions or to withdraw at any time. No penalty or loss of benefits will be involved if you make that decision.

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- Prof Witness Mudzi on 011 717 3716 or witness.mudzi@wits.ac.za
- Ms Zanele Ndlovu on 011 717 1252 or zanele.ndlovu@wits.ac.za (Research Administrator for the Human Research Ethics Committee)

Kind Regards

Principal Investigator (PI): Samantha Leeferink

Life Fourways Hospital – 011 875 1827

APPENDIX 9 LETTER OF APPROVAL: LIFE FOURWAYS HOSPITAL TO CONDUCT RESEARCH

Life Healthcare Head Office
Oxford Manor, 21 Chaplin Road, Illovo 2196
Private Bag X13, Northlands 2116, South Africa
Telephone: +27 11 219 9000
Telefax: +27 11 219 9001
www.lifehealthcare.co.za

26 June 2017

Dear University of the Witwatersrand's Human Research Ethics Committee (Medical)

On behalf of Life Healthcare, specifically Life Fourway's Hospital, I am writing to grant permission for Miss Samantha Jane Leeferink (student no. 302876), a Physiotherapy Master's student in the field of Orthopaedics at the University of the Witwatersrand, to conduct her research titled, "Hip Arthroscopy Outcomes: a Longitudinal Study" at the premises. The study will be conducted in Suite A12b and Suite B22.

We are happy for her to conduct this study and contribute to this important research.

Kind Regards

Mark Stafford
Head: Legal & Insurance

APPENDIX 10 DEMOGRAPHIC INFORMATION SHEET

Participant Number _____

Age: _____

Gender: Male / Female

Employment status: Employed / Unemployed

Description of occupation: _____

Leg dominance: Left / Right / Both (which leg would you kick a ball with?)

Smoker: Yes / No

Diabetes: Yes / No

Osteoporosis: Yes / No

Vertigo: Yes / No

Neurological Fallout: Yes / No

Height (cm): _____

Weight (kg): _____

History of hip pain: Yes / No

If Yes: One hip / Both hips One hip: Left / Right

Surgical intervention: Yes / No

If Yes:

Details of Surgery: _____

Side of surgery: Left / Right

Chronic medication: _____

APPENDIX 11 LANGUAGE EDITOR'S CERTIFICATE

CERTIFICATE OF EDITING

This certificate confirms that the **Master of Science in Physiotherapy** at the **University of Witwatersrand** listed below was copy-edited by an associate member of the Professional Editor's Guild. The editing services included checking grammar, punctuation, spelling, sentence structure, logic and phrasing. A copy of the original, unedited document is available on request.

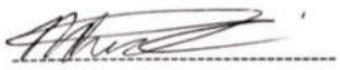
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HIP ARTHROSCOPY OUTCOMES:
A LONGITUDINAL STUDY

Author:
Samantha Jane Leeferink

Date Issued:
2020/02/11

Edited By:
Marizanne Linde

PEG Membership Number:
LIN006



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APPENDIX 12 PLAGIARISM DECLARATION

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Samantha Jane Leeferink (Student number: 302876) am a student registered for the degree of MSc Physiotherapy in the academic year 2019/20.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature:  Date: 09 January 2020

APPENDIX 13 APPROVAL OF TITLE

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

03 January 2020
Person No: 302876
PAG

Miss SJ Leeferink
#30 Lone Rock
19 Calderwood Road
Lonehill
2191
South Africa

Dear Miss Samantha Leeferink

Master of Science in Physiotherapy: Approval of Title

We have pleasure in advising that your proposal entitled *Hip Arthroscopy outcomes: a longitudinal study* 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

APPENDIX 14 TURNITIN REPORT

MSc Turnitin SJL

ORIGINALITY REPORT

14%	6%	8%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

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2	"Hip Arthroscopy and Hip Joint Preservation Surgery", Springer Science and Business Media LLC, 2015 Publication	1%
3	Tijssen, Marsha, Robert van Cingel, Enrico de Visser, and Maria Nijhuis-van der Sanden. "A clinical observational study on patient-reported outcomes, hip functional performance and return to sports activities in hip arthroscopy patients", Physical Therapy in Sport, 2016. Publication	1%
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