EARLY MOBILISATION AND FREQUENCY OF PHYSIOTHERAPY AFTER HIP AND KNEE ARTHROPLASTY

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A Research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Physiotherapy (Orthopaedic Surgery).

Johannesburg, 2022.

DECLARATION: STUDENT'S CONTRIBUTION TO ARTICLES AND AGREEMENT OF CO-AUTHOR

I, Retha-Mari Prinsloo declare that this research report is my own, unaided work. It is being submitted to the University of the Witwatersrand, Johannesburg for the Masters in Science degree in Physiotherapy (Orthopaedic Surgery). It has not been submitted to any other Universities before for examination or for any degree.

I further declare that I contributed adequately towards the proposal and results article publications below which are included in my research report.

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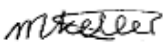
Signature of Primary Supervisor:  **Date:** 11/05/2022

Agreement by co-author: By signing this declaration, the co-author listed below agree to the use of the articles by the student as part of her Research Report.

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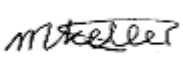
2nd Author	Monique M. Keller		11/05/2022

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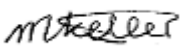
2nd Author	Monique M. Keller		11/05/2022

DEDICATION

To my Heavenly Father – Nothing but Grace and blessings, thank You!

In loving memory of my mother Frieda Prinsloo 1949-2019. I miss you every day.

To the rest of my family for your love, support and patience throughout this journey.

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Abstract

Considering increased prevalence of osteoarthritis (OA) and demand for hip and knee arthroplasty there is a lack of studies on physiotherapy protocols in South Africa (SA). The aim of this quantitative prospective cohort study was to investigate how early mobilisation and increased frequency of physiotherapy on post-operative day zero (POD0) impact hospital length of stay (LOS), safety, hospital cost and patient satisfaction. The prospective cohort (n=60) with earlier mobilisation and increased frequency of physiotherapy on POD0 was compared to a more conservative retrospective cohort. The two articles included in this research report discuss the physiotherapy protocol (methodology chapter three) and the results (chapter four) in detail. With a statistically significant decrease in LOS ($p<0.001$), less pain ($p<0.001$) and higher function ($P<0.001$) at six weeks, lower hospital, physiotherapy and total cost ($p<0.001$) this research is valuable in progressing physiotherapy protocols as part of an advanced rehabilitation pathway (ARP) towards reaching same day discharge (SDD) following hip and knee arthroplasty.

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NOMENCLATURE

ARP: Advanced rehabilitation pathways

BMI: Body mass index

DVT: deep vein thrombosis

ERAS: enhanced recovery after surgery

HIV: Human Immunodeficiency virus

IPCP: Intermittent pneumatic compression pumps

LOS: length of stay

NHI: National health insurance

OA: osteoarthritis

POD 0: Post-operative day zero

QOL: Quality of Life

ROM: Range of movement

SA: South Africa

SDD: same day discharge

THA: Total hip arthroplasty

TKA: Total knee arthroplasty

USA: United States of America

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

Chapter 1 Introduction

In Chapter One background on OA as a chronic degenerative joint disease and the management amidst the increased demand for hip and knee arthroplasty in the form of surgical intervention is presented. The problem statement, aim, objectives, the significance of the study for clinical practice, the research question and null hypothesis will be followed by a conclusion to Chapter One.

1.1 Background

OA, the most common form of arthritis contributes to reduced independence and to functional impairment in adults 65 years of age and above (Hawker 2019). Joints typically affected by OA are the hands, feet, hip, knee and spine (Contartese et al. 2020). It is estimated that 3.8% of the world population amounting to 242 million people live with symptomatic hip and /or knee OA. It is further estimated that 2.3% of men and 4.5% of woman worldwide are affected by hip and/or knee OA. (Carlesso et al. 2016; Felson et al. 2017). According to Katz et al. (2021) almost a third of people older than 45 years of age have radiographic evidence of OA affecting the knee, of which half of them have knee symptoms. Plenge et al. (2018) found lifestyle changes, increased life expectancy, obesity, trauma, and Human Immunodeficiency Virus (HIV) to be contributing factors to the rise in OA in SA.

Total hip and total knee arthroplasty (THA and TKA) surgical procedures are highly effective in the treatment of end-stage OA, where conservative treatment methods failed (Sculco & Pagnano 2015). According to Rupp et al. (2016) it is predicted that TKA and THA will increase by 45% and 23% respectively in Germany between 2016 and 2040. The biggest increase in TKA is predicted to be in the 40 to 49-year-old age group and in the 80 to 89-year age group for THA. This increased demand will add a substantial burden on the health care system and all involved stakeholders. Unfortunately, no local registries are available in South Africa and most studies done make use of a global trend using predictions from either the USA or Europe regarding the demand for joint arthroplasty.

With healthcare systems and involved stakeholders under increasing economical and resource strain due to the increased demand for joint arthroplasty, multi-disciplinary ARPs have gained popularity globally. Although differently named, these pathways according to numerous studies are safe and effective in reducing hospital LOS and cost substantially without an increase in complications when compared to more historic

and conservative protocols (Lasic et al. 2018; Riemer et al. 2017; Robertson et al. 2015).

In light of the current worldwide Coronavirus disease of 2019 (COVID-19) pandemic and its impact on elective surgeries being postponed accommodating the need for hospital beds and personnel resources, the need for decreased LOS and SDD surgery are even greater to deal with growing elective surgery waiting lists and dealing with the backlog for hip and knee arthroplasties (Anderson et al. 2021).

SDD or out-patient arthroplasty refer to patients being discharged from hospital on the same day as the arthroplasty either as an in-hospital patient or from a day-hospital respectively and is the future of elective hip and knee arthroplasty according to Sculco & Pagnano (2015). To our knowledge our team performed the first SDD and out-patient arthroplasties in SA in 2020 in the same period this study was done.

Physiotherapy plays a key role as part of an ARP with pre-operative patient education and early mobilisation on POD0 (Masaracchio et al. 2017; Soeters et al. 2017; Jordan et al. 2014). Since the Orthopaedic surgeon, implemented an ARP with early POD0 mobilisation at our private hospital, LOS decreased from an average 3.5 days to 2.4 days and then to 23hours. As part of this ARP, patients received extensive pre-operative education by the physiotherapist and was mobilised on POD 0.

1.2 Problem Statement

The South African health care system consist of both private and public health care funders. This study was conducted in the private health care system but with National Health Insurance (NHI) fast approaching, the increase in demand for joint arthroplasty, and the growing waiting lists of patients, an additional economic and resource burden may be placed on the health care system in South Africa. By 2030 the projected demand for THA will increase by 174% and TKA by 673% in the USA (Kurtz et al. 2007) and by 2040 it will increase by 23% and 45% respectively in Germany (Rupp et al. 2016)**.** The current worldwide pandemic COVID 19 is increasing the burden on already restricted resources and elective surgeries are being postponed accommodating the need for hospital beds and nursing resources. Therefore, the need for decreased LOS in hospital and SDD surgery is even greater to deal with growing waiting lists for elective surgery (Anderson et al. 2021). There, is currently a lack of studies done in SA on the effect of early mobilisation with increased frequency of physiotherapy intervention POD0, on LOS and patient satisfaction. There is a need to

decrease cost, by decreasing LOS, possibly through earlier mobilisation with increased physiotherapy frequency POD 0, without compromising patient safety and in doing so gain improved function and patient satisfaction.

1.3 Aim

To investigate how early mobilisation with increased daily frequency of physiotherapy intervention on POD 0, impacted the LOS, in-hospital cost, patient safety, and patient satisfaction, following hip and knee arthroplasty in a private hospital in SA.

1.4 Objectives

To determine how early mobilisation with the increased frequency of physiotherapy intervention on POD 0 impacted hospital LOS as primary outcome measure, in mean hours rather than in days.

To measure patient satisfaction (pain, function, stiffness, and expectation) six weeks and three months post-operative, using The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

To evaluate the safety, of implementing, an ARP, by documenting, any adverse event. (30-day re-admission date).

To determine and compare, the costs of LOS, by calculating cost of direct hospital expenses incurred per day, theatre time, assistive devices (crutches, walking frame, toilet-raiser, etc.), prosthetic, physiotherapy, anaesthetist and Orthopaedic specialist fees, in a simple comparison.

1.5 Significance of the Study

Early mobilisation and increased frequency of physiotherapy intervention on POD0 lead to a decrease in LOS, high patient satisfaction, no complications and cost reduction. Implementing SDD where the physiotherapists increase the frequency of sessions to two per day and mobilising the patient earlier, may be the future of arthroplasty in SA. Should current and future research results on implementing ARPs be favourable, both the private and public health care stakeholders may consider implementing these protocols to help accommodate the increased demand for hip and knee arthroplasty in SA, by using the available resources more effectively and saving on costs. It is essential that good standard health care is provided in a cost-effective

manner while improving patient reported outcomes and satisfaction. When LOS within an ARP could gradually be decreased to below 24 hours, SDD or out-patient arthroplasty, may become the new, best evidence-based treatment protocol after hip and knee arthroplasty in SA.

1.6 Research question and null Hypothesis

Considering joint arthroplasty moving towards day-case surgeries, the research question posed was, how does time before mobilisation and increased frequency of physiotherapy intervention POD 0, affect length of stay, in-hospital cost, patient satisfaction (pain, function, stiffness and, expectation) and patient safety in hip and knee arthroplasty?

After spending time in America, observing and receiving training in the field of SDD and out-patient arthroplasty the Orthopaedic Surgeon from Rustenburg, SA decided to implement an ARP in a private hospital and establish a multi-disciplinary team to gradually develop a protocol over the next two to three years. Since the Orthopaedic surgeon, implemented an ARP with early POD0 mobilisation, at our, private hospital, the average hospital LOS decreased from 3.5 days (84 hours) to 23 hours. As part of this ARP, patients received extensive pre-operative education by the physiotherapist and early mobilisation once, three hours post-operatively on POD0. The null-hypothesis was that by starting mobilisation earlier POD 0 (one to three hours) and by increasing the frequency from one session to two sessions POD 0, it would not influence LOS, in-hospital cost, pain, function, and stiffness, with more complications post-surgically, compromising patient's health and safety.

1.7 Conclusion

The study contributes to the evidence base of patient outcomes following hip and knee arthroplasty in SA and a physiotherapy protocol in an ARP, in the light of limited literature. In Chapter Two, a detailed literature review on current available research on the implementation of ARP protocols to improve patient care and outcomes in a cost-effective manner by decreasing hospital LOS, is included. The way in which physiotherapy contribute to the safe and cost-effective management of hip and knee arthroplasty patient is emphasised in this chapter.

Chapter 2

2.1 Introduction

In Chapter Two the available literature on aetiology, epidemiology, classification, treatment methods for hip and knee OA and the implication of the rising demand for hip and knee arthroplasty is covered. Literature on ARPs decreasing hospital LOS and cost, and the role of physiotherapy as part of the multi-disciplinary team forms the backbone of the literature review.

2.2 Literature review

2.2.1 OA aetiology and epidemiology

OA is a chronic degenerative joint disease known for its progressive damage to articular cartilage, sclerosis of subchondral bone, followed by osteophyte formation and soft tissue damage (Charlesworth et al. 2019, Vitaloni et al. 2019). Increased age, obesity, lifestyle changes, trauma, HIV and non-communical diseases lead to increased musculoskeletal and orthopaedic diseases like OA (Plenge et al. 2018). OA is more common in women than in men (Hawker et al. 2019) and may cause pain and chronic disability (Lespasio et al. 2017). Social interaction and psychological well-being are negatively impacted by decreased function and activity that decrease patients' quality of life (QOL) (Vitaloni et al. 2019). The treatment of OA focusses on pain relief, improvement of function and improving QOL since there is currently no cure for OA (Charlesworth et al. 2019). QOL is negatively influenced by lifestyle and social factors like age, gender, obesity, low physical activity, low socioeconomic and educational levels (Vitaloni et al. 2019). OA can be classified as primary (idiopathic) or secondary OA. Age associated physiological changes, genetics, biomechanical and ethnicity plays a role in primary OA while secondary OA may be caused by infections, inflammation, post-traumatic and biomechanical influences (Khon et al. 2016).

2.2.2 Classification of OA

Radiographical diagnosis and classification of OA were described by Kellgren and Lawrence on a five grade (0-4) scale. This classification focus on the narrowing of the joint space and formation of osteophytes with grade zero showing no joint space narrowing or osteophyte formation and grade four demonstrating clear joint space narrowing, bone sclerosis and deformity. This classification helps healthcare providers in clinical decision making and identifying patients who may benefit from surgical

management (Khon et al. 2016, Wing et al. 2021). Some medical funders also require this classification to approve an arthroplasty procedure. According to Wright et al. (2014) the classification is valid and reliable with high diagnostic accuracy. One limitation of the Kellgren and Lawrence classification system is that it is insensitive to disease changes and does not measure joint space narrowing in the absence of osteophyte formation. (Wright et al. 2014). According to Stone et al. (2017) patients with more severe radiographic disease tend to report higher patient satisfaction and patient outcomes.

2.2.3 Treatment of hip/knee OA

Treatment options for OA include lifestyle modification such as exercises and weight reduction, pharmacological management like paracetamol, NSAIDS and opioids, and intra-articular corticosteroids, platelet rich plasma and stem cell treatment. Surgical intervention includes arthroscopy and total joint arthroplasty (Charlesworth et al. 2019). According to a systematic review by Charlesworth et al. (2019) on the long-term safety implication of treatment options for OA they suggested that lifestyle intervention should be advocated for all patients due to the low risk of harm. NSAIDS should be avoided to decrease complications in the gastrointestinal system. Corticosteroid injections lead to cartilage degeneration at more than one year post injection. Arthroscopy as management of degenerative meniscal tears is associated with a threefold increase in TKA. TKA is associated with increased risk of infection, deep vein thrombosis (DVT) and bleeding (Charlesworth et al. 2019). Medical management of hip and knee OA with NSAIDS in the long run may carry a greater risk of long-term complications compared to surgery (Aweid et al. 2018).

Hip and knee arthroplasties have been performed since the 1970's. OA is one of the main indications for which arthroplasty procedures are performed (Gademan et al. 2016). Indications for these procedures are pain, function, radiological changes, and failed conservative treatments (Gademan et al. 2016). Hip and knee arthroplasty are highly effective in the treatment of end-stage OA (Sculco & Pagnano 2015).

2.2.4 Length of stay in hip/knee arthroplasty

Until recently, it was common for providers and patients to believe that it was necessary for joint arthroplasty patients to stay in hospital for several days to manage pain, decrease risk of infection and improve mobility and function (Krause et al. 2018). Prolonged hospital stay is associated with an increase in morbidity and mortality rates following joint arthroplasty (Maempel et al. 2016). The average LOS according to the

National joint registry is 6.6 days and 5.5 days in the UK and Australia respectively in patients following TKA (Henderson et al. 2018). Fear of pain, dependency on others and post-operative complications are some of the reasons patients feel unsure to be discharged early (Krause et al. 2018). According to Krause et al. (2018) patients indicated that if these fears were addressed, they would rather recover at home than stay in hospital.

2.2.5 Role of ARP's in hip/knee arthroplasty

Advanced or fast-track rehabilitation pathways were implemented to decrease the hospital LOS. Sutton et al. (2016) found that these pathways decreased LOS by one to three days. These pathways focus on an opioid sparing regime for pain management to decrease nausea, drowsiness and dizziness following surgery (Lasic et al. 2018; Riemer et al. 2017). A combination of general anaesthesia and local infiltration anaesthesia has less post-operative complications such as nerve damage, spinal haematoma, infection and it allows for early mobilisation due to motor function preservation (Marques et al. 2014). Adductor canal blocks and local infiltration of analgesia between the popliteal artery and the capsule of the knee is safe, provide peri-operative pain relief and is muscle sparing regarding motor function (Krause et al. 2017). According to a study by Kastelik et al. (2019) time to mobilisation and patient satisfaction improved while peri-operative time decreased by 25 minutes when using the combination of local infiltration analgesia and adductor canal block with general anaesthesia. Early hydration and mobilisation together with the use of Intermittent Pneumatic Compression Pumps (IPCP) post-surgery is helpful in thromboprophylaxis. An anti-coagulant is also prescribed according to the patient's risk profile (Lasic et al. 2018). The careful control of hypotension during surgery, the absence of drainage pipes, the use of tranexamic acid and appropriate use of tourniquet help restrict blood loss during surgery. A minimal invasive, surgical approach which is muscle sparing, with subcutaneous sutures and tissue adhesives are used to promote and accelerate recovery (Lazic et al. 2018).

Numerous studies have shown the implementation of ARP's to be safe and reduce LOS in hospital, without an increase in complications when compared to conservative protocols (Lazic et al. 2018, Robertson et al. 2015, Riemer et al. 2017).

By implementing an ARP there are several ways to decrease the cost of arthroplasties. Pre-operative education by the orthopaedic surgeon, anaesthetist and physiotherapist, have been found to decrease LOS, decrease patient admissions to high care and

promote early mobilisation. Pre-operative optimisation of patient's comorbidities and general health, pre-operative anaesthetist evaluation to identify any risk for potential adverse events that can increase LOS and then also early mobilisation that decreases LOS and post-operative complications (Riemer et al. 2017). Patients are medically optimised before surgery in terms of evaluating their overall medical status, medication, and nutrition. Infection markers, Haemoglobin (Hb) and Albumin levels are checked to decrease risk of post-operative blood transfusions and infections (Krause et al. 2018). According to Immelman et al. (2018) clear discharge criteria are essential to recognise possible complications to ensure safe discharge and decreasing re-admissions.

There is a lack of studies on ARP's implemented in SA. Two studies, done in SA showed that "Enhanced recovery after surgery (ERAS)" (Immelman et al. 2018) and "Advanced clinical pathways" (Riemer et al. 2017) could safely be implemented and reduce hospital LOS. Similarly, internationally, ARP's decreased the LOS, leading to out-patient arthroplasty in Europe and the USA, and since 2018 more than half of American surgeons are implementing out-patient protocols (Yates et al. 2018).

2.2.6 Physiotherapy in a multi-disciplinary ARP

Physiotherapy forms an integral part of the multi-disciplinary team involved in an ARP. The focus of physiotherapy is to optimise patient functionality and prepare patients for early discharge via pre-operative education and early mobilisation. Due to the decrease in LOS in an ARP, the physiotherapist helps the patients to achieve their functional goals and hospital discharge criteria in a shorter period of time. This requires a high level of patient engagement. Patient involvement in their recovery and goal setting improves patient compliance and ultimately, patient satisfaction (Pennestri et al. 2019).

Education and rehabilitation previously done in-hospital is now started prior to the surgery. More emphasis is therefore placed on the prehabilitation (or so called pre-operative physiotherapy and exercises) and the perioperative stage of rehabilitation. The term perioperative refer to the time from being admitted to hospital till time of discharge (Gleicher et al. 2021). From a rehabilitation perspective the patient then needs to be optimally prepared for surgery to ensure early and effective mobilisation and function and prepare the patient for SDD in an out-patient arthroplasty. In a systematic review with meta-analysis Masaracchio et al. (2017) found that early

mobilisation (two to six hours following surgery) and physical therapy is associated with decreased hospital LOS, lower total cost and can be implemented safely.

Multiple studies (Yakkanti et al. 2019; Guerra et al. 2015) found that there is a couple of reasons for delayed patient mobilisation. The use of motor nerve blocks compromises the Quadriceps muscle control and proprioception that leads to a fall risk and therefore delays mobilisation until the effect of the block has worn off (Yakkanti et al. 2019; Guerra et al. 2015). The delay of transferring patients back from the recovery room to the Orthopaedic ward, the lack of physiotherapy resources available after 17h00, the patient's level of motivation, and pre-operative expectations can further delay mobilisation. Patient factors like age, body mass index, co-morbidities, mental health, social support, and pre-operative function may also lengthen the hospital LOS (Yakkanti et al. 2019).

Soeters et al. (2017) found that a pre-operative one-on-one education session with the physiotherapist improved the patient's readiness for discharge, but that it had no effect on hospital LOS or WOMAC scores at six weeks. In this study the focus was not on a multi-disciplinary approach, and it can therefore be expected that in case of a multi-disciplinary approach the LOS may have decreased. As indicated by the study, pre-operative education prepares patients for the hospital and leads to a decrease in time needed in hospital to get patients ready for hospital discharge. It also led to decreased anxiety as patients know what to expect and gave patients confidence in their own ability to cope at home. In a study by Anderson et al. (2021) great emphasis was placed on the importance of pre-operative education and its role in decreasing hospital LOS and what aspects should be addressed in such a session. Despite these studies demonstrating the importance of physiotherapy as part of the multi-disciplinary team with per-operative patient education and early mobilisation, no studies were found giving clear specifications on what protocols were followed. Most studies give detail on the time patients were mobilized and some indicate discharge criteria. There is a lack of studies done on pre-operative and peri-operative physiotherapy protocols for hip and knee arthroplasty patients as part of an ARP and hence the reason for this study and the proposal for a protocol to follow in Chapter Three.

2.2.7 Patient satisfaction following hip/knee arthroplasty

Despite the success of arthroplasty surgeries as a cost-effective way of treating end stage hip and knee OA, studies indicate a 10% and 20% patient dissatisfaction rate after hip and knee arthroplasty, respectively (Gunaratne et al. 2017; Gill et al. 2013).

Patient satisfaction is determined by the patients' pre-operative expectations, post-operative complications and post-operative residual pain, joint stiffness, and functional level (Walker et al. 2018, Gill et al. 2013). Patient expectations following joint arthroplasty are usually based on improved function, QOL, decreased pain and decreased stiffness (Thambiah et al. 2015, Gunaratne et al. 2017). Pre-operative education decreases patient expectation and anxiety and improve post-operative exercise performance. The combination of education and physiotherapy with early mobilisation decreased LOS in hospital and therefore decrease cost of knee arthroplasty intervention (Jordan et al. 2014).

Looking at outcome measures commonly used and specifically patient reported outcome measures in OA patients following hip and knee arthroplasty different questionnaires like the Oxford Hip/Knee Score, KOOS and HOOS and The WOMAC was suggested. The WOMAC is specifically used for OA patients, has subscales that could be individually compared and was also linked to measure patient satisfaction.

2.3 Summary

In Chapter Two the available research on aetiology, epidemiology, classification, treatment methods of hip and knee OA and ARPs implemented in the management of hip and knee arthroplasty, and the role of physiotherapy with early mobilisation and patient education was noted. The lack of studies done in SA and the lack of literature regarding physiotherapy protocol nationally and internationally led to the research undertaken to answer the research question. In Chapter Three, the methodology and the physiotherapy protocol used in the research will be presented in the form of a published article.

Chapter 3 Methodology Article

3.1 Introduction

The lack of studies providing complete and detailed reporting on the physiotherapy protocol used in ARP, led to the methodology section of this research being published as a proposal article. Sharing the exact methodology and physiotherapy protocol with the SA physiotherapy as well as the international community was of utmost importance seeing that SDD is increasing in popularity in SA. Chapter Three starts with the publication and journal details, followed by author contributions, permission and rights sections. The article follows thereafter and include an introduction in the form of a literature review on the increased demand for hip and knee arthroplasty, the increased burden on resources and the global implementation of ARPs and the role of physiotherapy as part of these ARPs. Outcome measures used, data management, statistical analysis and ethical considerations were also included and followed by a short discussion and conclusion.

3.2 Publication details

Chapter three is presented as a published article. A quantitative cohort study proposal with detailed physiotherapy protocol. In submitting the quantitative cohort study proposal, the aim was to address the lack of studies done and documenting a detailed physiotherapy protocol that would help to determine how early mobilisation and increased frequency of physiotherapy on POD 0 impact the hospital LOS, safety, patient satisfaction and cost, after hip and knee arthroplasty in a private hospital in SA.

3.3 Journal details

Table 3.1 Publication specifics

Title of publication	Physiotherapy in an advanced rehabilitation pathway for patients after hip and knee arthroplasty: A proposal
Authors	Retha-Mari Prinsloo and Monique Marie Keller
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3.4 Author contributions

Table 3.2 Author contribution details

	Prinsloo	**Keller**
Conceptualisation	**X**	
Methodology and physiotherapy protocol	**X**	
Refinement of topic and proposal	**X**	**X**
Writing first draft	**X**	**X**
Writing review and editing	**X**	**X**
Project administration	**X**	
Supervision		**X**

3.5 Permissions and rights

3.6 Article

South African Journal of Physiotherapy ISSN: (Online) 2410-8219, (Print) 0379-6175

Physiotherapy in an advanced rehabilitation pathway for patients after hip and knee arthroplasty: A proposal

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Background: Accelerated rehabilitation pathway (ARP) decrease patients' hospital length of stay (LOS). A lack of evidence exists on physiotherapy management and outcome as part of ARP in South Africa (SA). This study aimed to determine whether early mobilisation and increased frequency of physiotherapy treatments for participants after hip or knee arthroplasty surgery on post-operative day 0 (POD 0) affect outcome.

Methods/design: A quantitative prospective cohort study incorporating ARP on (n = 60) non-randomised elective hip and knee arthroplasty participants will be compared with a more conservatively managed historical control group (n = 60). The physiotherapy protocol includes early mobilisation and exercises 1–3 h post-operatively on POD 0 and a second mobilisation and exercise session, 1–2 h later. **Outcomes measures are as follows**: hours for LOS, the WOMAC measured pre-operatively, 6 weeks and 3 months post-operatively, 30-day readmission for safety and cost comparison between the prospective and historical cohorts. Descriptive statistics will be undertaken. A paired t-test will be used to analyse each of the outcome measures across the time periods if data are normally distributed. Length of stay, WOMAC score and cost data will be compared between the groups, using a Mann–Whitney U test. The occurrence of adverse events will be compared between the

groups using Pearson's chi-square tests. The confidence interval will be set at 95% and p = 0.05 will be considered statistically significant.

Discussion: Globally, ARP's are successfully implemented to manage patients presenting with hip and knee osteoarthritis (OA). Research investigating physiotherapy protocols in an ARP is lacking in the literature.

Conclusion: Achieving the same-day discharge after hip and knee arthroplasty surgeries may help elective surgery backlogs and waiting lists in a more cost-effective manner.

Clinical implications: The same day discharge after arthroplasty may be a cost-effective management option in the future.

Protocol identification: Pan African Clinical Trial Registry, PACTR202103637993156.

Keywords: length of stay; early mobilisation; physiotherapy; arthroplasty; replacement; hip; knee.

Introduction

Increased life expectancy, lifestyle changes, obesity and non-communicable diseases, trauma and HIV contribute to increased musculoskeletal and orthopaedic diseases such as Osteoarthritis (OA) in South Africa (SA) (Plenge et al. 2018). OA is one of the leading causes of pain in patients' hips and knees and chronic disability, with a resulting adverse effect on quality of life and function (Lespasio et al. 2017). Hip and knee arthroplasty surgeries are very effective in treating end-stage OA (Sculco & Pagnano 2015).

Kurtz et al. (2007) determined that in the United States of America (USA) the demand for total hip arthroplasties would increase by 174% and for total knee arthroplasties by 673% by 2030 from the demand seen in 2007. The long-term effect is an increased demand for hip and knee arthroplasty procedures enabling individuals to live a fully functional life. It, however, places a directly increased financial strain on private and public stakeholders and medical funders. With National Health Insurance (NHI) on our doorstep in South Africa, the cost of this increased demand will be substantial for the SA healthcare system and medical funders. Decreasing hospital's length of stay (LOS) after elective total hip and knee arthroplasty surgical procedures may impact the individual, medical funders and government stakeholders positively. In addition, the Covid-19 pandemic has negatively affected waiting times for surgery, leaving a backlog

of patients waiting for elective hip and knee arthroplasty surgeries. Over the last year and a half many countries decided to cancel elective surgeries to reserve resources and personnel to prioritise management of patients infected with Covid-19 (Lancet 2021).

When considering the increased cost and burden on resources, there has been a national and international shift towards advanced multidisciplinary approaches for hip and knee arthroplasty surgeries. A variety of names are used in the literature for these advanced protocols. Advanced clinical pathway (Plenge et al. 2018), fast track (Tayrose et al. 2013), accelerated rehabilitation protocol (Robertson et al. 2015) and rapid recovery are drawing more and more attention worldwide for an alternative method of management and rehabilitation of patient undergoing total hip and knee arthroplasty surgeries.

Studies conducted on a fast track or ARP demonstrate that advanced protocols can be implemented safely, effectively and reduce the hospital's LOS, without increasing complications more than conservative protocols (Lazic et al. 2018; Riemer et al. 2017; Robertson et al. 2015). Evidence of the implementation of advanced clinical pathways and enhanced recovery after surgery (ERAS) in a SA context shows that advanced clinical pathways can be implemented safely and reduce LOS (Immelman et al. 2018; Riemer et al. 2017). As a result of the decreased LOS, the healthcare system's cost-saving is of great value moving towards the NHI and considering the aftermath of the Covid-19 pandemic.

Although advanced pathways have different names, the focus of these protocols is standardised care. The standardised care includes patient education, pain control, thromboprophylaxis (preventing blood clot formation in blood vessels), managing blood loss during surgery and early mobilisation, as the key elements (Lazic et al. 2018; Riemer et al. 2017).

We will now describe the specific core adaptations included in advanced protocols. The pain control is a focussed multimodal, opioid sparing regime to decrease nausea, dizziness, and sleepiness after surgery, thus enabling patients to mobilise within hours of the surgery. Intermittent pneumatic compression pumps (IPCPs) are used post-operatively for thromboprophylaxis. Depending on the patient's risk profile, aspirin or clexane is prescribed. Blood loss in surgery is restricted by controlled hypotension, no drainage pipes, using a tourniquet at appropriate pressures only during the surgery's cementation and tranexamic acid. The surgical technique is a minimally invasive,

muscle-sparing approach with kinematic alignment and subcutaneous sutures with tissue adhesives that contribute to rapid recovery (Lazic et al. 2018).

The advancement in elective total hip and knee arthroplasty has reached a point where decreasing the LOS by using advanced pathways led to outpatient joint arthroplasties in the United States of America and Europe. In 2018, total knee arthroplasties were no longer only in-hospital procedures. According to Yates et al. (2018), more than half of the American Academy of Hip and Knee Surgeons were instructed by their hospitals to implement outpatient protocols. One day or outpatient arthroplasty, according to Sculco and Pagnano (2015) is the way forward. In outpatient or 1-day total hip and knee arthroplasty surgeries, patients are discharged on the same day as the surgery. Outpatient total joint arthroplasties can be implemented safely, cost-effectively and are beneficial to patients. Increased LOS is associated with higher morbidity and mortality (Lazic et al. 2018; McCulloch et al. 2017). In SA, outpatient arthroplasty surgeries have not yet been performed.

Physiotherapy forms an integral part of the advanced pathways through patient education, management before the surgery, early mobilisation and rehabilitation. Early mobilisation (patient ambulating/walking with an appropriate mobility aid away from the bed), plays an essential role in decreasing post-operative complications, including deep vein thrombosis (DVT), prosthesis-related infections and postural hypotension (Chen et al. 2012; Dossett & Chesser 2017). Physiotherapy intervention also improves patients' function and muscle strength (Chen et al. 2012; McCulloch et al. 2017). When considering outcomes after total knee arthroplasty, Kolisek et al. (2009) reported that joint range of motion (ROM) and function were comparable with the final follow-up for both patients having surgery out- and in-hospital. In total hip arthroplasty surgeries, the pain and Harris Hip score were similar 4 weeks post-operatively (Goyal et al. 2016).

Studies have shown that early mobilisation post-operative day 0 (POD 0) plays a significant role in decreased LOS (Lazic et al. 2018; Masaracchio et al. 2017; McCulloch et al. 2017; Riemer et al. 2017; Tayrose et al. 2013; Yakkanti et al. 2019). In a systematic review and meta-analysis of 17 studies, Masaracchio et al. (2017) found that early initiation of rehabilitation on POD 0 decreases the LOS without increasing adverse events in patients following joint replacement surgery. Tayrose et al. (2013) reported that patients mobilised in the recovery room directly following the surgery, while others reported mobilising patients 2–4 h POD 0 (Raphael et al. 2011).

Despite the advancements in decreased LOS in the hospital for patients who underwent hip and knee arthroplasty surgeries, studies indicate a 10% and 20% patient dissatisfaction percentage for outcomes (Gunaratne et al. 2017). Patient satisfaction depends on factors such as residual pain, stiffness, post-operative function, post-operative complications and pre-operative patient expectations (Walker et al. 2018). Patient expectations are usually based on improved function, decreased pain, decreased stiffness and an overall increase in quality of life (Gunaratne et al. 2017; Thambiah et al. 2015).

The orthopaedic surgeon at the private hospital where our study is to be carried out has implemented an ARP and early POD 0 mobilisation. As the ARP, the average LOS has decreased from 3.5 to 2.4 days and now is 23 h. When talking about day-surgery, McCulloch et al. (2017) made a vital point about the LOS documentation after hip and knee arthroplasty surgeries. Length of stay measurement should be performed in hours and not in days to be more precise in documenting the time taken before discharge. Patients who have their operation later in the day may be discharged after a similar time as the patient who was operated on first. Length of stay measured in hours prevents confusion and improves accurate documentation of the actual time from going to the operating theatre, till the time of discharge.

If early mobilisation (patient ambulating/walking with an appropriate mobility aid away from the bed) and increased frequency of physiotherapy intervention on POD 0 lead to decreased LOS, stakeholders and medical funders will benefit from the cost-saving reduced length of hospital stay in the private and the public sectors in SA. Private and public healthcare, the SA government and NHI can accommodate the increased demand for joint arthroplasties by effectively using the available resources and saving on costs. Patients may benefit from a shorter waiting period for their hip or knee arthroplasty leading to a quicker recovery and better quality of life. Good quality healthcare must be provided cost-effectively and improve patient-reported outcomes and satisfaction. The ARP provides a possible improved way of elective total hip and knee arthroplasties.

Appropriate physiotherapy management plays an integral part in the ARP. With a lack of evidence guiding clinical practice in SA, our study thus aims to determine how early mobilisation and increased daily frequency of physiotherapy on POD 0 impact the hospital LOS, safety and patient satisfaction, after hip and knee arthroplasty in a private hospital in SA.

The specific objectives of our study are to:

• determine how early mobilisation and the increased frequency of physiotherapy on POD 0 impacts hospital LOS in mean hours, (primary outcome)

• determine patient satisfaction (pain, function, stiffness and expectation) 6 weeks and 3 months post-operative

• evaluate the safety of implementing an accelerated rehabilitation pathway on patients after hip and knee arthroplasty, documenting any adverse events and 30-day readmission rate

• determine and compare the costs of LOS, in a simple cost comparison between historic cohort and prospective cohort groups.

Method

The study is a prospective cohort study that includes a purposive convenient, selected sample of patients (n = 60). The ARP guides the management after total hip and knee arthroplasty surgery. The prospective cohort will be compared with a historical control group (n = 60) managed with an older protocol. The sample was determined by the total number of patients who underwent total hip and knee arthroplasties in the historical control group at the private hospital performed by the same orthopaedic surgeon as for the prospective group. The setting and multidisciplinary team for both the prospective participants and the historical control group is the same.

All consecutive elective hip and knee arthroplasty patients cleared pre-surgically by the physician as per ARP will be included. Patients with revision surgery, trauma-related surgeries, bilateral arthroplasty, poor balance and cognitive deficiencies will be excluded from participation.

All patients in both the historical and prospective groups received the same treatment and protocol at the Medicare private hospital in Rustenburg, the difference lying in the time before first mobilisation and the frequency of treatment on POD 0. The historical group received a more conservative protocol that included an educational session in hospital pre-operatively and mobilisation once on POD0-3 hours post-operatively.

The prospective group will receive the new protocol, that is, an educational session the week prior to surgery and before hospital admission; mobilisation 1–3 h post-operatively (Raphael et al. 2011; Tayrose et al. 2013) and then again for a second time 1–2 h thereafter.

Information will be provided to all potential participants and informed consent to be included in our study will be obtained. The multidisciplinary team for all surgeries consists of the same group of individuals: orthopaedic surgeons, anaesthetists, physiotherapists and nursing staff. The protocols will be uniform throughout our study except for the differences described here.

Pre-intervention protocol and assessment for hip and knee arthroplasty

The physiotherapy protocol will start with pre-operative education, pre-habilitation (rehabilitation performed by the physiotherapist before the surgery) and include an evaluation session (measurement of hip and knee range of movement (ROM) with a goniometer, hip and knee muscle strength with the Oxford Scale and a The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) questionnaire is also completed in this session). This session emphasises post-operative expectations for the patient and physiotherapist, post-operative exercises, bed mobility, gait re-education, navigating stairs with crutches, preventive measures, early mobilisation and ice programme (Andersen et al. 2021). The exercises consist of foot pumps to encourage circulation, heel slides exercises to improve hip and knee ROM, static quadriceps muscle strengthening exercises to improve knee support, free active hip abduction ROM/ functional exercises and to encourage joint ROM. The patients are instructed to do one set of 10 repetitions, a minimum of five times per day. The education session also includes discharge requirements, information about in hospital and follow-up physiotherapy sessions, education regarding the home environment, safety aspects at home and preparing the patient for a possible same day discharge (Andersen et al. 2021; Thompson et al. 2021). Preventive hip arthroplasty measures implemented for the first 3 months post-operatively include no hip internal rotation, no hip adduction (crossing the legs) and no hip flexion more than 90°. The patient is provided with a printed information sheet with all the exercises for pre- and post-operative. The same exercises are used for both pre-habilitation and postoperatively. The physiotherapy protocol used in the ARP will now be explained in detail.

Protocol after returning from the recovery room

Post-operatively, patients are routinely monitored in the ward by the nursing staff for nausea, hypotension, tachycardia or desaturation. An ice pack is applied as soon as the patient is back in the ward after surgery. Ice is applied almost continuously during the day through a light compression bandage (Tubigrip). Patients are advised to apply the ice for 8 h per day with short intervals without ice for the first 3 days. Karaduman

et al. (2019) also advocated for using ice for a total of 8 h per day, icing for 2 h periods four times per day, in the acute phase after arthroplasty.

Patients have no catheter or drainage pipes. Patients return to the ward with a short drip in the arm and cardiac monitor electrodes on their chests, which is removed to make mobilisation easier. Intermittent pneumatic compression pump is in place around the patient's calves to help in preventing DVTs. Patients are mobilised POD 0 as soon as they are fully awake, no nausea or dizziness is observed and with the surgeon's permission, 1–3 h post-operatively (Raphael et al. 2011; Tayrose et al. 2013; Yakkanti et al. 2019). Patients are encouraged to start eating and drinking as soon as possible. The physiotherapy post-operatively starts by making the patient sit more upright (while respecting hip flexion precaution of 90° after total hip replacements) to assist with hypotension. Bed exercises consisting of foot pumps, static quadriceps muscle strengthening exercises, free active hip abduction ROM/functional exercises and heel slides exercises to encourage joint ROM are performed (Jenkins et al. 2019; Thompson et al. 2021).

The bed exercise prescription is one set of 10 repetitions, a minimum of five times per day. The patient is then mobilised to sit over the side of the bed. While the patient sits over the side of the bed, a short lever quadriceps extension exercise is prescribed. If the patient has no dizziness, nausea or intense pain and adequate knee proprioception (Jenkins et al. 2019) in the operated knee, standing with a walking frame follows. Gait and knee-locking are explained, a revision of the education was performed during the pre-habilitation phase. Then, the patient mobilises from the bed to the toilet and back, approximately 20 m in total. If the patient is mobilising well with a walking frame, he or she can walk with elbow crutches. Ice is re-applied after the mobilisation. The patient is encouraged to sit out in the chair for lunch and dinner.

A second physiotherapy session, 1–2 h after the first physiotherapy session, follows for the prospective group. The second physiotherapy session comprises the same exercises and mobilisation programme as the first session. The physiotherapist will also help the patient to get dressed in their clothes during the second session. In-between the two physiotherapy sessions, the patient, may mobilise with the nursing staff's assistance to the bathroom if the need arises. Depending on how well and safe the patient is in mobilising, stair climbing might be included in the second session on POD 0 or in the first physiotherapy session on post-operative day 1. Patients will receive physiotherapy sessions twice per day while in hospital.

Post-intervention assessment and protocol before discharge

Before discharge, the patient is expected to demonstrate good independent bed mobility (be able to get in and out of bed by themselves), mobilise 50 m or more with an appropriate assistive device, navigate by climbing five stairs safely with crutches or one step in case of a walking frame (Berger et al. 2009; Thompson et al. 2021). Range of motion should be close to 90° knee flexion and 90° hip flexion for knee and hip arthroplasty. When the patient is medically stable, pain is under control (patient indicating that they feel they will manage at home using pain tablets with a visual analogue scale rating of equal or less than 5 out of a maximum of 10 pain), and the physiotherapy criteria are met, the patient is discharged home (Thompson et al. 2021). A home exercise programme that was already provided pre-operatively is continued. The home exercise programme after a knee arthroplasty includes foot pumps (ankle dorsiflexion and plantar flexion), knee extension static quadriceps, knee flexion and extension heel slides, knee extension over a foam roller or pillow, hip flexion straight leg raise, knee extensions through full ROM while seated. The exercise prescription for all the exercises is one set, 10 repetitions, five times per day with progression during follow-up physiotherapy outpatient visits. The home exercise programme after a hip arthroplasty includes foot pumps (ankle dorsiflexion and plantar flexion), knee extension static quadriceps, knee flexion and extension heel slides within limits, hip abduction within limits of pain, knee extensions through full ROM while seated. In standing knee flexion hamstring curls, hip abduction and hip extension exercises are added. The exercise prescription for all the exercises is one set, 10 repetitions, five times per day with progression during follow-up physiotherapy outpatient visits. A follow-up appointment for outpatient physiotherapy is arranged. Patients will follow-up once per week for 6 weeks. The WOMAC questionnaire will be completed again at 6 weeks and 3 months after surgery.

Upon completing the prospective cohort study, a retrospective comparison with data from our historical control will be conducted including a simple cost comparison.

Outcome measures

Length of stay is frequently used as an outcome measure after hip and knee arthroplasty surgeries and will be measured in hours to be more precise and to be able to detect more effectively any small changes in the time period. Length of stay will be measured in hours from when the patient goes to the theatre to when the patient is discharged to be accurate (McCulloch et al. 2017).

The WOMAC, a patient-administered questionnaire, is a widely used, valid and reliable outcome measure in patients with hip and knee arthroplasty. It measures pain, stiffness and physical function (Collins et al. 2011; Giesinger et al. 2015). Cronbach's coefficient alpha scores are 0.86 for pain, 0.90 for stiffness and 0.95 for physical function. The reliability intraclass correlation coefficients scores are high measured at 0.88 for pain, 0.76 for stiffness and 0.91 for physical function (Bellamy et al. 1988; Söderman & Malchau 2000). The WOMAC score is rated on an ordinal scale of 0 to 4. Subscores or global scores are calculated, with lower scores indicating lower levels of pain, stiffness and physical disability. Data collected from the WOMAC will be analysed against patient satisfaction measured on a 5-point Likert scale (extremely satisfied, satisfied, neutral, dissatisfied and extremely dissatisfied). According to answers, there will be two groups, satisfied (extremely satisfied and satisfied) and unsatisfied (neutral, dissatisfied and extremely dissatisfied) (Thambiah et al. 2015). The WOMAC questionnaire will be administered pre-operatively and repeated at 6 weeks and 3 months post-operatively. Walker et al. (2018), identified values for the total WOMAC scores that are predictive of patients' level of satisfaction.

The proposed protocol's safety will be measured with the 30-day readmission rate. Unplanned readmissions within 30 days after the patient is discharged from the hospital will be documented (Rumball-Smith & Hider 2009). Finally, the direct cost of LOS will be compared in a mini cost analysis between the prospective and historical cohorts by calculating the cost of direct hospital expenses incurred per day, theatre time, assistive devices (crutches or walking frames), prosthetics, physiotherapy fees and orthopaedic specialist fees.

Data management

All data obtained will be safely kept electronically on the researcher's password-protected computer for 6 years if not published and 2 years if published. The informed consent and questionnaire hard copies will also be stored securely in the first author's code-protected office for 6 years.

Statistical analysis

Descriptive statistics, namely frequencies and percentages for categorical data and mean and standard deviation or median and percentiles for numerical data, will be calculated. Quantitative outcome variables will be tested for normality using the Shapiro–Wilk test. International Business Machines Statistical product and service solutions (IBM SPSS) version 27 will be used to analyse the data. A paired t-test will

be used to analyse each of the outcome measures across the time periods if data are normally distributed. Length of stay, WOMAC score and cost data will be summarised using median and interquartile ranges and compared between the two groups, using a non-parametric Mann–Whitney U test. The occurrence of adverse events will be compared between the two groups using Pearson's chi-square tests. Sub-group analysis will be performed based on age, gender and type of arthroplasty performed. The confidence interval will be set at 95% and power of probability of p = 0.05 will be considered statistically significant.

Validity and reliability

Validity will be ensured by using consistent, standardised verbal instructions during the protocol. Reliability will be improved by collecting the data in a standardised environment and implementing standardised procedures.

Ethical considerations

The trial is registered with the Pan African Clinical Trial Registry (PACTR202103637993156). Ethical clearance was obtained from the University of the Witwatersrand Human Research Ethics (Medical) Committee (reference number: M200576), the orthopaedic surgeon and manager of the private hospital in Rustenburg. Permission for data from hospital records for the data collection in the main prospective and historical cohort group will be obtained. Information will be given to prospective participants and written permission to participate in our study will be requested.

Discussion

Hip and knee pain because of osteoarthritis is one of the leading causes of pain, disability and decreased life quality. Hip and knee arthroplasties have become the answer for optimal function and quality of life. Using an ARP pathway in hip and knee arthroplasty surgeries on patients waiting for elective surgeries may decrease the already long waiting lists (Wainwright 2021) in the public sector and address the backlog in the private sector in SA.

Accelerated rehabilitation protocol has become very popular internationally and is gaining popularity in SA (Immelman et al. 2018; Riemer et al. 2017). A multidisciplinary team in Rustenburg, SA, has started implementing an ARP affecting LOS, with the first same-day discharge from the hospital. The costs saved because of a decrease in LOS

may be beneficial for medical funders, stakeholders such as the government as they plan to implement the NHI in the future.

There is a lack of evidence on the physiotherapy protocol in the ARP (Anderson et al. 2021). Thus, the proposed study investigates the physiotherapy protocol on how early mobilisation and increased frequency of physiotherapy treatments, that is, twice per day, for participants after hip or knee arthroplasty surgery on POD 0 in a private hospital in SA affects outcomes. The outcomes include LOS in hours and not days, patient satisfaction (pain, function, stiffness and expectation) with the WOMAC, safety by documenting any readmission within 30 days of the hip and knee arthroplasty, with an added simple cost comparison between the prospective and historical cohorts to indicate any cost-savings if present.

Conclusion

Our study will determine the LOS, patient satisfaction, safety and cost comparison of early mobilisation and frequency of physiotherapy compared with a historic physiotherapy protocol. The feasibility of a physiotherapy protocol in an ARP will thus be evaluated and may provide a cost-effective rehabilitation method in a resource restraint SA.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

R.P. conceptualised the idea, wrote a physiotherapy protocol and proposed the topic of research. M.M.K. assisted in the refinement of the topic and proposal. R.P. and M.M.K. wrote the first draft of the article. The article was read, elaborated and refined by R.P. and M.M.K.

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Data availability

The authors confirm that the data supporting the findings of this study are available within the article and/or its supplementary materials. Any future results will be made accessible on the author's ORCID accounts.

Disclaimer

The views expressed in the submitted proposal by the authors are their own and not an official position of the institution or funder.

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3.7 Summary

Chapter Three included the proposal and detailed methodology and physiotherapy protocol for the proposed quantitative cohort study. The results for this study will be presented in chapter four in the form of an article submitted for publication.

Chapter 4 Results Article

4.1 Introduction

Chapter Four is presented as a submitted article under review with the South African Journal of Physiotherapy. It includes an abstract and background/introduction on OA and the effective surgical management through hip and knee arthroplasty. The role of physiotherapy to decrease hospital LOS and cost as part of a multi-disciplinary ARP while providing effective, safe and good quality of health care are demonstrated. The null hypothesis, problem statement and significance of the study are again presented and elaborated on in this chapter and the objectives stated. Although covered in detail in chapter three the methodology is described in short followed by outcome measures, data management, statistical analysis and ultimately the results and the discussion.

4.2 Publication details

In conducting the quantitative cohort study, the aim was to determine how early mobilisation and increased frequency of physiotherapy on POD 0 impact the hospital LOS, safety, patient satisfaction and cost, after hip and knee arthroplasty in a private hospital in SA.

4.3 Journal details

Table 4.1 Publication specifics

Title of publication	Same-day discharge after early mobilisation and increased frequency of physiotherapy following hip and knee arthroplasty
Authors	Retha-Mari Prinsloo and Monique Marie Keller
Journal name	South African Journal of Physiotherapy
Year	2022

4.4 Author contributions

Table 4.2 Author contribution details

	Prinsloo	**Keller**
Conceptualisation	**X**	
Methodology And physiotherapy protocol	**X**	
Data collection	**X**	
Proposed topic of research	**X**	
Refinement of topic and proposal	**X**	**X**
Writing first draft	**X**	**X**
Read, elaborated, and refined article	**X**	**X**
Project administration	**X**	
Supervision		**X**

4.5 Permissions and rights

The corresponding author contacted the editor of the journal to notify the editor of the inclusion of the article into a research report.

4.6 Article

Same-day discharge after early mobilisation and increased frequency of physiotherapy following hip and knee arthroplasty

Abstract

Background

Advanced rehabilitation pathway (ARP) after total hip and knee arthroplasties is popular globally and is gaining ground in South Africa (SA) (Immelman et al. 2018,

Riemer et al. 2017). A multidisciplinary team in Rustenburg, SA, has implemented an ARP with the first same-day discharge (SDD) from the hospital. The lack of evidence on physiotherapy protocols within an ARP determined this study.

Methods/design:

A quantitative prospective patient (treatment) group (n=60) receiving early mobilisation with increased frequency of physiotherapy on post-operative day zero (POD0) was compared to a conservatively managed retrospective historical (control) group (n=60) following post-operative elective hip and knee arthroplasties. Outcome measures included hours for hospital length of stay (LOS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) for patient satisfaction (pain, function, stiffness, and expectation), 30-day readmission for patient safety, and a simple cost comparison between the two cohorts.

Results:

Results for the prospective group which were significantly improved relative to the retrospective group included decreased LOS (median 7.650, $p<0.001$), less pain at six weeks (mean 16.20, SD=2.673, $p<0.001$), less stiffness (mean 5.82, SD=1.214, $p=0.007$), higher function (mean 54.87, SD=8.544, $p<0.001$) and lower hospital cost (mean R43340, $p<0.001$), physiotherapy cost (mean R1069, $p<0.001$) and total costs compared to the retrospective group (mean R117062, $p<0.001$).

Clinical Implication:

Achieving safe SDD after total hip and knee arthroplasty surgeries saved costs and improved patient satisfaction with a decrease in LOS being beneficial for medical funders and stakeholders including government aiming to implement National health insurance (NHI) in the future.

Conclusion:

Safe and cost-effective SDD is possible in an ARP with earlier mobilisation and increased frequency of physiotherapy on POD0.

Keywords: length of stay, early mobilisation, physiotherapy, arthroplasty, replacement, hip, nee

Background and Introduction

Osteoarthritis (OA) is a chronic degenerative joint disease that can affect any joint (Contartese et al. 2020). OA affects women more than men and can decrease function and independence, thus reducing quality of life (Hawker et al. 2019). Individuals living with symptomatic hip and/or knee OA number an estimated 242 million (3.8% of the world population) people worldwide (Carlesso et al. 2016). Musculoskeletal and orthopaedic diseases such as OA is on the rise in SA due to lifestyle changes, obesity, increased life expectancy, trauma, and the high incidence of human immunodeficiency virus (HIV) (Plenge et al. 2018).

Hip and knee arthroplasty has been effective as interventions for end-stage OA since the 1970s, treating pain, stiffness, decreased function and quality of life where conservative treatment methods failed (Sculco & Pagnano 2015; Gademan et al. 2016). In the United States of America (USA), the demand for joint arthroplasties are predicted to increase by 174% for hips and 673% for knees by 2030 from the demand in 2007 (Kurtz et al. 2007). According to Rupp et al. (2016) it is predicted that joint arthroplasties will increase by 23% for hips and 45% for knees in Germany between 2016 and 2040.

The increased demand for hip and knee arthroplasties creates an enormous financial strain on the SA health care system. Elective surgeries being postponed during the Covid 19 pandemic to prioritise hospital resources and staff towards the care of Covid -19 patients led to extended waiting times, further delaying elective hip and knee arthroplasties (Lancet 2021; Anderson et al. 2021).

Multidisciplinary ARP's have been introduced globally to deliver good quality health care in a cost-effectively safe manner while improving patient satisfaction and outcomes when compared to more conservative protocols (Immelman et al. 2018; Plenge et al. 2018; Riemer et al. 2017; Robertson et al. 2015; Tayrose et al. 2013). Implementing an ARP, there is several ways to decrease the cost of arthroplasties, one being pre-operative education and early mobilisation that decreases LOS and post-operative complications (Riemer et al. 2017). These ARP pathways focused on standardised care, including patient education, multi-modal opioid-sparing pain control, thromboprophylaxis, restricting blood loss during surgery, and early mobilisation (Lazic et al. 2018; Riemer et al. 2017).

Prolonged hospital stay is associated with increased mortality and morbidity following joint arthroplasty (Maempel et al. 2016, McCulloch et al. 2017; Lasic et al. 2018). By

safely implementing ARP and gradually decreasing hospital LOS, these pathways led to SDD joint arthroplasties in Europe and the USA (Yates et al. 2018). Same day joint arthroplasty refers to patients being discharged on the same calendar day as the surgery (McCulloch et al. 2017). Jean-Yves & Gisonni (2022) suggested that reluctance to use ambulatory or SDD was based on concerns for increased complication rates. Multiple studies found that there was no significant increase in complication rate with SDD when compared to longer LOS (Jean-Yves & Gisonni 2022; Bovonratwet et al. 2020; Kelmer et al. 2021). Common complications identified in these studies are stiffness, delayed wound healing, infections, dislocation and fractures, thromboembolic complications, swelling and pain. Continues improvement of pre-operative education on home medication and oedema management will further decrease risk of complications (Kelmer et al. 2021)

As part of the multidisciplinary team, physiotherapists play an essential part of the ARP with patient education and early mobilisation. Pre-operative education decreases patient expectations, improves patient knowledge, improves knee flexion range of movement, and improves post-operative performance specifically exercises and functional activities (Jordan et al. 2014). The combination of education and early mobilisation decreases hospital LOS and the cost of knee arthroplasty (Jordon et al. 2014). Early mobilisation POD0 decreases hospital LOS significantly (McCulloch et al. 2017; Masaracchia et al. 2017; Lazic et al. 2018; Tayrose et al. 2013; Riemer et al. 2017; Yakkanti et al. 2019), decreases post-operative complications like deep venous thrombosis, infections related to the prosthesis and postural hypotension (Chen et al. 2012; Dossett et al. 2017). In a systematic review and meta-analysis, Masaracchia et al. (2017) found that early initiation of rehabilitation one to four hours post-operative (Tayrose et al. 2013; Raphael et al. 2011) on the day of surgery decreases the LOS without increasing adverse events or readmission rate in patients following joint arthroplasty surgery.

Several factors have been identified in studies that can make early mobilisation easier. Opioid-sparing pain control decreases dizziness, nausea, orthostatic hypotension, and sleepiness and the absence of surgical drains and urine catheters makes mobilisation easier and improve patient independence (Lasic et al. 2018; Sharma et al. 2016). Using the tourniquet sparingly during surgery and at appropriate pressures is associated with decreased post-operative pain, and the combination of general anaesthesia and local infiltration anaesthesia has fewer post-operative complications and allows for early mobilisation since the motor function is preserved (Marques et al. 2014). Quick patient

transfers from the recovery room to the ward and the availability of physiotherapists even for patients returning from theatre late in the day, allows for early mobilisation of patients and therefore may decrease LOS (Guerra et al. 2015).

Despite arthroplasty being a cost-effective way of treating OA and the progress made in decreasing LOS in the hospital, studies indicate a 10% for total hip arthroplasty (THA) and 20% for total knee arthroplasty (TKA) patient dissatisfaction with outcomes (Gill et al. 2013; Gunaratne et al. 2017). Follow-up periods for studies included three months up to 3.5 years with one-year post-operative the most common follow-up period following arthroplasty surgery (Gunaratne et al. 2017). Factors such as pre-operative patient expectations and post-operative pain, stiffness, function, and complications influence patient satisfaction (Gill et al. 2013; Walker et al. 2018). Patients expect a decrease in pain and stiffness and improvement in function and quality of life following an arthroplasty (Thambiah et al. 2015; Gunaratne et al. 2017).

Since implementing an ARP with early mobilisation POD0 at a private hospital the average LOS decreased from 3.5 days to 23 hours. Physiotherapy as part of the multidisciplinary ARP plays a vital role, and with a lack of studies in this area on best evidence practice for arthroplasty management in SA the aim of this study was to investigate the effect of early mobilisation and increased frequency of physiotherapy on POD 0 on patient outcomes following elective hip and knee arthroplasty in a private hospital in SA.

Problem statement

The projected demand for joint arthroplasty is ever increasing. The COVID 19 pandemic led to this demand rising even more due to the postponement of elective surgeries impacting patient waiting lists. The increased demand adds an enormous financial and resource burden on private and public healthcare funders and, even more so with the NHI fast approaching in SA. There is a need for cost-effective quality health care without compromising patient care while improving patient-reported outcomes and patient satisfaction. Globally ARP’s have been successfully implemented to address this increased demand with physiotherapy playing a vital role. This approach is however new in SA. The lack of studies done in SA on physiotherapy protocols in the ARP with early mobilisation and an increased frequency of physiotherapy intervention on POD0 and its effect on LOS and patient satisfaction was the reason for this research being conducted

Significance of the study

Despite current COVID 19 pandemic challenges, the patient, the SA health sector, private, public, and the proposed NHI will benefit from the advantages from implementing ARP's. With LOS within 24hours the focus will shift to same day discharge to address the increased demand and long waiting lists for joint arthroplasty with quicker bed turn-around time. Thus, the proposed multi-disciplinary ARP with early mobilisation with increased frequency of physiotherapy treatment on the day of surgery might improve patient outcomes and satisfaction following hip and knee arthroplasty. Providing good quality health care while decreasing hospital LOS might also lead to considerable cost saving enabling stakeholders to possibly assist greater volumes of patients with available resources.

Objectives

The objectives of the study were:

To determine how increased frequency of physiotherapy with early mobilisation on POD 0 impacts hospital LOS in mean hours, as the primary outcome, rather than in days in patients after hip and knee arthroplasty.

To determine patient satisfaction (pain, function, stiffness, and expectation) six weeks and three months post-operative.

To evaluate the safety of implementing an ARP by documenting the 30-day readmission rate and any adverse event for patients after hip and knee arthroplasties.

To determine and compare the costs of LOS, by calculating the cost of direct hospital expenses incurred including, theatre time, prosthetics, assistive devices (walking frames or elbow crutches), physiotherapy fees, Anaesthetist and Orthopaedic specialist fees, in a plain cost comparison between the cohort groups.

Methods/design

This prospective cohort study included a purposive convenient, selected sample of patients (n=60). With the margin for error set on 0.05 and a power of 95%, we calculated that (n=53) patients were required for the study to compare the two cohorts.

The ARP guided the management following hip and knee arthroplasty surgery. The prospective cohort was compared to a retrospective control group (n=60), managed with a more conservative protocol. The sample size was determined by the total number of patients who underwent either a total hip or knee arthroplasty in the retrospective control group year at the private hospital performed by the orthopaedic surgeon who implemented the ARP and consented to the study. The setting and multidisciplinary team for both the prospective treatment group and retrospective control group were the same. The multidisciplinary team for all surgeries consisted of an orthopaedic surgeon, anaesthetist, physiotherapist, and nursing staff. The protocols stayed consistent throughout the study. The physiotherapy protocol for the retrospective control group included early mobilisation with exercises three hours post intervention on POD 0. The prospective physiotherapy protocol included early mobilisation with exercises one to three hours post-operative on POD 0 and a second mobilisation with exercise session one to two hours later. The physiotherapy protocol included the pre-intervention physiotherapy session, assessments of outcomes, a session after returning from the recovery room, the post-intervention assessment and session and criteria before discharge (Prinsloo & Keller 2021).

All consecutive elective hip and knee arthroplasty patients cleared pre-operatively by the anaesthetist or general physician (depending on co-morbidities) as per the ARP protocol were included. Participants received information regarding the study, and informed consent was obtained. Patients excluded were trauma- related arthroplasty, bilateral arthroplasties, revision surgery, cognitive deficiencies and patients with poor balance. Patient s with conditions affecting their balance or poor balance observed during the education sessions by either the orthopaedic surgeon or the physiotherapist were excluded from the study. Demographically the prospective and retrospective groups were matched according to age, gender, body mass index (BMI), and type of arthroplasty.

Patients in both the retrospective and prospective cohorts received the same multi-disciplinary ARP management and protocol at Medicare private hospital in Rustenburg, the difference being the time before the first mobilisation and the frequency of physiotherapy intervention on POD0. The previous more conservative protocol included a pre-operative education session in the hospital and patients mobilising once on POD0, three hours post-operative. With the new protocol, patients received an education session the week before surgery, mobilising one to three hours post-operative (Tayrose et al. 2013; Raphael et al. 2011) and then again for a second time

one to two hours after the first session. Standardised verbal instructions and procedures were used in a standardised environment when collecting data to ensure and improve reliability with the outcome measures listed below.

Outcome measures

LOS is often used as an outcome measure following hip and knee arthroplasty and measured in mean number of days. LOS was measured in hours to be more accurate and to detect subtle changes in LOS more effectively (McCulloch et al. 2017). LOS was calculated from the time the patient went to theatre until discharge.

The WOMAC is a frequently used, valid, and reliable outcome measure for patients following hip and knee arthroplasty surgery measuring the total score and sub scores for pain, function, and stiffness (Collins et al. 2011; Giesinger et al. 2015). The score is calculated according to an ordinal scale of 0 to 4. However, recent studies (Walker et al. 2018) have used a reverse scale from 4 to 0 (none, mild, moderate, severe, extreme) with a total score of 100 being the best possible outcome and 0 being the worst possible outcome. For this study, we used the reversed scale to score.

Patient satisfaction was measured as suggested by The International Society of Arthroplasty registries patient-reported outcome measure (PROMs) working group, using a 1-item satisfaction outcome (Rolfson et al. 2016). A single question, "How satisfied are you with your hip/knee arthroplasty?" was posed to patients on a 5-point Likert scale (1-5) of extremely dissatisfied, dissatisfied, neutral, satisfied and extremely satisfied (Thambiah et al. 2015). Participants were then grouped as either satisfied (4-5) or dissatisfied (1-3).

Patient safety was measured by documenting any adverse events or readmissions within the first 30 days following surgery. Lastly the direct cost of hospital LOS was compared between the prospective and retrospective cohorts. Hospital (including theatre), orthopaedic surgeon, anaesthetist, physiotherapy, and assistive device costs were considered and included in the simple cost comparison.

Data management

Data were collected using datasheets and the WOMAC questionnaire. All data collected will safely be kept electronically on the researcher's password protected computer for ten years. Hard copies of all questionnaires and informed consent documents are stored for ten years in the researcher's code protected office. The researcher will destroy and delete all hard copies with participant information ten years after data collection.

Statistical analysis

Data analysis was performed by a statistician utilising the IBM SPSS version 27 and a p-value <0.05 was considered statistically significant. Descriptive statistics, namely frequencies and percentages for categorical data and means and standard deviations or medians and percentiles for numerical data, were calculated. Quantitative outcome variables were tested for normality using the Shapiro-Wilk's test in order to assess whether parametric tests were appropriate or not. If data were found to be normally distributed, parametric tests were used, and if not normal, non-parametric tests were used. Safety data were collected as binary data. Demographics were compared between the treatment groups using t-tests for quantitative demographic variables such as age, BMI, and chi square tests in the case of categorical demographics.

LOS was presented using median and inter-quartile ranges and for comparison between the two treatments groups using a non-parametric Mann-Whitney test since this variable was not normally distributed. WOMAC scores, were normally distributed and thus summarised using mean and standard deviation and a comparison between the two treatment groups using t-tests. Repeated measures ANOVA tests of the effect of time was used in the treatment group to assess the significance of the change in scores over the three-time points using the Wilk's lambda statistic. This was the appropriate test for comparison of three paired means in normally distributed data. The occurrence of adverse events was compared between the two treatment groups using Fisher's exact test. Cost of LOS data were summarised using median and inter-quartile ranges and the two treatment groups compared using non-parametric Mann-Whitney tests.

Results

The reporting of the results section is according to demographics, and thereafter the results per objective.

Demographics

There was no significant difference in the mean age (p=0.217) or BMI (p=0.903) between the groups as summarised in Table 1.

Table 1: Patient demographics as per age and BMI (n=120)

		Group		p-value*
		Retrospective Control	Prospective Treatment	
Age	Mean	62	59	0.217
	Standard Deviation	10	11	
BMI	Mean	31.89	31.74	0.903
	Standard Deviation	6.39	6.84	

*Independent samples t-test

The demographics of the study sample are shown per group according to gender and arthroplasty type (Table 2). There was no difference between the retrospective and prospective groups.

Table 2: Patient demographics as per gender and arthroplasty type (n=120)

		Group				p-value*
		Retrospective Control		Prospective Treatment		
		n	%	n	%	
Gender	Male	34	56.7%	29	48.3%	0.361
	Female	26	43.3%	31	51.7%	
	Total	60	100.0%	60	100.0%	
Type	TKA**	30	50.0%	33	55.0%	0.674
	PKA**	15	25.0%	11	18.3%	
	THA**	15	25.0%	16	26.7%	
	Total	60	100.0%	60	100.0%	

*****Chi square test

**Total knee arthroplasty=TKA; partial knee arthroplasty=PKA; total hip arthroplasty=THA

There was a statistically significant difference in LOS between the two groups (p<0.001). The median hours were much higher in the retrospective group (median = 43.15) than in the prospective group (median = 7.65), as seen in Table 3 below.

Table 3: Comparison of hospital length of stay in hours between groups (medians and inter-quartile ranges) (n=120)

		Group		p-value*
		Retrospective Control	Prospective Treatment	
LOS hours	Median	43.150	7.650	<0.001
	Percentile 25	27.133	6.292	
	Percentile 75	49.433	21.249	

*Mann-Whitney test

Data were normally distributed for the WOMAC subscale and there were no differences pre-operatively between the two groups, but at six weeks, each of the WOMAC scales and the total scores were statistically significantly different between the two groups (Table 4) in favour of the prospective group.

Table 4: Comparison of patient reported outcome WOMAC between groups (n=120)

Variable	Group	n	Mean	Std. Deviation	Std. Error Mean	95% CI of the difference	p-value*
Pre-Operative Pain	Retrospective Control	60	8.18	3.661	.473	-1.034 to 1.700	0.630
	Prospective Treatment	60	7.85	3.896	.503		
Pre-Operative Stiffness	Retrospective Control	60	2.83	1.758	.227	-1.099 to .299	0.259
	Prospective Treatment	60	3.23	2.094	.270		
Pre-Operative Function	Retrospective Control	60	27.00	11.102	1.433	-2.811 to 5.611	0.512
	Prospective Treatment	60	25.60	12.166	1.571		
Total WOMAC score pre-operative	Retrospective Control	60	39.67	15.454	1.995	-4.077 to 7.277	0.578
	Prospective Treatment	60	37.93	17.292	2.232		

6/52 Pain	Retrospective Control	60	13.72	2.464	.318	-3.413 to -1.554	<0.001
	Prospective Treatment	60	16.20	2.673	.345		
6/52 Stiffness	Retrospective Control	60	5.22	1.180	.152	-1.033 to -.167	0.007
	Prospective Treatment	60	5.82	1.214	.157		
6/52 Function	Retrospective Control	60	49.68	5.655	.730	-7.803 to -2.564	<0.001
	Prospective Treatment	60	54.87	8.544	1.103		
Total WOMAC score at six weeks	Retrospective Control	60	71.58	8.280	1.069	-12.622 to -5.043	<0.001
	Prospective Treatment	60	80.13	12.022	1.552		

***** t-test

Patient satisfaction up to three months in the treatment group

Pain, stiffness, function and total WOMAC scores increased statistically significantly over time in the treatment group (p<0.001). Figure 1 shows the means of the total score over time at 95% confidence intervals. The highest change was between the pre-operative and six-week periods.

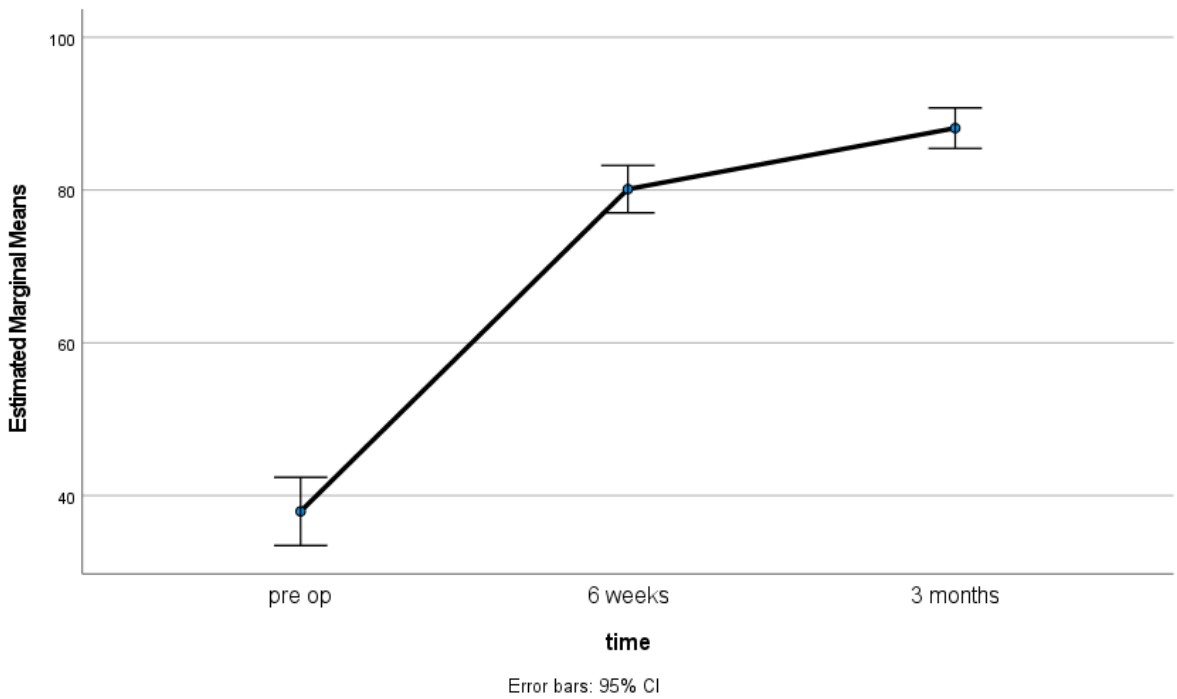

Figure 1: WOMAC mean total score over time with 95% CI in the treatment group

A single question, "How satisfied are you with your hip/knee arthroplasty?" was posed to patients three months post-operative on a 5-point Likert scale (1-5) of extremely dissatisfied, dissatisfied, neutral, satisfied and extremely satisfied (Thambiah et al. 2015; Rolfson et al. 2016). Participant's responses were then grouped as either satisfied (4-5) or dissatisfied (1-3). In our study, 98% of participants indicated that they were satisfied, and only 2% (n=1) of patient was dissatisfied, with one patient indicating no relief in pain

The results regarding the adverse events indicated that there were six readmissions. In the control group, 6.7% (n=4) participants were readmitted, and in the treatment group, 3.3% (n=2) participants were readmitted. The difference was small and not statistically significant (p=0.679 – Fisher's exact 2-sided test), as seen in Table 5 below. The estimated difference between the groups in terms of readmission was 3.4% (95% CI-4.3% to 11.18%). In the control group two patients were re-admitted within 30-days with pneumonia, one with pain and one for urine retention. In the treatment group severe swelling and COVID were documented as reasons for re-admissions within 30-days after the arthroplasty was done. It was noted that the COVID positive case could not be directly linked to the patients stay in hospital.

Table 5: Comparison of patient safety 30-day readmission rate between the two groups

			Group		Total
			Retrospective Control	Prospective Treatment	
Readmission	0	n	56	58	114
		%	93.3%	96.7%	95.0%
	1	n	4	2	6
		%	6.7%	3.3%	5.0%
Total		n	60	60	120
		%	100.0%	100.0%	100.0%

*Fisher's exact 2-sided test

There was a statistically significant difference in the hospital costs (p<0.001) between the groups, with the retrospective group having higher hospital costs than the prospective group. The findings were similar for physiotherapy costs (p<0.001) and

total costs (p<0.001). However, prosthesis costs were significantly higher in the prospective group (p=0.004) (Table 6).

Table 6: Simple in-hospital cost comparison between groups (median and inter-quartile ranges)

		Group		p-value*
		Retrospective Control	Prospective Treatment	
Hospital cost	Median	R 53703	R 43340	<0.001
	Percentile 25	R 48355	R 37072	
	Percentile 75	R 58937	R 48188	
Orthopaedic surgeon	Median	R 24910	R 24205	0.415
	Percentile 25	R 20000	R 22666	
	Percentile 75	R 33000	R 28250	
Anaesthetist	Median	R 8500	R 8034	0.811
	Percentile 25	R 6292	R 6244	
	Percentile 75	R 10467	R 8800	
Physiotherapy treatment	Median	R 1923	R 1069	<0.001
	Percentile 25	R 1600	R 832	
	Percentile 75	R 2327	R 1248	
Prosthesis	Median	R 36700	R 38350	0.004
	Percentile 25	R 35435	R 38000	
	Percentile 75	R 42171	R 39603	
Assistive devices	Median	R 881	R 673	0.416
	Percentile 25	R 521	R 485	
	Percentile 75	R 1318	R 1314	
TOTAL COST	Median	R 128416	R 117062	<0.001
	Percentile 25	124367	111636	
	Percentile 75	137157	125862	

*Mann-Whitney test

The average number of physiotherapy treatment sessions in the retrospective group was five, and two in the prospective group, with a statistically significant difference between the groups ($p<0.001$).

Ethical considerations

The trial is registered with trial number PACTR202103637993156 with the Pan African Clinical Trial Registry. Ethical clearance was obtained from The University of the Witwatersrand Human Research Ethics (Medical) Committee with ethics number M200576. Permission from the orthopaedic surgeon and Medicare private hospital manager in Rustenburg where data collection took place were obtained. Permission for using data obtained from the hospital records for the two cohorts were included. Information regarding the research and participation was given to prospective participants with a consent document asking for written permission. Participants participated in this study free of will and could withdraw at any time and without prejudice. No remuneration for participating was given to participants. The data obtained from the study remain confidential and anonymous. Identifiers were used on the outcome measures and will only be used for this purpose of this study. No treatment was withheld from a patient. Patients received treatment that is part of the standard procedure as per the doctor and hospital protocol, and there were no additional costs involved for participants

Discussion

The primary outcome measure LOS was measured in hours as suggested by McCulloch et al. (2017) to be more accurate in documentation, detect more minor changes, and decrease outlier distortion. With LOS below 24 hours, day-case arthroplasty could now be considered. Since implementing earlier mobilisation within one to three hours post-operative and increasing the frequency of treatment adding a second session one to two hours later, the results for this study indicated a statistically significant decrease in LOS with the prospective treatment group at 7.65 hours compared to the retrospective control group at 43.15 hours. There was no difference in LOS between the different types of arthroplasties ($p=0.283$). Supporting our study, numerous studies found that early mobilisation on POD0 following joint arthroplasty is associated with a significant decrease in LOS without an increase in adverse events (Masaracchio et al. 2017). Auyong et al. (2021), showed LOS to be reduced by 20

hours, and Yakkanti et al. (2019) found a significant decrease (p=0.002) in LOS in the group of patients that was out of the theatre by 17:00 and mobilising POD0 versus the group mobilising POD1. A meta-analysis of five randomised control trials showed a decrease in LOS by 1.8 days (43.2 hours) after early mobilisation on POD0 following hip and knee arthroplasty (Guerra et al. 2015). Reasons for delayed discharge were identified as a lack of physiotherapy resources, delayed transfers from the recovery room back to the ward, using motor nerve blocks affecting the lower limb muscle motor control, and low patient motivation levels (Guerra et al. 2015). A multidisciplinary approach is needed to optimise patients' pre-operatively, using multi-modal opioid-sparing analgesia and early mobilisation to ensure early discharge (Yakkanti et al. 2019). In our study all patients received a combination of general anaesthesia and adductor canal block preserving muscle control, with swift transfer to the ward and mobilisation after one to three hours. Mobilisation was performed with the assistance of the physiotherapist on call to accommodate the increased demand to ensure early mobilisation and discharge. Patient motivation was optimised, and anxiety decreased in the pre-operative education session provided by the physiotherapist.

Jenkins et al. (2019), encouraged patients to avoid knee flexion following knee arthroplasty since the author thought it would increase swelling and pain, and delay mobilisation and discharge. By mobilising early on POD0 the LOS decreased and SDD was possible in 39% of patients, and 38% of patients were discharged on POD1. Our patients started knee flexion exercises immediately after their TKA surgery up to 90˚ with no delay in mobilisation found with 61.66% (n=37) patients with SDD and 33.33% (n=20) discharged POD1. In contrast to Jenkins et al we did not find early knee flexion to delay mobilisation or to delay discharge.

Lessen et al. (2006) found that increasing the frequency of treatment on POD0 from one to two sessions did not make a significant difference in LOS, pain, function, or knee ROM. This might be because their study protocol was not part of a multi-disciplinary ARP and no pre-operative education sessions were performed. In contrast to this, we experienced that those patients, who received only one session on POD0 in the retrospective control group tended not to mobilise again until they saw the physiotherapist the next morning. Firstly, patients seemed to not have the confidence to mobilise alone and secondly, nursing staff were reluctant to assist patients to mobilise to the toilet during the night and would instead use bedpans due to the fear that the patient may fall. In our prospective group, patients received a second session one to two hours after the first session and gained confidence in their own functional

ability and the belief that they would cope at home. A large percentage of patients could progress to climbing stairs and walk independently out of the hospital after discharge with their mobility aid. Patients that only mobilised the following morning for the second time showed readiness for discharge only the day following the surgery. From this, it seems that two physiotherapy sessions in the hospital on the day of the surgery led to the patient being ready for discharge and achieving discharge criteria sooner compared to only one physiotherapy session.

The number of physiotherapy sessions needed to get patients prepared for discharge is currently a relevant topic. Certain funders will allow patients three in-hospitals sessions but restricting providers to only one session per day. So, if the average amount of sessions needed for patients to be discharge ready is two sessions like we found in this study, the patient would need to wait till the next day to receive the second session and therefore drastically increasing hospital cost versus the cost of the second physiotherapy session. Rules like these by funders should be reviewed not to hinder early and SDD. The role of physiotherapists in SDD should be recognised by funders and providers should be compensated accordingly. In our prospective treatment group 66% of patients achieved SDD through early mobilisation with increased frequency of physiotherapy. It is therefore recommended that if teams wish to progress to next day and eventually SDD, there should be a physiotherapist on call to mobilise patients out of bed on POD0 even when they return late from theatre. We also recommend that hip and knee arthroplasty patients are first on the theatre list to allow enough time to reach functional goals and discharge criteria set at their pre-operative education session.

Three months post operative, when posed a single question, “How satisfied are you with your hip/knee arthroplasty?” 98% (n=59) of participants indicated on a 5-point Likert scale (1-5) that they were satisfied, and only 2% (n=1) of patients were dissatisfied, with one patient indicating no relief in pain. This is similar to the 98% of patients being extremely satisfied in a study by Riemer et al. (2017) three months post-operatively. Only one patient felt stressed and hurried by early discharge associated with the rapid recovery pathway. Walker et al. (2018) found 89.7% of patients to be satisfied and only 10.3% unsatisfied following total knee arthroplasty out of 2589 patients indicating that The WOMAC post-operative score can be reliably used by the health care professional to classify patients' satisfaction following arthroplasty as ‘excellent, good, fair, and poor’ at one-year post-operatively as it is a measure of pain, function, and stiffness (Collins et al. 2011; Giesinger et al. 2015). We used the reversed scoring scale as suggested by Walker et al. (2021). No difference was found in the pre-

op WOMAC scores between the two groups. At six weeks post-operative, however, there was a significant difference between the two groups in favour of the prospective treatment group (P<0.001) indicating that the prospective group had favourable short-term outcomes in terms of decreased pain and stiffness and also improved function. This could be due to patients becoming independent and functional quicker with earlier and increased frequency of physiotherapy treatment POD0 and gaining confidence that they are able to cope on their own at home. Since there were no WOMAC scores available three months post-operatively for the retrospective group, this comparison was not possible. The mean total WOMAC score for the prospective group pre-operatively was 37.93 and three months post-operatively 87.34. Riemer et al. (2017) had a mean total WOMAC score pre-operatively of 35 and 85 at three months post-operative after implementing a rapid recovery protocol and early mobilisation on POD0 six hours after surgery. The frequency of treatment was also increased with mobilisation done two to three times per day. For pain, joint stiffness, and function scores, the prospective treatment group showed a statistically significant increase with less pain and stiffness, and higher function, as compared to the retrospective group. The greatest increase was seen between the pre-operative and six weeks post-operative participants' scores (p<0.001). Thambiah et al. (2015) also found that patients with increased WOMAC total and function scores were more satisfied. However, post-operative pain and stiffness were not statistically significant for patient satisfaction in their study.

To evaluate the safety of implementing an ARP with early mobilisation we compared the 30-day readmission rate or rate of adverse events between the two groups. In the retrospective group, 6.7%(n=4) of patients were readmitted compared to 3.3%(n=2) in the prospective group. Thus, the difference was small and statistically insignificant (p=0.679). With 61.66% SDD patients in the prospective group this result correlates with several studies that found earlier mobilisation with increased frequency of physiotherapy intervention on POD0 as part of an ARP can be implemented safely without an increase in adverse events (Riemer et al. 2017; Krause et al. 2018, Yakkanti et al. 2019; Thompson et al. 2021). The reasons for readmission in our study were due to a total hip replacement patients' family member being concerned about excessive swelling around the thigh area. The patient was admitted by the family general practitioner without consulting with the orthopaedic surgeon. This highlights the importance of educating the patients and family members/caregivers on expectations

following arthroplasty. Another patient was admitted with COVID-19, and this could not be linked to the patient's hospital stay during the arthroplasty.

In a simple cost comparison of direct in-hospital cost between the two groups, we found a statistical difference, with higher costs incurred in the retrospective control group ($p<0.001$). The total cost and cost of physiotherapy showed a statistically significant difference between the two groups, with the retrospective group having higher costs ($p<0.001$). The cost of physiotherapy decreased by 44.4% in the prospective group, and the reason for this is the decreased LOS and the average number of physiotherapy sessions decreasing from five sessions in the retrospective group to two sessions in the prospective group. There was no significant difference in the orthopaedic surgeon, anaesthetist, or assistive device cost per arthroplasty. Prosthesis costs however, were significantly higher in the prospective group ($p=0.004$). This might be due to more total knee arthroplasties than partial knee arthroplasties in the prospective group. In agreement with our study, several studies found early mobilisation associated with decreased LOS and total hospital cost. Schultz et al. (2019) found that early mobilisation decreased LOS from 3.4 days to 1.6 days ($p<0.001$) decreasing hospital cost by 24.7% while also decreasing post-operative complications. Similarly, Pelt et al. (2017) found that by changing physiotherapy shifts having a physiotherapist on call after hours for patients returning late from theatre, led to more patients mobilising early on POD0 a median cost saving of 28% were achieved in patients following total joint arthroplasty. There is a lack of research to determine the cost saving in physiotherapy fees following early mobilisation as part of an ARP. Thompson et al. (2021) found in a systematic review of 13 manuscripts and 3370 patients of day-case total knee arthroplasties that both the patient and healthcare system benefit from decreased LOS with decreased cost, improved patient outcome in terms of function, decreased post-operative complications and 30-day readmission rate.

A limitation to the study was the retrospective nature of the control group. Due to the nature of the ARP, it was not possible to have a prospective control group since the Orthopaedic surgeon no longer make use of the old protocol. Another limitation was that WOMAC scores were not available for the retrospective control group for comparisons to be made at three months post-operative. A future suggestion for research is to compare outcomes at six weeks, three months, and one-year post-operative. A strength of the study is that, to our knowledge, it is the first study disseminating the results following the implementation of a detailed and documented

physiotherapy protocol for hip and knee arthroplasty in an ARP. It is also the first study on early mobilisation and frequency of physiotherapy in South Africa, with results leading to SDD. A further strength is that the study included a cost comparison augmenting the lack of studies in this field.

Conclusion

SA is in the position to use the latest protocols to ensure individuals waiting for hip and knee arthroplasty surgeries that have been delayed due to Covid-19 receive earlier, safe, and more cost-effective management. Reaching SDD requires a multidisciplinary approach. This study demonstrated that SDD is possible in SA in patients following hip and knee arthroplasty by implementing a multi-disciplinary ARP. Physiotherapy with patient education, early mobilisation and increased frequency of treatment on POD0 and as part of this ARP led to decreased LOS, improved patient reported outcomes and satisfaction in a safe and cost-effective manner.

List of abbreviations

ARP: Advanced rehabilitation pathways

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

SDD: same day discharge

LOS: length of stay

NHI: National Health Insurance

OA: osteoarthritis

POD 0: post-operative day 0

SA: South Africa

USA: United States of America

BMI: Body Mass Index

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Competing interests

The authors Retha-Mari Prinsloo and Monique M. Keller declare no competing interests.

Authors' contributions

Retha-Mari Prinsloo conceptualised the idea, wrote the physiotherapy protocol, collected the data, and proposed the research topic. Monique M. Keller assisted in the refinement of the topic of research and proposal. Retha-Mari Prinsloo and Monique M. Keller wrote the first draft, read, elaborated and refined the article.

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Ethical approval

The University of the Witwatersrand Human Research Ethics (Medical) Committee approved this research with the number M200576.

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials. Results will be made accessible on the author's ORCID accounts.

Disclaimer

The views expressed in the submitted study by the authors are that of her own and not an official position of the institution or funder.

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4.7 Summary

In Chapter Four the results of the proposed quantitative cohort study as set out in the published article in chapter three, is presented. These results will now be further discussed in Chapter Five.

Chapter 5 Discussion and Conclusion

5.1 Introduction

In Chapter Five the findings of the study will be discussed referring to current and relevant literature. The chapter also includes a section covering the clinical implication of the findings and finally a conclusion is given.

5.2 Discussion

OA is a degenerative joint disease affecting approximately 3.8% of people globally (Carlesso et al. 2016) and is known to decrease function and quality of life (Hawker, 2019). Hip and knee arthroplasty has been shown to be effective in the treatment of patients with hip and knee OA not responding to conservative treatment (Sculco and Pagnano, 2015). It is predicted that the already high demand for hip and knee arthroplasties will increase substantially over the next decade (Kurtz et al. 2007; Rupp et al. 2016). The current COVID-19 pandemic increased this demand with elective surgeries being postponed accommodating for the care of COVID-19 patients as priority (Anderson et al. 2021). Despite elective surgeries now being active again the backlog as aftermath of the pandemic and the prior existing backlog especially in the public sector, is now even greater. This increased demand putting a greater financial and resource burden on private and public health sectors led to ARPs being implemented with the private sector leading the way.

The goal of ARP's is to decrease hospital LOS and decrease cost through implementation of standardised care providing good quality health care in an economically viable manner without compromising the patient's safety. An ARP is dependent on a multi-disciplinary approach with the aim to decrease hospital LOS and therefore cost by optimising the patient's health before admission and standardising care during hospitalisation. It is each member of the multi-disciplinary teams' responsibility to constantly improve and keep up with best evidence practice ensuring early and save discharge. Increased hospital stay is associated with increased mortality and morbidity (Maempel et al. 2016). Following a visit to the USA the orthopaedic surgeon at a private hospital in Rustenburg, SA, started to implement such an ARP for hip and knee arthroplasty patients. During this study we found good communication between different disciplines to be essential in helping to develop the best protocol. An example of this is the physiotherapist communicating with the team the amount of nausea or dizziness or the absences thereof, experienced by the patient

post-operative and linking that with any changes made in the opioid sparing pain management protocol.

Physiotherapy as part of the multi-disciplinary team plays a vital role in helping to optimise patients pre-operatively with patient education. During this education session, patient and physiotherapist expectations are addressed, pre- and post-operative exercises are demonstrated and practised while the patients are taught how to do transfers, mobilise, and navigate stairs with assistive devices. Patients are prepared for early discharge and home safety is discussed. Pre-operative education involving patients in their rehabilitation, decreases patient anxiety, decrease hospital LOS, improve patient satisfaction, and help with realistic expectation and goal setting (Moyer et al. 2017; Pennestri et al. 2019). This was also what we experienced during our study where patients felt well prepared, knowing what to expect during their hospital stay. Patients knew they would mobilise within one to three hours post-operative and they were willing and felt confident in their ability to do so and to achieve their discharge goals.

Our study has shown that physiotherapy contributed with early mobilisation and increased frequency of physiotherapy on POD0, leading to earlier discharge. Early mobilisation is beneficial to the patients as it decreases length of stay (McCulloch et al. 2017; Masaracchia et al. 2017; Lasic et al. 2018; Riemer et al. 2017; Yakkanti et al. 2019) the risk of DVT, postural hypotension and prosthesis related infections (Hui-wen et al. 2012; Dossett et al. 2017). Patients that did experience mild postural hypotension in the prospective treatment group were minimal and the hypotension was cleared up by the second treatment session with no delay in discharge.

The gradual decrease in LOS since implementing early mobilisation on POD0 over the last two years and then increasing the frequency of physiotherapy from one to two sessions on POD0 during the last year of our study led to patients being able to be discharged on the same day as surgery. It should be said that the decrease in LOS is due to all disciplines in the multi-disciplinary team improving their protocols as experience is gained along the way. SDD is not possible without a committed multi-disciplinary team. Preparing the patient during the education session for early mobilisation and discharge, quick transfers from theatre to the ward, decreased nausea and dizziness, absence of drainage pipes and urine catheters and good motor control of Quadriceps post-operatively (Guerra et al. 2016; Yakkanti et al. 2019), enable physiotherapists to mobilise patients within hours after surgery, achieving

functional goals and discharge criteria set in the pre-operative session within two sessions as shown in our study.

With initial implementation of early mobilisation on POD0 we would have a physiotherapist working after hours to also mobilise patients coming out of theatre late afternoon and even after 17h00. These patients were then mobilised out of bed three hours post-operative. We did however find that most of these patients did not mobilise to the toilet as requested during the night due to both the patients and the nursing staff not having the confidence and due to fear of falling. After mobilising the next morning with the physiotherapist most patients achieved all functional and discharge criteria and next day discharge was achieved with ease. This led us to believe that increasing the frequency of physiotherapy to two sessions on POD0 may lead to SDD and that together with a lack of research done in this area were the motivation behind our study. The number of physiotherapy sessions needed to get patients prepared for discharge is currently a relevant topic. Certain funders will allow patients three in-hospitals sessions but restricting providers to only one session per day. So, if the average amount of sessions needed for patients to be discharge ready is two sessions like we found in this study, the patient would need to wait till the next day to receive the second session and therefore drastically increasing hospital cost versus the cost of the second physiotherapy session. Rules like these by funders should be reviewed not to hinder early and SDD. The role of physiotherapists in SDD should be recognised by funders and providers should be compensated accordingly. In our prospective treatment group 66% of patients achieved SDD through early mobilisation with increased frequency of physiotherapy. It is therefore recommended that if teams wish to progress to next day and eventually SDD, there should be a physiotherapist on call to mobilise patients out of bed on POD0 even when they return late from theatre. By implementing shifts or a call roster it could ensure the availability of a physiotherapist to assist patients but also prevent more working hours for the therapist. We also recommend that hip and knee arthroplasty patients are first on the theatre list to allow enough time to reach functional goals and discharge criteria set at their pre-education session.

Patients and stakeholders benefit from decreased LOS with decreased cost, improved patient outcome in terms of function, decreased post-operative complications and 30-day readmission rate (Thompson et al. 2020). By decreasing LOS physiotherapy is important in decreasing direct in-hospital cost as shown in our study. There was a statistically significant decrease in total cost, hospital cost, and physiotherapy cost due to the decrease in LOS. Over the last decade more and more global fee structures

were introduced by medical aid funders where all stakeholders are paid from a fixed pool of funds. Although most stakeholders would be pleased with the cost saving associated with early or SDD, hospitals and physiotherapist might not be. It is however to be noted that the cost saving would in fact mean that more resources will be available to help more patients due to the increased demand. In dealing with the increased demand the provider will make up the income they would seem to have lost due to higher bed turnaround time.

Out-patient or SDD is not a new concept and like stated by Yates et al. (2018) Surgeons in America was instructed to implement out-patient protocols. SA will be no different as medical aids in SA are already signing on. It is not a single surgeon that is implementing an ARP leading to SDD, but rather a very brave one leading the way for others in SA."

The accelerated pathway for SDD is developed over a two to three years, and the high SDD rate may be due to more experience and iteration of the SDD process. Should hospitals or institutions wish to progress to SDD we suggest a slow and safe decrease in LOS from three to four days then two days till next day discharge is achieved. Only when the team is confident and comfortable with next day discharge can SDD be considered with careful selection of patients.

5.3 Conclusion

Reaching SDD requires a multi-disciplinary approach. Physiotherapy plays an important role with pre-operative patient education and earlier mobilisation with increased frequency of Physiotherapy on POD0. This decrease in LOS led to SDD, in a cost-effective manner improving patient reported outcome measure without compromising patient care and safety.

5.4 Summary

Although SDD and out-patient arthroplasty is common protocol in the USA and Europe it is new in SA. As far as known the first SDD was done during this study at our private hospital. SDD and out-patients joint arthroplasty is the future and physiotherapy, and all disciplines part of the multi-disciplinary team should strive to optimise their protocols to contribute to achieving good quality health care in a cost-effective and safe manner.

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Appendixes

i) Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG	HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Office of the Deputy Vice-Chancellor (Research & Post Graduate Affairs)

TO: Ms R-M Prinsloo
School of Therapeutic Sciences
Department of Physiotherapy
Medical School
University

E-mail: prinsloophysio@gmail.com

CC: Supervisor: Ms M Keller <Monique.Keller @wits.ac.za>
and <HREC-Medical.ResearchOffice@wits.ac.za>

FROM: Iain Burns
Human Research Ethics Committee (Medical)
Tel: 011 717 1252

E-mail: Iain.Burns@wits.ac.za

DATE: 2020/06/30

REF: *R14/49*

PROTOCOL NO: **M200576** *(This is your ethics application study reference number. Please quote this reference number in all correspondence relating to this study)*

PROJECT TITLE: *Early mobilisation and frequency of physiotherapy after hip and knee arthroplasty*

Please find attached the Clearance Certificate for the above project. I hope it goes well and that an article in a recognized publication comes out of it. This will reflect well on your professional standing and contribute to the Government funding of the University.

MSWorks2000/Iain0007/Clearscan.wps

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R14/49 Ms R-M Prinsloo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200576

NAME: (Principal Investigator)	Ms R-M Prinsloo
DEPARTMENT:	School of Therapeutic Sciences Department of Physiotherapy Medical School University
PROJECT TITLE:	Early mobilisation and frequency of physiotherapy after hip and knee arthroplasty
DATE CONSIDERED:	2020/05/29
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Ms M Keller
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/06/30

This clearance certificate is valid for 5 years from the 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 on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

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 submit details to the Committee. I agree to submit a yearly progress report. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **May** and will therefore reports and re-certification will be due early in the month of **May** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Prinsloo
Principal Investigator Signature

02/07/2020
Date

ii) Pan African Registration

29 March 2021

To Whom It May Concern:

RE: Early mobilisation and frequency of physiotherapy after hip and knee arthroplasty.

As project manager for the Pan African Clinical Trial Registry (www.pactr.org) database, it is my pleasure to inform you that your application to our registry has been accepted. Your unique identification number for the registry is **PACTR202103637993156**.

Please be advised that your trial is registered under an initiative within our system that allow us to capture data of trials that are already in progress or completed. As such, your trial registration may not adhere to the mandates set forth by the International Committee of Medical Journal Editors for registration requirements, and it is your duty to be transparent to any journal that may ask about the retrospective status of your registration.

Please note you are responsible for updating your trial, or for informing us of changes to your trial. Additionally, please provide us with copies of your ethical clearance letters as we must have these on file (via email or post or by uploading online) at your earliest convenience if you have not already done so.

Please do not hesitate to contact us at +27 21 938 0835 or email epienaar@mrc.ac.za should you have any questions.

Yours faithfully,

Elizabeth D Pienaar
www.pactr.org Project Manager
+27 021 938 0835

iii) Research Protocol

TICK LIST

SCHOOL OF THERAPEUTIC SCIENCES PROTOCOL SUBMISSIONS

The following documents should be submitted with each protocol (hard copy):

	Item	Tick Box
1	Full protocol (Hard Copy) including documents listed below: (Submitted to Mrs Irene Janse Van Noordwyk at Room 4B02, Level 4, Medical School)	√
1.1	- Front Page (fully completed)	√
1.2	- Front Page Signed by Supervisor	√
1.3	- Front Page Signed by Head of Department	√
1.4	- Front Page Stamped by Postgraduate Office	
2.	Memorandum of Agreement Form – signed by student and supervisor	√
3.	Appointment of Supervisor Form – signed by supervisor/s and Head of Department	√
4.	Plagiarism Form – signed by student	√
5.	Ethics Declaration Form	√
6.	Full protocol (Electronic PDF Copy) including all the above documents (Submitted to STSProtocol@gmail.com.)	√
7.	Full protocol (Hard Copy) including all the above documents (Submitted to Ms Palesa Khumalo at Phillip Tobias Health Sciences Building)	√
8.	Protocol should not exceed 10 pages (excluding front page, references and appendices)	√

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

CANDIDATE'S SURNAME: **PRINSLOO**	FIRST NAME: **RETHA-MARI**		STUDENT NUMBER: **2417859**
CURRENT QUALIFICATIONS: **B.Sc. Physiotherapy (UF)**			
TEL:	CELL: **0766988655**	E-MAIL: **prinsloophysio@gmail.com**	FAX:
DEGREE FOR WHICH PROTOCOL IS BEING SUBMITTED: **M.Sc. Physiotherapy Surgical Orthopaedics**			
PART-TIME OR FULL-TIME: **Part-time**			Sex: F **X** M
FIRST REGISTERED FOR THIS DEGREE:	TERM : **1st**		YEAR: **2020**
DEPARTMENT: **Physiotherapy**			
TITLE OF PROPOSED RESEARCH: **Early mobilization and frequency of Physiotherapy in hip and knee arthroplasty**			
CANDIDATE'S SIGNATURE:			DATE: 14/04/2020
SUPERVISOR 1 (NAME & SURNAME): Mrs Monique Keller			100% Supervision
SUPERVISOR'S QUALIFICATIONS: B Physiotherapy (UP), Masters in Hand Rehabilitation (UKZN)			
SUPERVISOR'S DEPARTMENT: Department of Physiotherapy			
SUPERVISOR'S ADDRESS / TEL / E-MAIL: 8 York Road, Parktown, 2193, 011 717 3715; monique.keller@wits.ac.za			
SUPERVISOR 2 (NAME & SURNAME):			% Supervision
SUPERVISOR'S QUALIFICATIONS			
SUPERVISOR'S ADDRESS / TEL / E-MAIL:			
SUPERVISOR 3 (NAME & SURNAME):			% Supervision
SUPERVISOR'S QUALIFICATIONS			
SUPERVISOR'S ADDRESS / TEL / E-MAIL:			

SYNOPSIS OF RESEARCH:(Brief summary of proposed research project; between 200-300 words only; with sub-headings: an introduction and justification for study, aim/s, proposed methodology and expected outcome/s)
[Use reverse side of this page if more space is required]

1. Background and Rationale

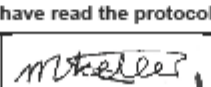
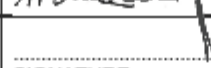
With National Health Insurance (NHI) fast approaching the increase in demand for joint arthroplasty will place an additional economic and resource burden on the health care system.

By 2030 the demand for THA will increase by 174% and TKA by 673% in the USA (Kurtz et al 2007). Studies found that Enhanced recovery after surgery (ERAS) or Advanced clinical pathways can be implemented safely and reduce length of stay (LOS) (Immelman et al 2018, Riemer et al 2017).

Physiotherapy plays an important role in the patient education and early mobilization part of these pathways.

In light of joint arthroplasty moving towards day-case surgeries, the research question posed is, How does time before mobilization and increased frequency of Physiotherapy intervention post-operative day zero (POD 0), affect length of stay?

Since implementing an Accelerated rehab pathway and early POD0 mobilization, at our, private hospital, the average LOS decreased from 3.5 days to 2.4 days.

WITS ETHICS NOT REQUIRED: Yes No WITS ETHICS PENDING: Yes No WITS ETHICS APPROVED: Yes No (circle appropriate symbol)* ***Please note the final human ethics clearance certificate or animal ethics certificate must be available prior to starting research**		IF Y SUPPLY ETHICS CLEARANCE CERTIFICATE AS ATTACHMENT AND INCLUDE ETHICS NUMBER HERE:
As supervisor/s, I/we confirm that I have read the protocol which has been submitted for assessment.		
SIGNATURE OF SUPERVISOR/S:		8 April 2020
PROTOCOL ACCEPTED BY HEAD OF DEPARTMENT/RESEARCH COORDINATOR	 SIGNATURE	11 April 2020 DATE
SIGNATURE PG OFFICE STAFF	REGISTERED YES..... NO.....	STAMP

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

SYNOPSIS OF RESEARCH CONTINUED

2. Aim of the Study

To investigate how early mobilization and increased daily frequency of physiotherapy on POD 0, impact the LOS and function in patients after hip and knee arthroplasty in a private hospital in South Africa.

3. Methodology

Prospective cohort study. Outcomes will be compared to our historical control group of 2019.

The historical cohort group comprise of 60 elective hip and knee arthroplasty patients operated in 2019, by the same Orthopaedic surgeon at Medicare Hospital, in Rustenburg, North-West province, SA. Patients were mobilized only once, 3 hours POD 0, as per Dr's protocol.

The prospective cohort group will comprise of the first 60 elective hip and knee surgeries in 2020. These patients will be under the new protocol where the Orthopaedic surgeon requested earlier mobilization and also increased frequency of Physiotherapy treatment on POD 0.

Outcome Measures will be LOS, WOMAC questionnaire, 30 day Re-admission rate and cost of LOS and Physiotherapy

4. Expected outcome: My hypothesis is that by starting early mobilization POD 0(1-3hours) and by increasing the frequency from 1 session to 2 sessions POD 0, the LOS would decrease further, without compromising patient's health or safety.

11 March 2019/MP

Early mobilisation and frequency of Physiotherapy after Hip and Knee Arthroplasty

Introduction

Increased life expectancy, lifestyle changes, obesity and non-communicable diseases, trauma, and HIV in South-Africa (SA) contribute to increased musculoskeletal and orthopaedic diseases like Osteo Arthritis (OA) (Plenge et al 2018). OA is one of the leading causes of chronic disability and also hip and knee pain (Lespasio et al 2017). Pain and symptoms from OA might affect the quality of life and function of patients. Hip and knee arthroplasty are very effective in the treatment of end-stage OA (Sculco and Pagnano 2015). In a study by Kurtz et al 2007, they determined that by 2030 the demand for total hip arthroplasty (THA) in the USA would increase by 174% and for total knee arthroplasty (TKA) by 673%. With National Health Insurance (NHI) on our doorstep, the cost of this increased demand will be substantial on the SA Health care system.

Considering the increased cost and burden on resources there has been a national as well as international shift towards multi-disciplinary approaches. The term Advanced clinical pathway (Plenge et al 2018), Fast track (Tayrose et al 2013), Accelerated rehabilitation protocol (Robertson et al 2015) and Rapid recovery, is drawing more and more attention world-wide when talking about hip- and knee arthroplasty. Numerous studies have shown that fast track or advanced clinical pathways can be implemented safely and effectively and reduce length of stay (LOS) in hospital, dramatically, without increase in complications when compared to conservative protocols (Lazic et al 2018, Robertson et al 2015, Riemer et al 2017). Due to the decreased LOS, the cost saving for the health care system is of great value, moving forward.

Only 2 studies were found on Enhanced recovery after surgery (ERAS) or Advanced clinical pathways, implemented in SA. These studies showed that such pathways can be implemented safely and reduce LOS (Immelman et al 2018, Riemer et al 2017).

Although differently named all these pathways focus on standardized care. Patient education, pain control, Thromboprophylaxis (preventing the formation of blood clots in blood vessels), managing blood loss during surgery and early mobilisation is key elements in these pathways (Lazic et al 2018, Riemer et al 2017). With pain control they focus on multi-modal, Opioid sparing regime to decrease nausea, dizziness, and sleepiness after surgery, thus helping the patient to be able to mobilise earlier. The use of Intermittent Pneumatic Compression Pumps (IPCP) post-surgery is helpful in Thromboprophylaxis. Depending on patient's risk profile, Aspirin or Clexane will be prescribed. Blood loss is restricted in surgery by controlled hypotension, no drainage pipes, using tourniquet at appropriate pressure only during the cementation part of the surgery and using tranexamic acid. Surgically a minimal invasive, muscle sparing approach, kinematic alignment and subcutaneous sutures with tissue adhesives contribute to rapid recovery (Lazic et al 2018).

By decreasing LOS these pathways led to out-patient joint arthroplasties in the USA and Europe. In 2018, TKA is no longer an in-hospital only procedure. According to Yates et al 2018, more than half of surgeons from the American Academy of Hip and Knee Surgeons were instructed by their hospitals to implement out-patient protocols.

One day or out-patient arthroplasty is clearly the way forward. “Get ahead and stay ahead” (Sculco and Pagnano 2015). In these cases, patients are discharged on the same day as the surgery. Currently, out-patient arthroplasty is not done in SA, yet.

According to studies, day-case, or out-patient total joint arthroplasty, can be implemented safely and is cost- effective and beneficial to patients, since increased LOS is associated with higher morbidity and mortality (McCulloch et al 2017, Lazic et al 2018)

Physiotherapy forms an integral part of the protocol with patient education and early mobilisation. Early mobilisation also helps to decrease post-operative complications like deep vein thrombosis (DVT), prosthesis related infections and postural hypotension (Hui-wen et al 2012, Dossett et al 2017). Physiotherapy also helps to improve patients function and muscle strength (McCulloch et al 2017, Hui-wen et al 2012).

Studies have shown that early mobilisation post-operative day zero (POD 0), play a significant role in decreased LOS (McCulloch et al 2017, Masaracchia et al 2017, Lazic et al 2018, Tayrose et al 2013, Riemer et al 2017, Yakkanti et al 2019). In a systematic review with meta-analysis of 17 studies, Masaracchia et al 2017, found that early initiation of rehabilitation on POD0, decreases LOS without increasing adverse events in patients following joint replacement surgery. Tayrose et al 2013, reported patients mobilising already in the recovery room, while others reported mobilising patients 2-4 hours POD0 (Raphael et al 2011).

Studies also showed that outcomes such as joint range of motion (ROM) and function is comparable at final follow-up for both out- and in-hospital TKA (Kolisek et al 2009). In THR the pain and Harris Hip score is also comparable at four weeks post-operatively (Goyal et al 2016)**.**

Despite the success of hip and knee arthroplasty, studies indicate a 10% and 20% patient dissatisfaction percentage for outcomes after Hip and knee arthroplasty, respectively (Gunaratne et al 2017). Patient satisfaction is dependent on factors such as residual pain and stiffness, post-operative function, post-operative complications as well as pre-operative patient expectations (Walker el al 2018). Expectations is usually based on improved function, decreased pain, decreased stiffness, and increase in overall quality of life (Thambiah et al 2015, Gunaratne et al 2017).

Since the Orthopaedic surgeon, implemented an Accelerated rehabilitation pathway and early POD0 mobilisation, at our, private hospital, the average LOS decreased from 3.5 days to 2.4 days. As part of this accelerated rehab pathway, patients received extensive pre-operative education by the Physiotherapist. This included explanation of protocol, pre-habilitation exercises, gait re-education and expectation. Patients were mobilised three hours post-operative POD 0 and then again, the next morning. Bed exercises and navigating stairs were also included in these sessions. The protocol for 2020 is the same, but patients now mobilise, as soon as they return from the recovery room, and they are fully awake, 1- 3 hours post-operative. Patients also mobilise twice per day on POD 0, with the Physiotherapist and not only once per day as in 2019 protocol. Patients receive the same bed exercises and navigate stairs with their crutches as soon as it is safe. Patients are only mobilised if it is safe to do so.

When talking about day-surgery, McCulloch et al 2017, makes a vital point that the measurement of LOS should be done in hours and not in days anymore, to be more

precise in documenting the time taken, before discharge. Some patients are only operated later in the day but might be discharged at the same time as the patient that was done first. To say that they have the same LOS is inaccurate. In light of joint arthroplasty moving towards day-case surgeries, the research question posed is, how does time before mobilisation and increased frequency of Physiotherapy intervention POD 0, affect length of stay, patient satisfaction (pain, function, stiffness and, expectation) and patient safety in hip and knee arthroplasty.

My null-hypothesis is that by starting mobilisation earlier POD 0(1-3hours) and by increasing the frequency from 1 session to 2 sessions POD 0, it would not influence LOS, pain, function and stiffness, with more complications post-surgically, compromising patient's health or safety.

Problem Statement

With National Health Insurance (NHI) fast approaching the increase in demand for joint arthroplasty will place an additional economic and resource burden on the health care system.

By 2030 the demand for THA will increase by 174% and TKA by 673% in the USA (Kurtz et al 2007)**.** There is currently a lack of studies done in SA on the effect of early mobilisation and the increased frequency of Physiotherapy intervention POD0, on LOS and patient satisfaction. LOS measured in mean days is not precise enough, whereas measurement in hours could be more sensitive to change. There is a need to decrease cost, by decreasing LOS, possibly through early mobilisation and increased frequency POD 0, without compromising patient safety while gaining improved function and patient satisfaction.

Aim

To investigate how early mobilisation and increased daily frequency of physiotherapy on POD 0, impact the LOS, safety, and patient satisfaction, after hip and knee arthroplasty in a private hospital in South Africa.

Objectives

To determine how early mobilisation and the increased frequency of physiotherapy on POD 0 impacts hospital LOS in mean hours rather than in days.

To measure patient satisfaction (pain, function, stiffness, and expectation) six weeks and three months post-operative, using The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

To evaluate the safety, of implementing, an Enhanced Rehab protocol, by documenting, any adverse event. (30-day re-admission date)

To determine and compare, the costs of LOS, by calculating cost of direct hospital expenses incurred per day, theatre time, assistive devices (crutches or walking frames), prosthetic, Physiotherapy fees, and Orthopaedic specialist fees, in a simple comparison.

Significance of the Study

In the event that early mobilisation and increased frequency of Physiotherapy intervention on POD0 lead to a decrease in LOS, this can be the way forward. Private health care as well as SA government and NHI can accommodate the increased

demand for joint arthroplasty, by effectively using the available resources and saving on costs. It is essential that good quality health care is provided in a cost-effective manner while improving patient reported satisfaction.
If LOS within an advanced clinical pathway could gradually be decreased to below 24 hours, out-patient Arthroplasty, might become a reality in the near future in South Africa.

Methodology

Type of Study

Prospective cohort study. Outcomes will be compared to a historical control group of 2019, managed in the same setting.
In 2020 data will be collected prospectively with the new protocol being followed as this is the standard routine followed by the Surgeon and the hospital. In 2019 a more conservative protocol regarding mobilization and frequency of Physiotherapy on the day of surgery was followed. All patients received the same treatment. Therefore, there is two cohort groups that will be compared. One prospective and one retrospective. In the prospective group, treatment cannot be withheld to form a conservative protocol group, since this will be unethical.

Participants

Site of Study

Medicare Private Hospital, Rustenburg, North-West province, SA.

Source of Participants

The historical cohort group comprise of 60 elective hip and knee arthroplasty patients operated in 2019, by the same Orthopaedic surgeon. Patients were mobilised only once, 3 hours POD 0, as per Dr's protocol.

The prospective cohort group will comprise of the first 60 elective hip and knee surgeries in 2020, after ethics clearance is obtained. These patients will be under the new protocol where the Orthopaedic surgeon requested earlier mobilisation and increased frequency of Physiotherapy treatment on POD 0.

Sample Size

The study population consist of all elective hip and knee arthroplasty done per year at Medicare Private hospital. The average number of elective hip and knee arthroplasties done at Medicare Private Hospital in Rustenburg per year is 65. Setting the level of significance at p = 5% (0.05) and power = 95%, will require a sample size of 56.
The 2019 historical control group consisted of 60 non-randomised patients that underwent elective hip and knee arthroplasty surgery at Medicare Hospital, Rustenburg under the old protocol. For this reason, a convenience sampling method was chosen to be used in this study so that the 2020 prospective group will comprise of the first 60 patients to undergo elective hip and knee Arthroplasty surgery, under the new protocol.

Sample Selection

Inclusion Criteria

All, elective hip, and knee arthroplasty patients, cleared by the physician, as per clinical advanced protocol, will be included.

Exclusion Criteria

Patients with revision surgery, trauma related surgeries, bilateral arthroplasty, poor balance, and cognitive deficiencies will be excluded from the study.

Instrumentation and Outcome Measures

Length of stay (LOS) – Is frequently used as outcome measure in Hip and Knee arthroplasty and is measured in mean number of days. In this study LOS will be measured in hours to be more precise and to be able to detect small changes more effectively. LOS will be measured from patient going to theatre to patient being discharged to be accurate since some patients lie and wait the whole day, only to go to theatre late afternoon (McCulloch et al 2017).

WOMAC – The Western Ontario and McMaster Universities Osteoarthritis Index is widely used, valid (0.86 pain, 0.90 stiffness, 0.95 physical function) and reliable (0.88 pain, 0.76 stiffness, 0.91 physical function) (Bellamy et al 1988 and Söderman et al 2000) as an outcome measure in patients with hip and knee arthroplasty. It measures pain, stiffness, and physical function (Collins et al 2011 and Giesinger et al 2015). (Appendices iv). The score is rated on an ordinal scale of 0 to 4. Sub scores or global score can be calculated, with lower scores indicating lower levels of pain, stiffness, and physical disability. Data collected from the WOMAC will be analysed against patient satisfaction measured on a 5-point Likert scale (extremely satisfied, satisfied, neutral, dissatisfied and extremely dissatisfied). According to answers there will be two groups, satisfied (extremely satisfied and satisfied) and unsatisfied (neutral, dissatisfied and extremely dissatisfied) (Thambiah et al 2015).
Walker et al 2018, also identified values for the total WOMAC score that is predicative of patient's level of satisfaction.

30-day Re-admission rate – Unplanned re-admissions within 30 days after patient was discharged from hospital (Rumball-Smith and Hider 2009).

Cost – For this study, direct cost of LOS will be compared between the 2019 and 2020 Cohorts. The comparison will include hospital, theatre, physiotherapy, assistive devices, prosthetic and orthopaedic surgeon fees incurred in hospital.

Procedure

Pilot Study

A pilot study consisting of six participants (10% of sample size) will be conducted to identify any problems. The pilot study participant data will only be omitted from the overall research data if the procedures have been changed after conducting the pilot study.

Main Study

In this prospective cohort study, we will review consecutive total hip and knee arthroplasty as well as partial knee arthroplasty patients at Medicare private hospital,

in Rustenburg. Information will be provided to all potential participants and informed consent will be obtained (Appendices iii). The multi-disciplinary team for all surgeries will consist of the same Orthopaedic surgeon, Anaesthetist, Physiotherapists and nursing staff and protocols will stay uniform throughout the study.

The Physiotherapy protocol starts with a pre-operative education, pre-habilitation and evaluation session. This session place emphasis on post-operative expectations from the patient and therapist, post-operative exercises, bed mobility, gait re-education and navigating stairs with crutches, precautionary measures, early mobilisation, ice programme, discharge requirements and information pertaining to in-hospital as well as follow-up physiotherapy sessions. A WOMAC Questionnaire is also completed in this session. The patient is provided with a printed information sheet with all the exercises for pre- and post-surgery. The same exercises are used for pre-habilitation and post-operatively.

Post-operatively, patients are monitored in the ward for nausea, hypotension, tachycardia, or desaturation routinely. Ice pack is applied as soon as patient is back in the ward. Ice is applied almost continuously during the day through the light compression bandage, eight hours per day for the first three days. Patients have no catheter or drainage pipes. A short drip and monitor electrodes are in place and will be removed to make mobilisation easier. IPCP is in place around the patients calves to help in preventing DVT's. Patients are mobilized POD0 as soon as they are stable and with the surgeon's permission, 1-3hours post-operative. Patients are encouraged to start eating and drinking as soon as possible. The Physiotherapist starts by sitting the patient more upright to assist with hypotension. Bed exercises consisting of foot pumps, static quadriceps muscle exercises, hip abduction and heel slides are done next. All exercises are done with one set of 10 repetitions each at least five times per day. Patient is then mobilised to sit over the side of the bed. Short lever quadriceps extension in sitting and if patient is feeling well, we will progress to standing with walking frame. Gait and knee-locking is explained and then the patient is mobilised out of bed to the toilet and back, approximately 20 metres in total. Ice is re-applied after mobilisation. Patient is encouraged to sit out in the chair for lunch and dinner. A second Physiotherapy session comprising of the same programme as used during the first session will be performed 2-3 hours later. In-between the patient will mobilise with the nursing staff. Depending on how well and safe patient is mobilising, stair climbing might be included in the second session on POD0, or alternatively in the 1st physiotherapy session on POD1.

Patients will receive these Physiotherapy sessions twice per day while in hospital. Before discharge, patient is expected to demonstrate good independent bed mobility, be able to mobilise 50 metres or more, navigate stairs safely with crutches and knee flexion ROM should be close to 90º. When the patient is medically stable, pain is under control (patient indicating that they feel they will manage at home using pain tablets) and the Physiotherapy criteria are met, the patient may discharge from hospital to home. Home exercise programme that was already provided pre-operatively is continued and follow-up appointment for out-patient Physiotherapy is arranged. Patients will follow-up 1 x session per week for 6 weeks. WOMAC Questionnaire will be completed again 6 weeks and 3 months after surgery.

Length of stay (LOS) in hospital is measured from the time the patient goes to theatre till the time the doctor discharges the patient. LOS will be measures in hours. In addition to LOS, procedure length, estimated blood loss, length of tourniquet use, type

of anaesthesia, re-admissions within 30 days of surgery and WOMAC scores for pain, function, and stiffness, will be followed.

Upon completion of the prospective cohort study, a retrospective comparison with data from our historical control of 2019 will be conducted as well as a simple cost comparison.

Ethical Considerations

Permission to conduct the study will be obtained from the WITS Human Research Ethics Committee, the Orthopaedic surgeon (Appendices i), and Medicare Hospital Rustenburg manager (Appendices ii). It will include the request for use of data from hospital records for the 2019 historical cohort and then also for the data collection in the main prospective 2020 Cohort group. Information will be given to prospective participants with written consent document. (Appendices iii) Participants will take part in this study free of will and may withdraw from the study anytime and without prejudice. The data obtained from the study will remain confidential and will only be used for the purpose of this study. No treatment will be withheld from a participant. Patients will receive treatment that is part of the standard procedure kas per doctor and hospital protocol and there will be no additional costs involved for participants in the study. Patients not taking part in the study will receive exactly the same treatment.

Data Analysis

A statistician will be consulted in the analysis of data. Descriptive statistics namely frequencies and percentages for categorical data and means and standard deviations or medians and percentiles for numerical data will be calculated. Confidence interval will be set on 95% and power of probability of p=0.05. Data will be captured and analysed using the SPSS version 26.0.

Objective	Type of data	Variable	Test
To determine effect of timing and frequency of Physiotherapy on LOS 92019 vs 2020)	Interval Parametric	Dependent	T-test
To measure patient's satisfaction 6 weeks post-op with WOMAC Questionnaire (2020)	Ordinal Non-parametric	Dependent	Wilcoxon / Sign test
To evaluate the measurement of LOS in hours	Interval Parametric	Dependent	T-test
To compare 30-day re-admission rate (2019 vs 2020)	Interval Parametric	Dependent	T-test

To determine and compare the cost of LOS (2019 vs 2020)	Ratio Parametric	Dependent	T-test

Time Frame of the Project

Description	Feb-Apr 2020	April 2020	June 2020	Feb-May 2021	June 2021
Proposal development	X				
Departmental protocol presentation		**X**			
School of Medicine submission		**X**			
Human Research Ethics Committee Submission			**X**		
Pilot study			**X**		
Data Collection			**X**	**X**	
Data analysis				**X**	
Writing of results and discussion				**X**	
Submission to faculty					**X**

Budget

Description	Price per item	Number of items	Total
Printing consent form (2 Pages)	R1.00	120	R120.00
Printing information & exercise sheet (9pages/participant)	R1.00	540	R540.00
Printing of WOMAC questionnaire (3/patient x 1 page)	R1.00	180	R180.00
Binding protocol	R50.00	2	R100.00
Total			**R940.00**

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iv) Orthopaedic doctor consent

Retha-Mari Prinsloo
Department of Physiotherapy
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10 March 2020

To: Dr JWT Potgieter

I, Retha-Mari Prinsloo, am a postgraduate student at the Department of Physiotherapy WITS. I am currently conducting research for the completion of my Masters of Science in Physiotherapy Orthopaedics: Early mobilization and frequency of Physiotherapy after Hip- and Knee Arthroplasty.

I hereby request permission to conduct research at Medicare private Hospital, in Rustenburg.

The study will be conducted on all your elective Hip and Knee Arthroplasty patients performed at Medicare Hospital, Rustenburg, South Africa. The study will aim to determine whether early mobilization and increased frequency of Physiotherapy post-operative day zero (as per Dr's current protocol in 2020) will impact the length of stay in patients that had hip and knee arthroplasty surgery. All patients will receive treatment as per Dr Potgieter's protocol and no treatment will be withheld from any patient. The results and data collected will be compared to the previous year (our historical cohort group), where patients were mobilized and received Physiotherapy once on post-operative day zero (as per Dr's protocol in 2019)

2019 – Data will be collected from hospital data since this group will form the historical cohort group.
2020 – These patients will form part of my actual prospective study.
Permission was granted by Medicare hospital for the use of hospital data for 2019 and 2020 for the duration of the study.

In order to apply for ethical clearance, I kindly need written permission from you. Patient consent, to use data will be obtained from the patients and it will be voluntary. The patients name and personal details will not be revealed and all data will be treated confidentially. Data regarding patients length of stay, general demographics and WOMAC scores (Western Ontario and MacMaster Universities Osteoarthritis Index), will be used.

The research will be conducted from March 2020 to October 2021.
Thank you in advance for your assistance.

Sincerely
Retha-Mari Prinsloo
Postgraduate M.Sc. Physiotherapy, student.

Permission granted: Dr JWT Potgieter

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V) Hospital Manager Consent

Retha-Mari Prinsloo
Department of Physiotherapy
University of the Witwatersrand
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10 March 2020

Medicare Private Hospital Manager
Sr Anja Markram

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The study will be conducted on Hip and Knee Arthroplasty patients performed by Dr JWT Potgieter. The study will aim to determine whether early mobilization and increased frequency of Physiotherapy will impact the length of stay in patients that had hip and knee arthroplasty surgery. All patients will receive treatment as per Dr Potgieter's protocol and no treatment will be withheld from any patient. The results and data collected will be compared to the previous year.

In order to apply for ethical clearance, I kindly need written permission from you. Patient consent, to use data will be obtained from the patients and it will be voluntary. The patients name and personal details will not be revealed and all data will be treated confidentially. Data regarding patients length of stay, general demographics and WOMAC scores (Western Ontario and MacMaster Universities Osteoarthritis Index), will be used.

The research will be conducted from March 2020 to October 2021.
Permission is also requested to use hospital data from 2019.

Thank you in advance for your assistance.

Sincerely
Retha-Mari Prinsloo
Postgraduate M.Sc. Physiotherapy, student

Permission granted by:

A Markram
……………………………………
Date 01.04.2020

Medicare Private Hospital- H.R Dept
271 Beyers Naude Drive
Rustenburg
Tel: (014) 523 9300
086 56 99 777

vi) Patient information and consent

Study: Early mobilisation and frequency of Physiotherapy after hip and knee arthroplasty.

Dear Sir/Madam.

I, Retha-Mari Prinsloo, am doing research on hip and knee replacements. In this study I want to learn about the effect that timing of mobilisation (when you get out of bed after operation) and the frequency (how many times per day) of treatment has on your length of stay in hospital.

Data on how long you stay in hospital, age, gender, your type of replacement and whether there were any complications, will be used.

We will also make use of a Questionnaire that you will be asked to complete before surgery, and then again at six weeks and three months after the operation. In this questionnaire we can determine your progress in terms of pain, function, and stiffness.

The information is confidential, and no names or personal detail will be used. Your data will be identified for instance as participant no 1. Your data will only be used for the purpose of this study. Personal information may be disclosed if required by law and the Human Research Ethics Committees of the University may exceptionally require personal data to respond to a formal complaint, or for a compliance audit.

What is involved?

You will have an evaluation session that takes about 1 hour and there will be no cost involved. During this session we will do a simple evaluation to test muscle strength of the lower limb, measure how far your knee/hip can bend and straighten. You will fill in a WOMAC Questionnaire with questions regarding pain, function, and stiffness. I will teach you how to walk with crutches/walking frame, how to navigate stairs and also the exercises that we will do to strengthen the leg before and after the operation. The role of ice will be explained and how it should be applied after the surgery. We will discuss what you can expect from Physiotherapy in hospital and what is expected from you before you can be discharged from hospital. The protocol will be followed during your hospital stay for your arthroplasty surgery and data will be collected from your hospital file.

There is no risk of taking part in the study since we are following our normal standard protocol of Dr Potgieter and all participants will receive the same treatment whether they participate in the study or not. There is no direct benefit for you to participate in the study, but the knowledge gained from the study may lead to improved treatment protocols for future arthroplasty patients. Permission from the Human Research Ethics Committee of the University of the Witwatersrand will be obtained before the study commence.

If you have any concern over the way the study is being conducted, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be

contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za

I would appreciate it if you would be willing to participate in this research project.

Kind regards.

Retha-Mari Prinsloo

Principal investigator

Patient consent.

Research title: Early mobilisation and frequency of Physiotherapy in Hip- and Knee arthroplasty.

I _____, have read the above information regarding the study and give consent for my data to be used. I understand what the study is about and that I may withdraw my participation from the study at any time. I had time to ask questions and all my questions was answered in a satisfactory and clear manner. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything. I understand that my name and personal information will not appear in any results and that the data will only be used for the purpose of this study.

_____

Signature of participant

Retha-Mari Prinsloo

Primary researcher

_____

Date

Contact details:

Retha-Mari Prinsloo, Principal Investigator, telephone no. 0766988655, or by e-mail at prinsloophysio@gmail.com,
Monique Keller, Supervisor, on telephone no. 011 717 3715, or by e-mail at Monique. Keler@wits.ac.zaProfessor CB Penny, Chairperson of the Human Research Ethics

Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.
Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

vii) WOMAC Questionnaire

PATIENT NUMBER	DOB

WESTERN ONTARIO AND
MCMASTER OSTEOARTHRITIS INDEX (WOMAC)

Please circle the appropriate rating for each item.

RATE YOUR PAIN WHEN...	NONE	MILD	MODERATE	SEVERE	EXTREME	PRACTICE USE ONLY
Walking	4	3	2	1	0	
Climbing stairs	4	3	2	1	0	
Sleeping at night	4	3	2	1	0	
Resting	4	3	2	1	0	
Standing	4	3	2	1	0	TOTAL
RATE YOUR STIFFNESS IN THE...	NONE	MILD	MODERATE	SEVERE	EXTREME	PRACTICE USE ONLY
Morning	4	3	2	1	0	
Evening	4	3	2	1	0	TOTAL
RATE YOUR DIFFICULTY WHEN...	NONE	MILD	MODERATE	SEVERE	EXTREME	PRACTICE USE ONLY
Descending stairs	4	3	2	1	0	
Ascending stairs	4	3	2	1	0	
Rising from sitting	4	3	2	1	0	
Standing	4	3	2	1	0	
Bending to floor	4	3	2	1	0	
Walking on even floor	4	3	2	1	0	
Getting in/out of car	4	3	2	1	0	
Going shopping	4	3	2	1	0	
Putting on socks	4	3	2	1	0	
Rising from bed	4	3	2	1	0	
Taking off socks	4	3	2	1	0	
Lying in bed	4	3	2	1	0	
Getting in/out of bath	4	3	2	1	0	
Sitting	4	3	2	1	0	
Getting on/off toilet	4	3	2	1	0	
Doing light domestic duties (cooking, dusting)	4	3	2	1	0	
Doing heavy domestic duties (moving furniture)	4	3	2	1	0	TOTAL

REVIEWED BY PHYSIOTHERAPIST	DATE	WOMAC TOTAL SCORE /96

WOMAC OSTEOARTHRITIS INDEX QUESTIONNAIRE

REHABILITATION SERVICES
PT THA/TKA WOMAC QUESTIONNAIRE

Gmail Retha Prinsloo <prinsloophysio@gmail.com>

Urgent: Permission to use WOMAC questionnaire

2 messages

Retha Prinsloo <prinsloophysio@gmail.com> 4 April 2020 at 18:41
To: n.bellamy@uq.edu.au

Good day Dr.

I trust you are well. My name is Retha-Mari Prinsloo and I am currently busy with my Masters degree in Physiotherapy at WITS University in South Africa. The title of my study is : Early mobilization and frequency of Physiotherapy in Hip and knee arthroplasty patients.

May I kindly request permission to use the WOMAC questionnaire in my study of 60 patients, please.

I would appreciate it if you can respond to this email, as I need this for our ethics committee.

Thank you in advance.

Kind regards.
Retha-Mari Prinsloo
Physiotherapist
prinsloophysio@gmail.com

Retha Prinsloo <prinsloophysio@gmail.com> 9 April 2020 at 14:28
To: mopanielaan13 <mopanielaan13@gmail.com>

[Quoted text hidden]

viii) Plagiarism declaration

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

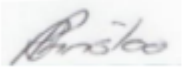
PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

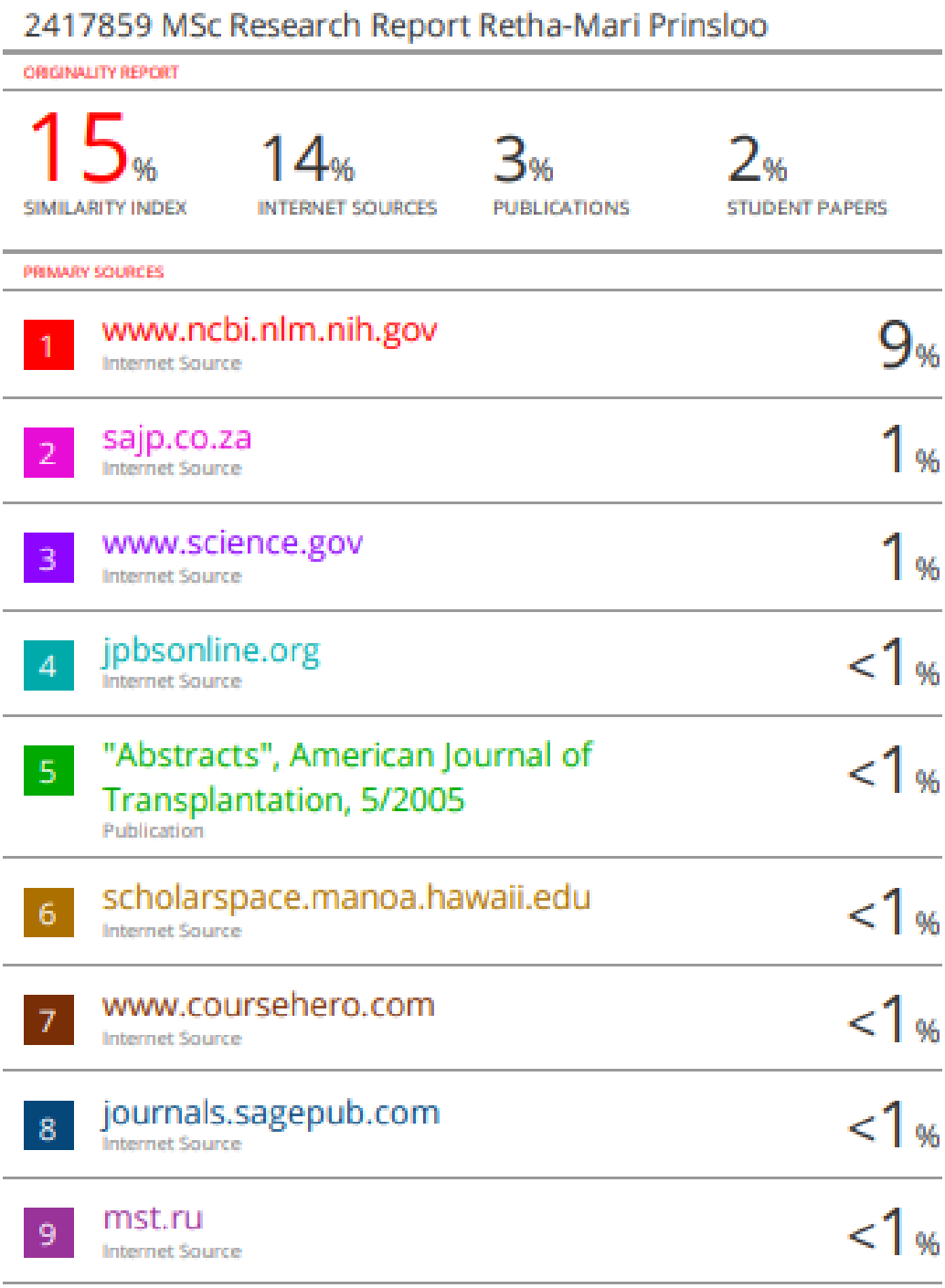
I, Retha-Mari Prinsloo (Student number: 2417859) am a student registered for the degree of M.Sc. Physiotherapy (Orthopaedic Surgery) in the academic year 2022.

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: 01/02/2022

ix) **Turnitin report:** Please note that Since Chapter 3, The Methodology chapter is a published article it was removed before the research report was uploaded to Turnitin.



2417859 MSc Research Report Retha-Mari Prinsloo

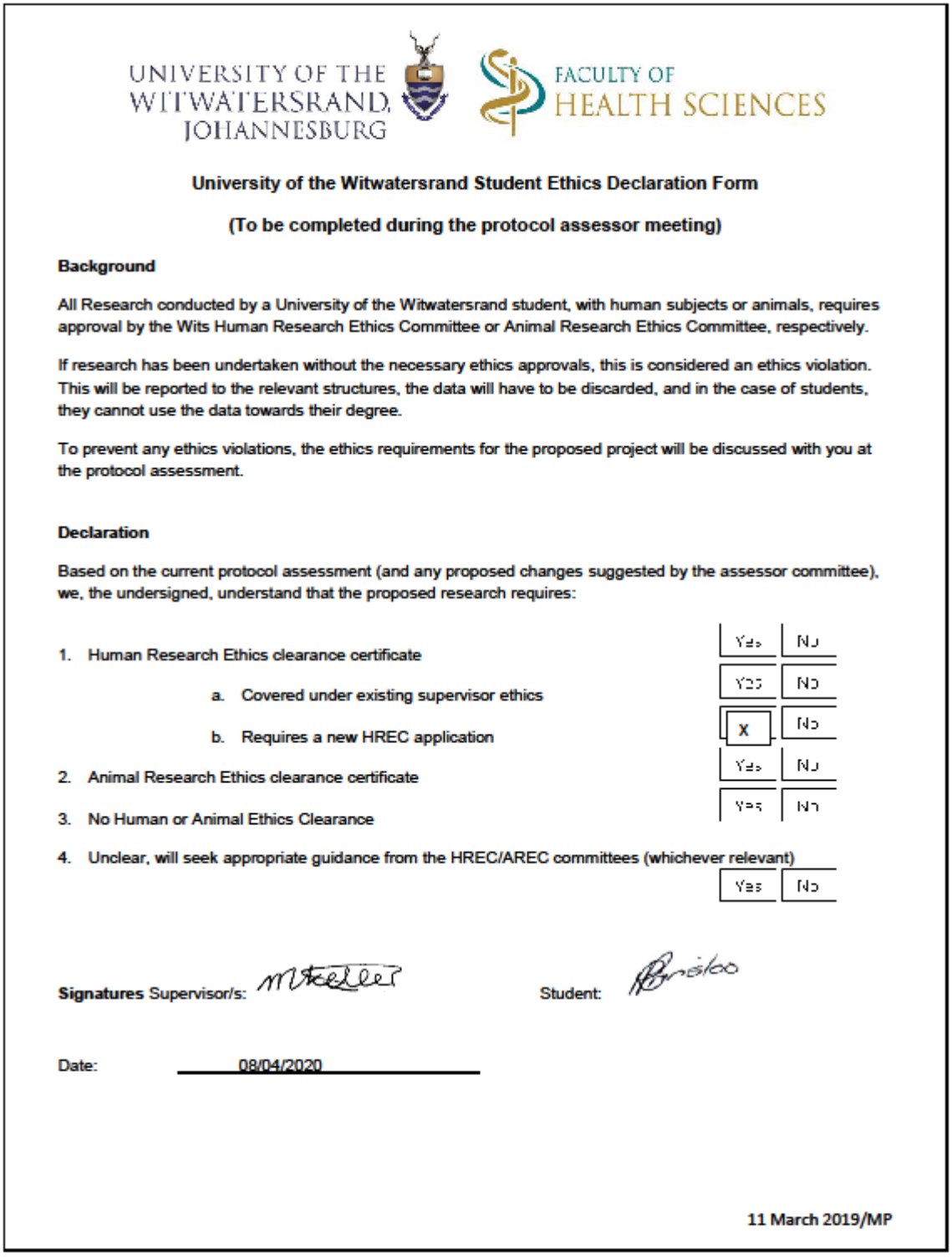
ORIGINALITY REPORT

15%	14%	3%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.ncbi.nlm.nih.gov Internet Source	9%
2	sajp.co.za Internet Source	1%
3	www.science.gov Internet Source	1%
4	jpbsonline.org Internet Source	<1%
5	"Abstracts", American Journal of Transplantation, 5/2005 Publication	<1%
6	scholarspace.manoa.hawaii.edu Internet Source	<1%
7	www.coursehero.com Internet Source	<1%
8	journals.sagepub.com Internet Source	<1%
9	mst.ru Internet Source	<1%

x) Ethics Declaration



UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

University of the Witwatersrand Student Ethics Declaration Form

(To be completed during the protocol assessor meeting)

Background

All Research conducted by a University of the Witwatersrand student, with human subjects or animals, requires approval by the Wits Human Research Ethics Committee or Animal Research Ethics Committee, respectively.

If research has been undertaken without the necessary ethics approvals, this is considered an ethics violation. This will be reported to the relevant structures, the data will have to be discarded, and in the case of students, they cannot use the data towards their degree.

To prevent any ethics violations, the ethics requirements for the proposed project will be discussed with you at the protocol assessment.

Declaration

Based on the current protocol assessment (and any proposed changes suggested by the assessor committee), we, the undersigned, understand that the proposed research requires:

1. Human Research Ethics clearance certificate		
a. Covered under existing supervisor ethics		
b. Requires a new HREC application	X	
2. Animal Research Ethics clearance certificate		
3. No Human or Animal Ethics Clearance		
4. Unclear, will seek appropriate guidance from the HREC/AREC committees (whichever relevant)		

Signatures Supervisor/s: Student:

Date: 08/04/2020

11 March 2019/MP

xi) Appointment of supervisor

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG | FACULTY OF HEALTH SCIENCES

RECOMMENDATION FOR APPOINTMENT OF SUPERVISOR(S) OF RESEARCH REPORT, DISSERTATION OR THESIS

Motivation / Reason for Appointment:
Mrs. Monique Keller an Orthopaedics lecturer in the Physiotherapy department at the University of the Witwatersrand and is doing a PhD (Research field: Orthopaedics). She has a Masters in Hand Rehabilitation and also has in-depth clinical experience working with hip and knee arthroplasty patients.

Recommendation of Division / Department / School:
Mrs. Monique Keller has the necessary expertise as indicated above (Orthopaedics ad Research knowledge)

Student Surname and Full name(s)	Retha-Mari Prinsloo
Student number	2417859
Degree	M.Sc Physiotherapy (Surgical Orthopeadics)
Div / Dept / School	Physiotherapy
Title	Early mobilization and frequency of physiotherapy in hip and knee arthroplasty

(Supervisor 1): Mrs Monique Keller

Supervision %: 100%

Supervisor Qualifications: B Physt (UP) Masters in Hand Rehabilitation (UKZN)

Supervisor Department: Department of Physiotherapy

Supervisor Telephone: 011 717 3715 E-mail: monique.keller@wits.ac.za

Student Signature:

Supervisor 1 Signature:

RECOMMENDATION BY HEAD OF DIVISION / DEPARTMENT / SCHOOL:

Associate Professor Veronica Ntsiea		08 April 2020
(Full name(s) and Surname)	(Sign)	(Date)

APPROVAL BY CHAIR OF ASSESSOR GROUP:
(On behalf of the FGSC)

Dr Natalie Benjamin-Damons		11 May 2020
(Full name(s) and Surname)	(Sign)	(Date)

PLEASE NOTE: RECOMMENDATION FOR APPOINTMENT OF SUPERVISOR(S) FOR CIRCULATION TO THE FGSC FOR APPROVAL

Statement of principles for postgraduate supervision

In a context of academic freedom and within a framework of individual autonomy and the pursuit of knowledge, this statement is written in the belief that there is a reciprocal relationship and mutual accountability between supervisor and student

THE SUPERVISOR AND THE STUDENT:

1. Will establish agreed roles and clear processes to be maintained by both parties. In the case of joint supervision, the roles and responsibilities of each supervisor and the student need to be clarified.
2. Will meet regularly and as frequently as is reasonable to ensure steady progress towards the completion of the proposal, research report, dissertation or thesis. This time varies but the normal minimum requirement for face-to-face contact spread across each year of registration is: 10 contact hours for an Honours project, 15 contact hours for a Masters by coursework and research report and 24 contact hours for a Masters by dissertation and a PhD.
3. Will keep appointments, be punctual and respond timeously to messages.
4. Will keep one another informed of any planned vacations or absences as well as changes in his or her personal circumstances that might impact on the work schedule. Unplanned absences or delays should be discussed as soon as possible and arrangements should be made, to catch up lost time.
5. Will ensure that research on animal or human subjects is conducted with prior approval and according to the procedures and the requirements of the relevant Ethics committee.
6. Will both complete Progress Reports on the research project as required/requested by the relevant Faculty Graduate Studies Committee.

THE SUPERVISOR:

1. Undertakes to provide guidance for the student's research project in relation to the design and scope of the project, the relevant literature and information sources, research methods and techniques and methods of data analysis.
2. Will provide guidance at the commensurate NQF level requirements for autonomy and accountability that the student is expected to demonstrate.
3. Has a responsibility to be reasonably accessible to the students.
4. Will be prepared for meetings with the student. This includes being up-to-date on the latest work in his/her area of expertise.
5. Will expect written work as jointly agreed, and will return that work with constructive criticism within a timeframe (a suggestion of 2-4 weeks) jointly agreed at the outset of the research.
6. Will provide advice that can help the student to improve his/her writing. This may include referrals for language training and academic writing. The supervisor will provide guidance on technical aspects of writing such as referencing as well as on discipline specific requirements. Detailed correction of drafts and instruction in aspects of language and style are not the responsibility of the supervisor.
7. Will guide the student in the production of a research report, dissertation or thesis. Provision should be allowed for adequate, mutually respectful, discussion around recommendations made.
8. Will assist with the construction of a written time schedule, which outlines the expected completion dates of successive stages of the work.
9. Will encourage the student to present work at postgraduate/ staff seminars/national/international conferences as appropriate.
10. Will assist with the publication of research articles as appropriate.
11. Will discuss the ownership of research conducted by the student in accordance with the University rules on intellectual property, copyright, **guidelines on authorship/co-authorship**, and **policy on research integrity**.
12. Will ensure that the student is aware of the University's Plagiarism Policy, knows what plagiarism is, and what the consequences are for academic dishonesty and violation of research integrity and intellectual property.
13. Will ensure that the student is made aware in writing of the inadequacy of progress and/or of any work where the standard is below par. Acceptability will be according to criteria previously supplied to the student.
14. Has a duty to refuse to allow the submission of sub-standard work for examination, regardless of the circumstances. If the student chooses to submit without the consent of the supervisor, then this should be clearly recorded and the appropriate procedures followed.

THE STUDENT:

1. Takes full responsibility for the research and its successful completion; including managing the process under the guidance of supervisor (s).
2. Will attend such courses and lectures that are compulsory for the degree, and undertakes to catch up fully on any work, lectures and/or assignments, that are missed.
3. Undertakes to work independently under the guidance of the supervisor(s). This includes reading widely and critically to ensure that the seminal and current literature pertinent to his/her chosen topic has been identified, consulted and critiqued.
4. Undertakes to work in accordance with the academic standards expected by the University for the commensurate NQF level of qualification.
5. Is obliged to make appointments to consult the supervisor(s) and arrange meeting times convenient to both parties well in advance.
6. Should submit written work for discussion with the supervisor(s) well in advance of a scheduled meeting. The kind and frequency of written work should be agreed with the supervisor(s) at the outset of the research.
7. Written work that is submitted to the supervisor, including final submissions to examiners, should be relatively free from basic spelling mistakes, incorrect punctuation and grammatical errors. Responsibility for the accuracy of language, the overall structure and coherence of the final research report, dissertation or thesis rests with the student.
8. Cannot expect the supervisor to be proof-reader and editor of his/her work or to approve work with any of the weaknesses spelt out in 7 above.
9. Undertakes to heed the advice given by the supervisor(s) and to engage in discussion around suggestions made. Ultimately the student has to take responsibility for the quality, integrity and presentation of the work.
10. Should strive to maintain a focus on his/her research area and to work diligently within the agreed time schedule.
11. Agrees to honour agreements about ownership of the research and in accordance with the University's guidelines and rules in relation to co-authorship, copyright and intellectual property.
12. Will ensure that the work contains no instances of plagiarism, violation of intellectual property and research integrity standards, that all citations are properly referenced, and that the list of references is accurate, complete and consistent.
13. Agrees to work in accordance with the criteria of acceptability as supplied by the supervisor(s).
14. Undertakes not to place the supervisor(s) under undue pressure to submit work for examination until the supervisor is satisfied that it has reached an acceptable, **examinable*** level of quality.

We confirm that we have read and understood this statement and agree to be guided by its principles for as long as we continue to work together.

Name of student: Retha-Mari Prinsloo

Student Number : 24178539

Student's signature:

Name of Supervisor: Mrs Monique Keller

Supervisor's signature:

Name of Co-Supervisor: N/A

The broad area of study is: Orthopaedics, Hip and Knee arthroplasty
Provisional submission date is: 14/04/2020

Degree: M. Sc. Physiotherapy (Orthopaedics)
School: Medical
Faculty: Physiotherapy

Date: 05/04/2020

Specific agreements pertaining to: ownership, joint publication, funding, confidentiality and disclosures pertinent to the Certificate of Clearance and ETD Form which the student and/or supervisor are required to sign, must be attached to this agreement as and when appropriate and kept in the Faculty Office. In the event of disagreements between the supervisor(s) and student, the parties should act in accordance with the University Grievance Policy.

***Note: Consent by supervisor(s) to submit work for examination does NOT guarantee that the work will pass. The appointed examiners assess and determine whether the work is of a passable standard.**

(2020/04/05)

xiii) Example Data and variable Sheet

Demographics

Participant no	Retrospective=1 Prospective=2	Gender	Age	BMI	LOS Hours	Arthroplasty type TKR=1 PKR*=2 THR=3	Discharge day

WOMAC Questionnaire scores

PO * Pain	PO Stiffness	PO Function	PO Total Score	6/52 Pain	6/52 Stiffness	6/52 Function	6/52 Total score	3/12 Pain	3/12 Stiffness	3/12 Function	3/12 Total score

Safety, Patient satisfaction and Cost comparison data

30-day re-admission rate	Patient satisfaction	No of physio sessions	Hosp cost	Orthopaedic surgeon cost	Anaesthetist cost	Physio cost	Prosthesis cost	Assistive device cost	Total cost

*PO=pre-operative

*PKR=partial knee replacement