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Quantifying the functional and psychological outcomes after periprosthetic femoral fracture in association with total hip arthroplasty in older adults

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Abstract

This thesis evaluated the functional and psychological outcomes in older adults with a periprosthetic femoral fracture (PPF) after total hip arthroplasty. The first study was a retrospective chart review of 130 people who had PPF surgery to evaluate the functional and psychological outcomes and mortality rate at one-year post-PPF surgery. The second study assessed falls, mobility, balance, and lower extremity strength in ten people at 6-months to 4-years after PPF surgery. In Study 1, people had low scores on function and psychological well-being and the one-year mortality was 15.4%. Participants in Study 2 demonstrated slower gait, reduced mobility, balance and leg strength compared to age and sex-matched normative values, social isolation, a lack of falls awareness and a falls occurrence of 50.0%. These indicate that the evaluation of rehabilitation protocols for functional and psychological recovery is warranted to achieve better outcomes in this population.

Keywords: Periprosthetic femoral fracture, total hip arthroplasty, outcome, mortality rate, falls, older adults.

Summary for Lay Audience

A fall in an older adult after hip replacement surgery can cause a fracture around the new hip. These fractures usually require surgery to fix and few studies have evaluated the physical and mental health of patients after successful repair of the fracture. Importantly, no research has looked at new falls and awareness of falls prevention after the repair surgery. The purpose of these two studies was to increase our understanding of the physical and mental health outcomes of older adults after their fracture repair surgery. In the first study, medical charts of 130 people were reviewed to evaluate the physical and mental health status and the number of people who died at one-year after the surgery for the fracture. In the second study, ten people with this kind of fracture were assessed for falls occurrences and knowledge of falls. In addition, walking speed, mobility, balance, and leg strength were evaluated at 6-months to 4-years after the surgery for the fracture. We found poor physical and mental health at one-year after their repair surgery. We found 15.4% of people who had the surgery to repair the fracture had died in the first year. People in Study 2 walked slower and had reduced leg strength, balance, and mobility compared to healthy older adults and reported social isolation after their repair surgery. Half of the people fell after their repair surgery for the fracture and lacked the knowledge to prevent falls. Our findings demonstrate that the evaluation of the rehabilitation protocols is needed to ensure better mental and physical health status in older adults after this fracture.

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List of Abbreviations

ABC: Activities-specific Balance Confidence Scale

ASA: American Society of Anesthesiologists

B.L: Brent Lanting

BMC: Bone Marrow aspirate Concentrate

BMI: Body Mass Index

CAD: Canadian Dollars

CI: Confidence Interval

CT: Computed Tomography

DC: Disability component

FC: Functional component

FOF: Fear of Falling

FROP-Com: Falls Risk for Older People-Community setting

GDS-SF: Geriatric Depression Scale-Short Form

HA: Hemiarthroplasty

HHS: Harris Hip Score

IQR: Inter Quartile Range

LHSC-UH: London Health Sciences Centre, University Hospital

LLFDI: Late Life Functional and Disability Instrument

MCS: Mental Component Summary

m-CIRS: Modified Cumulative Illness Rating Scale

MoCA: Montreal Cognitive Assessment

OA: Osteoarthritis

ORIF: Open Reduction and Internal Fixation

PCS: Physical Component Summary

PPF: Periprosthetic Femoral Fracture

pTHA: Primary Total Hip Arthroplasty

QoL: Quality of Life

rTHA: Revision Total Hip Arthroplasty

SF-12: Short-Form-12 Survey

THA: Total Hip Arthroplasty

TUG: Timed Up-and-Go Test

WOMAC: Western Ontario and McMaster Osteoarthritis Index

30sec CST: 30-Second Chair Stand Test

Chapter 1: LITERATURE REVIEW

1.1 Introduction

Osteoarthritis (OA) is a chronic degenerative disease affecting the articular cartilage, peri-articular structures and subchondral bone.[1,2] In older adults, OA is the leading cause of lower extremity disability and is seen most often in the weight-bearing lower limb joints including the hip joint.[1,3] Conservative approaches such as weight reduction, analgesics, and lifestyle modification are introduced first to reduce the symptoms of OA.[4,5] In advanced stages of hip OA, if conservative management fails then the standard of care for surgical intervention is a total hip arthroplasty (THA).[4] After THA, most people report reduced pain symptoms and an improved quality of life (QoL) partly due to a regained ability to return to the activities they enjoy.[6,7] However, functional deficits in lower extremity strength, balance and gait are present after THA which can result in higher falls risk among older adults compared to healthy adults.[8–11]

Falls after THA can have devastating consequences, especially if a fracture occurs around the implant.[12] This type of fracture is called a periprosthetic femoral fracture (PPF).[12] Multiple predisposing risk factors have been identified for PPF including older age, female sex, osteoporosis, previous trauma, inflammatory arthritis, previous revision surgeries, and type of the implant, among others.[13–15] The majority of PPFs require surgical intervention such as a revision THA.[16] Undergoing revision surgery due to PPF after THA has been found to result in significantly decreased physical function and an increased mortality risk in older adults.[17–21] Current published studies on PPF after THA mainly focus on the predisposing risk factors, and the classification and

surgical management of these fractures.[22–24] Very little is known about the consequences, both physical and psychological, of PPF after THA.

1.2 Osteoarthritis of the hip

Osteoarthritis (OA) is a common chronic degenerative joint disease in older adults (> 60 years).[1,2] OA can affect multiple joint tissues including, articular cartilage, synovium, ligaments, periarticular muscles, subchondral bone and meniscus where present.[25,26] As a result of OA, a joint can demonstrate degradation of articular cartilage, formation of new bone at the joint margins, changes to subchondral bone, and inflammation of the synovium.[26–28] The primary symptoms of OA are pain, joint stiffness, reduced joint movement and joint swelling.[28,29] Weight-bearing joints are more likely to be affected by OA, such as the hip and knee.[1,3]

For OA of the hip, the joint pain is typically localized to the areas of the groin, anterior or lateral thigh and buttock areas.[30] In the early stages of the disease, the joint pain is usually exacerbated by activity and relieved by rest.[31] As the disease progresses, the pain can be severe, frequent and unpredictable and not relieved by resting.[31] Reduced muscle volume and strength in the affected lower limb compared to the contralateral side are common in people with advanced stages of hip OA.[32,33] The muscle weakness can also occur during the earlier stages of the disease.[34] Gait impairments such as reduced walking speed and step length, and decreased hip joint excursion are also present in people with hip OA compared to healthy adults.[35,36] These deficits and severe symptoms of hip OA restrict physical activity and participation, thus limiting daily life activities and adversely impacting the QoL.[28,37]

1.2.1 Epidemiology of OA

In older adults (> 60 years), about 9.6% of men and 18.0% of women have OA globally.[38] In the general Canadian population the prevalence of OA is approximately 10.0%.[39,40] The prevalence of hip OA among the Canadian population aged 65 or older is 44%.[41] The prevalence of OA increases with age from 1.6% among Canadians aged 30 - 39 years to 35.1% in those 80 years or older.[41,42] In Canada, OA is on the rise and expected to increase by 64% from 3.6 million in 2010 to almost 6.6 million individuals affected in 2031.[43]

OA is associated with a substantial economic burden for both the health-care system and the individuals living with the disease, a burden that will increase as the rate of OA increases.[43–45] The annual medical expenditure associated with OA for an average Canadian adult is incurred through both direct (hospitalizations, physician visits, prescription medications, rehabilitation and caregiver costs etc.) and indirect (unemployment, missed days of work and reduced productivity) costs.[43,44] The indirect cost makes up the majority of the annual medical expenditure with an average indirect cost of CAD $12,990 in contrast to CAD $2,300 for direct cost.[44] It is predicted that the total annual costs associated with OA in Canada will rise in coming years, from CAD $2.9 billion in 2010 to CAD $7.6 billion by 2031.[43]

1.2.2 Risk factors for the development of OA

Risk factors for developing OA can broadly be divided into local and systemic factors.[1,3,46,47] Local factors are biomechanical in nature and affect the application of forces to a joint including joint malalignment, trauma and joint structural abnormalities.[3,46,47] Several systemic risk factors have also been identified including age, sex, obesity and genetics.[46,47] These systemic factors are believed to increase the risk of OA by increasing the susceptibility for joint injury.[1,2,48]

The most prominent risk factor for the development of OA is increasing age.[1,46] Age-related changes such as reduced muscle strength, loss of proprioception, sarcopenia and increased bone turnover, play an important role in the development of OA in older adults.[49–51] Obesity, defined as a body mass index (BMI) ≥ 30 kg/m^2, is another prominent risk factor for the development of OA.[52,53] Jiang et al. reported that each additional increase of 5 units in BMI beyond the normal value of 24.9 resulted in an 11% increase in the risk of developing hip OA.[54] However, there are contradictory findings on the association between high BMI and hip OA.[2,47,53] Additionally, women have a greater risk of developing hip OA than men.[1,2] The increased risk for women is most remarkable after menopause.[55,56] The most common theory for the higher risk of OA among women is due to hormonal differences, yet there has been limited evidence to support these claims.[1,3] There is, however, increasing evidence of a genetic component in the development of OA.[57–59] Twin studies have determined that the influence of genetic factors in the development of hip OA is approximately 70%.[60] Genetic variations may also play a role in disease susceptibility.[58,59] The genetic heritability, which refers to variance in a trait, of hip OA is approximately 60%.[59]

Prolonged periods of repetitive and intense joint use in certain occupations have been shown to increase the risk of OA.[4,61] Occupations such as farming, construction work and those including prolonged standing, heavy lifting and climbing stairs are associated with the development of hip OA.[1,61–64] Prior hip injuries incurred from trauma and participation in contact sports have quadrupled the risk of hip OA.[65] The risk of developing hip OA is further exacerbated by bony abnormalities such as developmental dysplasia of the hip, femoral acetabular impingement and acetabular dysplasia.[66–69] While there has been limited evidence of the association between joint

malalignment and onset of OA, there are strong indications that joint malalignment plays a role in disease progression.[3,46,47]

1.2.3 Diagnosis of OA

Diagnosis of hip OA usually involves reviewing medical history, focused clinical examinations and radiographic evidence.[70,71] After reviewing the medical history and clinical symptoms, a focused clinical examination is performed to determine the source of the pain and to rule out other potential diseases such as spine pathology and trochanteric bursitis.[70–72] The clinical examination includes a thorough evaluation of hip range of motion and hip-specific testing (e.g., tenderness at the hip, comparing the leg length between affected and healthy limbs) along with gait assessments.[72]

OA is primarily a clinical diagnosis; however, plain radiography of the hip joint is often performed to confirm the diagnosis and determine the progression of the disease.[4,5,70] The common radiographic findings of hip OA include joint space narrowing, new bone formation on the joint margins, hardening of bone and formation of cysts below the cartilage surface.[71,73] These radiographic structural changes due to OA are often graded using a standard grading system, such as the Kallgren and Lawrence grade system, to determine the severity of disease and to guide the treatment options.[72,74,75] However, there is discordance between the clinical presentations, severity of the symptoms and the radiographic findings in the case of hip OA.[76–78] Only 20.7% to 23.8% of patients with radiographic hip OA report frequent hip pain, whereas only 9.1% to 15.6% of those with frequent hip pain show evidence of OA through imaging.[78] These findings demonstrate that the radiological findings do not always correspond with the presence and severity of hip pain in the case of hip OA.

1.2.4 Treatment of hip OA

The aim of the management of hip OA is to reduce joint pain, improve physical function and overall QoL.[79] There are several treatment options for managing the symptoms of hip OA. Lifestyle modifications (e.g., weight reduction and exercise) in conjunction with pharmacological therapies are considered first line treatments.[4,5] A wide range of oral analgesics, such as acetaminophen, NSAIDs and opioids, are commonly used to manage pain associated with hip OA.[5,65,70] Intra-articular corticosteroid injections are also considered when the joint pain is nonresponsive to oral analgesics.[5] In mild to moderate hip OA, intra-articular administration of hyaluronic acid, a glycosaminoglycan found in synovial fluid, is another widely used treatment option to reduce the pain and improve the functional disability.[80] Hyaluronic acid injections have also been found superior to platelet rich plasma in relieving the pain and improving the functional status in people with mild to moderate hip OA.[80] Autologous (involving one individual as both donor and recipient) bone marrow aspirate concentrate (BMC) containing mesenchymal stem cells, usually collected from the iliac crest, is an emerging treatment modality for the early stages of hip OA.[81,82] A recent cohort study involving 19 patients found that in 63.2% of people with early stages of hip or knee OA, intra-articular injections of BMC showed a significant improvement in the symptoms within the first 6 months of the treatment.[82] While these treatment options may relieve the joint pain and reduce disability in mild to moderate hip OA, severe hip OA may require surgical interventions such as total hip arthroplasty.[4]

1.3 Total hip arthroplasty

Total hip arthroplasty (THA) is a common orthopaedic procedure in older adults.[83] The surgical procedure of THA involves replacing the diseased acetabular cartilage, head and proximal neck of

the femur, and subchondral bone with a prosthesis. Currently, greater than 1 million THAs are performed worldwide each year.[84] Canadian patients underwent 58,492 THAs in 2017 - 2018, with the number increasing by 17.4% within the last 5 years.[83] For the average Canadian, a THA accounts for substantial annual health-care costs amounting to CAD $11,500, excluding physician and rehabilitation expenses.[83]

THA is indicated for several conditions of the hip joint, the most common of these being hip OA.[65,83,84] Conditions such as femoral neck fracture, avascular necrosis, post traumatic arthritis, dysplasia and inflammatory arthritis are also indications for THA; however, hip OA accounts for 81.3% of all THA procedures.[65,83,84] THA is typically performed in the advanced stages of hip OA; yet, the procedure may also be performed earlier in the disease progression based on the functional decline associated with hip OA.[85] THA is considered an effective procedure in alleviating the pain and improving the functional ability and health-related quality of life (QoL).[6,86] After THA, over 90% of people experience significant relief of pain and increased functional ability within 1-2 years of surgery, with the most marked improvements occurring during the first three to six months.[6,7] However, preoperative hip muscle weakness and gait impairments in the affected limb are not fully recovered after THA.[8,87,88] Rasch et al. reported that all preoperative hip muscle (flexors, extensors, and adductors) deficits in the affected limb showed a significant improvement 2-years after THA except for hip abductors deficits, which remained similar.[87] Reduced walking speed and hip range of movement, and decreased peak abduction, extension and external rotation moments during gait-related daily life activities also persist in people after THA compared to healthy older adults.[88]

1.3.1 The modes of failure of THA

THA may last for 25 years; however, it may fail earlier requiring revision surgery, referred to as revision THA (rTHA).[89,90] The rTHA is defined as the replacement of one or more damaged components of the THA.[84] Due to an increasing aging population, the number of rTHA surgeries performed in Canada has increased over time.[83] In Canada, 4,822 revision hip replacements were undertaken in 2017 - 2018, representing 8.2% of all THAs with an increase of 2.2% over the previous five years.[83] While the rTHA represents a small proportion of total annual THAs, the annual cost associated with the rTHA is higher than the primary THA (pTHA). The cost of rTHA is approximately CAD $18,600, a 63% increased from pTHA.[83]

Failure of the pTHA can happen for several reasons.[89,91] The most common reasons for the failure of pTHA include aseptic loosening of the femoral or acetabular components, periprosthetic infection (infection around the prosthesis), dislocation, and periprosthetic fracture around the femoral or acetabular component.[90–92] The modes of the failure are dependent on several factors including, age, obesity, surgical approach, and implant-related factors (e.g., cemented or cementless, modularity).[90,93,94] Obese people who undergo an uncemented pTHA are at a higher risk of failure of the pTHA than non-obese people.[93,95] Periprosthetic fractures have been reported as a leading cause of failure at 29.6% of pTHAs among Canadian females aged 65 - 74, whereas instability (24.4%) has been found as the most common reason for the failure of pTHA in those younger than 55 years.[83]

1.4 Falls in older adults after THA

Although THA is a successful procedure in improving the pain and health-related QoL of people with hip OA, decreased abductor muscle strength and gait imbalance are common after THA.[8–10] These functional deficits are common after pTHA and are exacerbated after rTHA, which may

contribute to a higher risk of falls in older adults with THA.[8,11] Falls are a major public health concern among Canadian older adults (> 65 years).[96] Approximately 20% to 30% of community-dwelling Canadian adults aged > 65 years experience at least one fall in a year, of which 61% are women and 39% are men.[97,98] The incidence of falls increases with age, with 17% of Canadians aged between 65 - 67 years experiencing falls compared to 27% in those aged 85 years or older.[97] The definition of falls differs among studies,[99] the most commonly used definition of a fall is "an unexpected event in which the participants come to rest on the ground, floor, or lower level".[100] The risk factors associated with falls are multifactorial.[101] Falls in older adults occur as a result of the interaction between personal (intrinsic) and environmental (extrinsic) factors.[101] The intrinsic factors are attributed to personal aspects such as increasing age, age-related sarcopenia (loss of muscle tissue), female gender, gait disorder, and cognitive impairment.[101–103] The extrinsic factors are related to the surrounding environment, such as living alone, environmental hazards (e.g., slipping, uneven surfaces), use of walking aids, and medications.[101,103]

In older adults, falls can have serious physical and psychological consequences and reduce their QoL.[104,105] Stel et al. found that 35.3% of older adults who have fallen within the last year reported reduced functional status, and 15.2% reported decreased physical activities as a direct result of the most recent falls.[105] Falls in older adults can lead to serious injuries such as fracture, dislocation, and head trauma.[106] These injuries are leading causes of emergency hospitalizations among older adults.[104] Every year, 81% of injury-induced hospitalizations among Canadian people aged >65 years are due to falls, and one-third of them end up in long-term care facilities.[97,107] The hospital admissions rate due to falls has increased by 9% within the last 3 years.[107] Accidental injuries are the fifth leading cause of unintentional deaths among older adults after cardiovascular disease, cancer, stroke and pulmonary disease, and two-thirds of these deaths are attributed to falls related

injuries.[103] Fear of falling (FOF), a common psychological consequence of falls may lead to reduced confidence, increased dependency, depression, and social isolation among older adults.[108] Individuals who experience falls restrict their daily life activities due to fear of future falling, leading to lower extremity muscle weakness, which can further increase the probability of future falls in older adults.[109] FOF is also a prevalent risk factor for older adults who have not sustained a fall.[109] More than one third of Canadian adults aged 65 years or older perceive a risk of falling regardless of a previous history of falls.[109]

In older adults, the falls risk after THA is significant. Approximately 25% to 36% of people experience at least one fall in the year following THA, which is comparable or slightly increased over risk for community-dwelling older adults.[12,106,110] In a recent meta-analysis, Lo et al. reported a fall rate during the first few days after THA ranging from 0.8% to 2.7%, which increases significantly during the 2-years post-THA which ranged from 3.14% to 51.8%.[111] Within our research group, a previous study on falls after THA in adults aged 60 years or older had also found a 21.5% falls prevalence within one-year after the surgery.[112] The higher fall risk after THA can be influenced by advanced age, female gender, and preoperative history of falls, severe depressive symptoms and comorbidities.[111,113,114] The postoperative factors that are associated with the higher risk of falls after THA include undergoing rTHA, gait imbalance, restricted hip range of motion and prescription medications (e.g., antidepressants).[99,111,115] Advanced age is the most frequently reported risk factor for both in-patient and post-discharge falls after THA, with an additional 7% increase in fall risk for each additional year beyond 65 years.[111]

1.5 Periprosthetic femoral fracture after THA

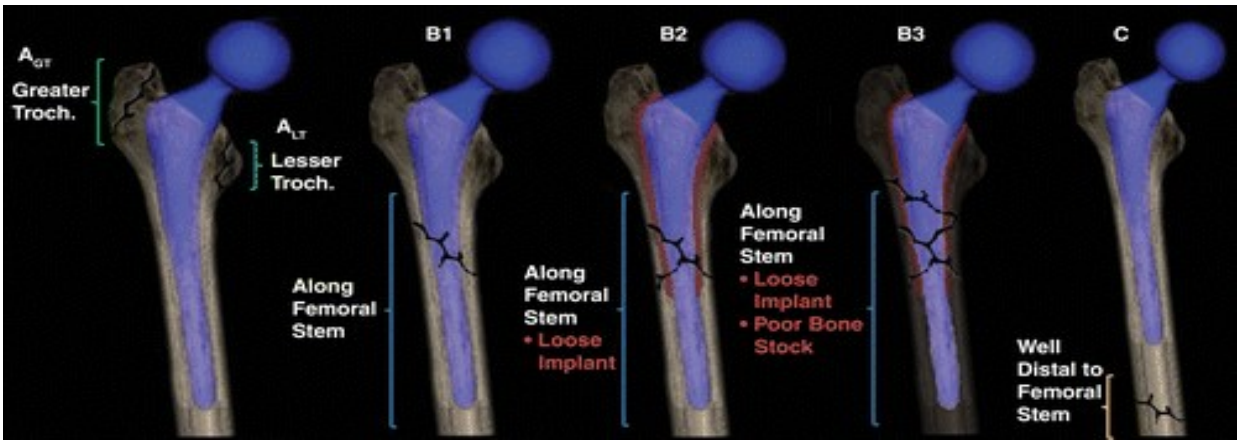
A fracture around the femoral implants in the THA, known as periprosthetic femoral fracture (PPF), can be a serious adverse event.[12] PPF can occur either during (intraoperative PPF) or after (postoperative PPF) a THA.[116] The intraoperative PPFs can be occult; however, in most cases they are identified and managed during the THA procedure.[23,116] The majority of intraoperative PPFs (35% - 60%) are related to THA procedures from forceful preparation of the femur or placement of the proximal femoral stem.[117,118] Postoperative PPFs can occur within days to several years after THA.[119] In a Swedish joint registry-based prospective study, Lindahl et. al., found the time interval between pTHA and the occurrence of PPF was 7.49 years, which was shorter in the case of rTHA (3.9 years).[119] A decrease in the time to PPF was observed as the number of rTHA increased, the time was reduced to 3.8 years with two rTHAs and 2.3 years for 3 or more revision surgeries.[119] Approximately 70 - 81% of the postoperative PPFs in older adults occur as a result of low energy traumas such as falls.[119,120]

Most people with a PPF after THA present with a sudden onset of thigh pain and difficulty in ambulation.[22,121] Diagnosis of PPF is made by obtaining a medical history, reviewing the previous surgical history, and performing a thorough clinical examination.[22] Plain radiography of the affected femur and pelvis is performed to identify and locate the fracture, and associated implant loosening.[22] A suspicion of periprosthetic infection being present prior to sustaining a PPF warrants further investigations such as blood profile or aspiration for cultures.[22,121] Diagnosis of PPF is confirmed by history of trauma along with the presence of the radiolucent lines in the plain radiography indicating a fracture around the implant.[22]

1.5.1 The classification of PPF

Several classification systems have been adopted to guide the treatment of PPF; however, the Vancouver classification (Figure 1.1) is the most commonly used scale due to its significant intra- and inter-observer reliability.[24,122,123] The Vancouver classification system for PPF, developed by Duncan and Masri in 1995, is based on the anatomic location and pattern of the fracture, prosthesis stability, and the proportion of bone loss.[24,121] The Vancouver classification of PPF is divided into three categories, that include type A, type B and type C.[124] The type A fracture is considered when the fracture is around the trochanteric area of the femur, and this category is further subdivided into AG (fracture around the greater trochanter) and AL (fracture of the lesser trochanter). The type B fracture is associated with the fracture around the shaft of the femur. The type B fracture has three subdivisions according to the fracture position and prosthesis stability, which are B1(fracture with a stable prosthesis), B2 (fracture with loose prosthesis), and B3 (fracture with loose prosthesis and bone loss). The type C fracture is considered when the fracture occurs beyond the tip of the femoral stem.

Figure 1.1: The Vancouver classification of periprosthetic femoral fracture. (Adapted with permission from © Marshall R A, Weaver M J, Sodickson A, et al. Periprosthetic femoral fractures in the emergency department: What the orthopedic surgeon wants to know. RadioGraphics 2017;37: 1202 1217).



1.5.2 Epidemiology of PPF

There is considerable variation in the reported incidence of PPF after THA among existing studies, which is likely due to significant variation in the patient demographics, differences in the reported length of the follow-up period after the THA, and the reporting of only PPFs that underwent surgery.[13,116] Additionally, to our knowledge, there is no epidemiological study of PPF after THA that is based on a Canadian sample.

The incidence of PPF ranges from 0.07% to 11% for pTHA and increases after rTHA from 1.19% to 18%.[116,120,125,126] The incidence rate is greater in those who undergo uncemented femoral stems (0.47% to 7.1%) during THA compared to cemented femoral stems (0.07% - 3.5%).[116,118] The cumulative incidence of PPF rises as the duration between the primary surgery and the occurrence of PPF increases.[118] In a large U.S. based cohort study of 32644 pTHAs over a 40-year period, Abdel et al. reported the cumulative incidence rate of PPF increased from 0.4% at one-year to 3.5% at 20 years after pTHA.[118] Although a small proportion of older adults sustain PPF after THA, the number of PPFs is expected to increase in coming years.[127] The incidence of PPF is expected to observe a 4.6% rise every 10 years over the next 30 years.[127] This phenomenon will likely be observed due to a significant increase in the aging population who have pTHAs and rTHAs performed every year, combined with higher falls rates in older adults.[125,127]

1.5.3 Risk factors of PPF

Several patient and surgery-related risk factors have been identified that are associated with the risk of PPF after THA.[13] Advanced age is the most common risk factor of PPF after THA, which is likely due to age-related osteoporosis and increase in falls risk.[15,116,128,129] The risk of PPF is 4.4 fold higher among people aged 80 years or older compared to younger adults.[125,128] Although there

are controversial findings regarding gender and its relation to PPF, [13,117] several studies have shown that female gender is associated with a higher risk of PPF.[126,129] The risk of PPF is further exacerbated in people with inflammatory arthropathies (e.g., OA, rheumatoid arthritis) and a prior history of trauma, which is speculated to be due to the association of osteoporosis, comorbidities, and steroid use in older adults.[13–15] Undergoing a THA due to a hip fracture has also been found to be associated with an increased risk of PPF.[15]

Surgical techniques, including surgical approach of the pTHA have been found to be influencing factors of PPF.[24,130] Griffiths et al. showed, the risk of a type B fracture occurring within 6 weeks of the index procedure was linked to the direct anterior surgical approach.[130] This is likely due to inadequate exposure of the femur which may result in malpositioning of the femoral component leading to reduced stability of the stem.[130] In the case of both pTHA and rTHA, acetabular under-reaming, forceful femoral insertion, and presence of osteolysis in the greater trochanter have been reported to increase the risk of both intra- or postoperative PPFs.[24,125] The risk of PPF is further influenced by the type of the femoral stem inserted during THA, with the greater risk of both intra- and postoperative PPFs among uncemented femoral stems compared to cemented femoral stems.[14,117,118,131] A recent study found that 65% of type B2 fractures were associated with an uncemented stem, whereas only 39% of type B2 fractures occurred in femurs with cemented femoral stems.[132] Additionally, prior history of ipsilateral lower extremity surgery has been found to increase the risk of PPF by 3 times.[16]

1.5.4 Management of PPF

The management of PPF in older adults can be challenging for the surgeon due to the patient's advanced age, associated comorbidities and osteoporotic bone loss.[123] The aims of the

management of PPF include prevention of fracture non-union, restoration of the bone alignment and pre-PPF functional status, reducing the pain, and improving the QoL.[13,121,124] The treatment of PPF is often guided by the classification of the fracture and patient characteristics such as age, comorbidities, activity level, expectations, and the bone quality.[24]

Un-displaced PPFs with stable implants PPF can be managed with conservative treatment such as weight-bearing restriction and symptomatic pain management; however, displaced fractures with unstable implants warrant surgical treatment.[16,124] The surgical options for managing PPF involve rTHA and/or open reduction and internal fixation (ORIF) of the fracture, with or without bone grafting depending on the type of the fracture.[123] PPF with a stable implant can be managed with ORIF without rTHA; however, PPF with a loose implant requires rTHA.[133] The fixation of the PPF during the ORIF procedure is typically done using locking plate, cable plating, and wires, either singly or in combination.[123] While either of these techniques can be utilized to fix the fracture, no surgical techniques have been found superior over others.[123]

A type A fracture that is un-displaced and stable can be managed conservatively, whereas a displaced type A fracture with or without proximal bone osteolysis may require surgical management.[16,121,133] The type B1 and C fractures can be managed with ORIF due to a stable implant; however, the type B2 and B3 fractures require rTHA and ORIF as these fractures are associated with loose implants.[13,123,124] The combination of rTHA and ORIF for the management of type B2 and B3 fractures has been found to be associated with a 98% union rate and only a 11% failure rate requiring another revision surgery.[123] Impaction bone grafting or insertion of a mega-prosthesis (large prosthesis) may be indicated in cases of type B3 fractures due to the association of inadequate bone stock that makes the surgical procedure challenging for these fractures.[123,133]

1.5.5 Outcomes of PPF in older adults

While PPF is a rare complication of THA, it can have unfavourable clinical outcomes in older adults.[17,18] Approximately 13% - 32% of PPFs are associated with postoperative complications such as wound infection, re-fracture, dislocation, non-union and aseptic femoral loosening, which subsequently require re-intervention.[19,134–138] In a prospective study of 1049 cases spanning 22 years, Lindahl et al. reported that 61% of people with PPF who underwent rTHA experienced variable degrees of pain after the surgery, and 23% of the people required re-operation.[119] Those who required re-operation, 44.5% of them were re-operated within 12 months postoperatively.[119] The re-operation rate after surgical treatment of PPF is higher among the people who undergo ORIF without rTHA than the people with rTHA.[19] The majority of the people who undergo surgical management for PPF suffer from significant pain, reduced mobility, worse hip function and difficulty in returning back to pre-PPF functional status even after achieving fracture union.[17,19–21] A previous history of rTHA prior to sustaining a PPF is associated with significant impaired function compared to PPF after pTHA.[19]

The mortality rate among people with PPF is significantly high, with the cumulative mortality rate ranging from 21% - 46%, and 11% to 17% of deaths occurring during the first postoperative year.[18,20,21,138,139] The majority of the deaths after PPF occurs within 2 weeks to 6 months from their surgery for PPF.[21,140] Managing PPF by ORIF without rTHA has a higher mortality rate than PPFs that are treated with rTHA.[18] Bhattacharyya et al. found the mortality rate among people with type B PPF who underwent ORIF without rTHA was 33% compared to people who had rTHA (12%) to fix the fracture, which is likely due to earlier return to weight-bearing status after rTHA.[18]

The mortality risk after PPF is further increased in people with comorbid orthopaedic conditions.[141]

1.6 Summary

Hip OA is the most common degenerative lower limb arthritis in older adults. A total hip arthroplasty (THA) is typically performed in the advanced stages of hip OA once conservative management has been exhausted. Total hip arthroplasty is an effective procedure in reducing pain, improving physical function and health-related QoL in older adults with hip OA. Despite being considered a successful procedure, gait imbalance and reduced lower extremity abductor muscle strength are common after THA. These functional deficits along with advanced age result in an increased falls risk after THA in older adults. Falls after THA can lead to severe injuries in older adults such as PPF.

The majority of PPFs after THA require revision surgery to fix the fracture and restore the pre-PPF functional status. The management of PPF is often challenging for the orthopaedic surgeon due to the occurrence of PPF at an advanced age and poor bone stock surrounding the fracture. Despite achieving fracture union after the appropriate surgical management, PPF is associated with a high rate of surgical complications and reoperation rates. Previous studies on the outcome of PPF have mainly focused on the surgical complications and mortality rate. Very few studies have evaluated functional and psychological consequences and overall QoL after PPF in the same cohort of older adults. Given the advanced age and the occurrence of PPF due to falls, older adults may remain vulnerable to future falls risk after sustaining a PPF. Falls risk and fear of falling have not been examined in people after sustaining PPF.

The incidence of PPF is growing due to the increasing proportion of older people in the population, falls, and THAs performed every year. Thus, a demand exists to have a better understanding of all aspects of surgical- and patient-relevant outcomes of PPF among older adults. In particular, there has not been a report of PPF after THA evaluating both functional and psychological outcomes among a Canadian sample of adults. Additionally, a comprehensive evaluation of falls risk, fear of falling and the functional and psychological impacts of PPF on a person's life will help health-care providers implement strategies to optimize the well-being and prevent future falls in this patient population.

Chapter 2

Evaluating the functional and psychological outcomes following periprosthetic femoral fracture after total hip arthroplasty.

2.1 INTRODUCTION

A fracture around the implant of a total hip arthroplasty (THA) after surgery, known as a periprosthetic femoral fracture (PPF), is a rare and serious complication in older adults.[17,18] The majority of PPFs after THA in older adults (70% - 81%) occur as a result of falls.[119,120] The consequences of a PPF can be dire, with most people reporting ongoing pain and difficulty in regaining pre-PPF functional status despite achieving fracture union after appropriate surgical treatment for this fracture.[17,19,20] Although the incidence of older adults that have a PPF after THA ranges widely from 0.07% to 18%,[116,120,125,126] it is predicted there will be a 4.6% rise in the number of PPF cases every 10 years over the next 30 years.[127] The combination of an aging population and the higher occurrence of falls among older adults is seen as the driving force behind the expected increase in PPF.[125,127] Therefore, a better understanding of the outcomes of older adults with PPF is warranted to help guide clinical care.

Previous research on the outcomes of PPF after THA has only evaluated post-surgical complications, functional outcomes and the mortality rate. Postoperative complications after PPF surgery are common and include wound infection, re-fracture, dislocation, and aseptic femoral loosening.[19,134–138] Importantly, the mortality rate during the first postoperative year following the PPF surgery is high at 11% to 17%.[18,20,21,138,139,142] Very few studies report functional[17,19,20,137,143] and psychological[137,143] outcomes following the surgical treatment for this fracture. Only one study

by Young et al.[21] assessed the short-term (e.g., at 6 months) functional outcomes and five other studies[17,19,20,137,143] have reported the long-term functional outcomes with a range of mean postoperative follow-up periods from 33.6 to 64.9 months. Young et al.[21] found poorer short-term functional outcomes at 6 months after surgery when compared with a control group of people with a revision THA for aseptic loosening. Zheng et al.[17] reported worse ambulatory status and poor hip function at a mean postoperative follow-up period of 38.2 months in patients with PPF after THA when compared with their preoperative functional status. Although the postoperative follow-up period in this study ranged from 24 to 60 months, the functional outcome scores were averaged and the study did not evaluate the pattern of the functional outcomes over the five year period.[17] In addition, only two studies have evaluated both functional and psychological outcomes in the same cohort of patients and the findings are variable.[137,143] In a study by Märdian et al.[137] patients with PPF after THA demonstrated significant long-term functional and psychological deficits at a mean follow-up of 45 months after undergoing surgery for a PPF. On the other hand, Kinov et al.[143] found 78.6% of the patients with PPF after THA had satisfactory functional and psychological outcomes at a mean follow-up of 5 years after the PPF surgery.

Several studies identified a number of patient- and surgery-related risk factors that are associated with an increased risk of sustaining a PPF after THA, such as advanced age, female gender, inflammatory arthritis, revision THA and cementless stem.[13,15,128,129,144,145] However, literature identifying factors predictive of functional[20,137] and psychological outcomes[137] post- PPF surgery is limited. Only the study by Märdian et al.[137] evaluated factors that are associated with the functional and psychological outcomes. This study reported comorbidities, measured using the American Society of Anesthesiologists (ASA) score, as a negative predictor. However, they did not mention the specific ASA score that is associated with worse functional outcomes and what

other patient or surgical factors were assessed. It is critical for health-care professionals to identify specific patient- and surgery-related factors that are associated with reduced outcomes after the PPF surgery in order to initiate pre- and postoperative interventions, including rehabilitation, to optimize the recovery after this surgery among older adults.

The current study aimed to reduce the knowledge gap regarding the functional and psychological outcomes associated with PPF surgery after THA. The objectives of this study were: 1) to define the clinical and surgical characteristics of people who underwent revision total hip arthroplasty (rTHA) after PPF, 2) to determine the mortality rate after rTHA due to PPF, 3) to evaluate the physical and psychological changes over two-years after surgery, and 4) to evaluate the factors associated with functional and psychological outcomes at one-year after the rTHA for PPF.

2.2 MATERIALS AND METHODS

2.2.1 Study design and participants

This was a retrospective study using an electronic clinical database at London Health Sciences Centre-University Hospital (LHSC-UH), London, Ontario, Canada. This study was approved by the Health Sciences Research Ethics Board at the University of Western Ontario and the Clinical Resources Impact Committee of Lawson Health Research Institute.

Using the electronic clinical database, we identified all patients who had a rTHA with or without open reduction and internal fixation (ORIF) due to a PPF between 2005 - 2019 in London, Ontario, Canada. To be fully comprehensive in patient identification billing codes were searched through for three surgeons who performed the majority of these surgeries at our institution. At our institution, multiple follow-up appointments are routine between surgery and one-year after

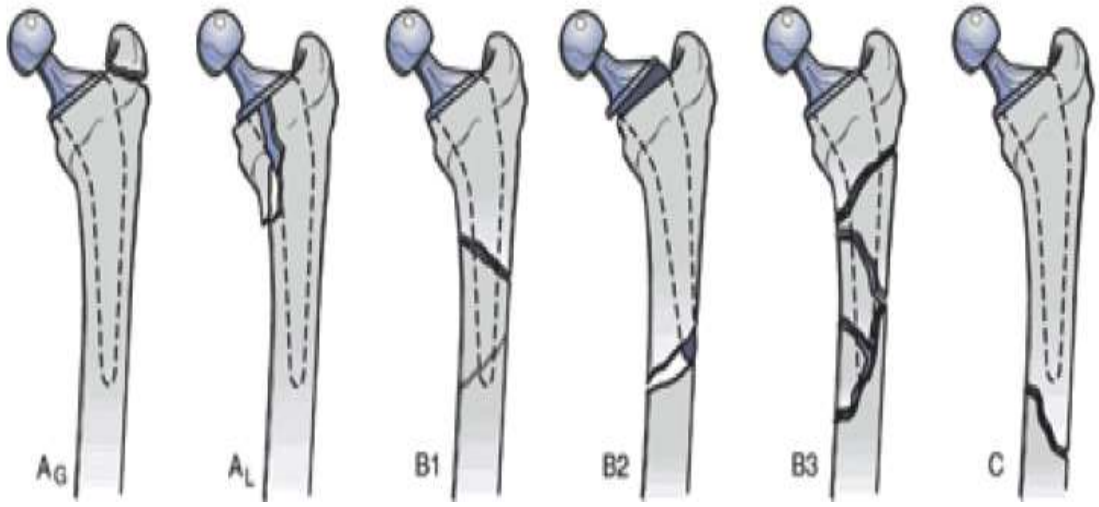
surgery, and then every 1 - 2 years afterwards. Patients' baseline demographics and surgical characteristics were collected from the surgical admission note and then people were followed forward in time to collect data from subsequent post-surgical follow-up clinic visits, from one-year to five-years post-surgery, in the outpatient orthopaedic clinics. Charts reviews were completed between April 29, 2019 and February 29, 2020.

Inclusion criteria were aged 60 years or older and had rTHA with or without ORIF for PPF after THA or hemiarthroplasty (HA) regardless of the mechanism of the PPF and the surgery was performed between 2005 - 2019. Patients were excluded if they sustained a PPF during THA (intraoperative PPF), the fracture was managed conservatively, had a periprosthetic acetabular fracture after THA, PPF occurred after a Birmingham hip resurfacing or a total knee arthroplasty, PPF occurred around antibiotic spacer or pathologic lesion, or if the PPF after HA was revised to HA or Girdlestone resection arthroplasty. Additionally, we excluded patients who underwent ORIF without revision THA for PPF.

Baseline demographic information extracted from the clinical charts was age, sex, the mechanism of injury, any previous lower extremity surgeries performed at our institution either on the same side or opposite side of the PPF surgery, and the index surgical procedure of the hip. The Vancouver Classification System (Figure 2.1) was used to classify the fractures. This classification system, developed by Duncan and Masri in 1995, is based on the anatomic location and pattern of the fracture, the amount of bone loss and prosthesis stability.[24,121] Surgical information extracted was operative diagnosis, surgical approach, type of the fracture fixation (e.g., cable, wire, plate), and bone grafting (e.g., femoral or acetabular). Additionally, we included any special surgical techniques (e.g., extended trochanteric osteotomy) and intraoperative events (e.g., trochanteric

fracture) that occurred during the surgery for the fixation of the PPF. If the fracture type was not mentioned in the clinical charts, author B.L reviewed the radiographs or computed tomography (CT) scans to identify and classify the fractures. Usual clinical practice at our facility included the administration of outcome measures at postoperative follow-up visits. The Harris Hip Score (HHS) and The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) evaluated hip joint and physical function, while the Short Form-12 Survey (SF-12) assessed psychological well-being.

Figure 2.1: The Vancouver classification of periprosthetic femoral fracture.



Note: Vancouver A, Fracture around the trochanteric region (AG= Greater Trochanter, AL= Lesser Trochanter); Vancouver B, Fracture around the femoral stem (B1= well fixed stem, B2= loose stem, B3= loose stem with inadequate bone stock); Vancouver C, Fracture distal to the tip of femoral stem. (Adapted from Francony F, Pailhé R, Gaillot J, Saragaglia D, scidoc.org. Periprosthetic femoral fracture).

2.2.2 Outcome measures

2.2.2.1 The Harris Hip Score (HHS)

The HHS is an outcome measure that is collected by the clinician and covers four domains of pain, function, range of motion, and absence of deformity of the hip joint.[146] The pain domain measures the severity of pain and the requirement of pain medication while performing daily life activities. The function domain is subdivided into gait (e.g., walking distance without using assistive devices, limping examination, mobility aid use) and functional activities (e.g., climbing stairs, tying shoes, public transport, and sitting). The range of motion domain measures the movement in flexion, abduction and adduction, and both internal and external rotation of the hip joint. The deformity domain involves the examination of flexion, abduction, and internal rotation of the hip, and limb length discrepancy. Every question in each domain is rated on a two to six-point Likert scale. The overall score has a maximum of 100 points, a higher score represents better hip function. The minimal clinically important difference, which is the minimal change in scores that are perceived as beneficial to health, for the HHS ranges from 15.9 to 18 points.[147] In THA patients, the HHS has demonstrated excellent reliability.[148]

2.2.2.2 The Western Ontario and McMaster Osteoarthritic Index (WOMAC)

The WOMAC questionnaire assesses pain and physical disability in patients suffering from a variety of orthopaedic conditions. The WOMAC is comprised of 24 questions divided into three domains: pain, stiffness, and physical function.[149] Every question in each domain is rated on an ordinal scale of 0 - 4. The total maximum WOMAC score is 96, where a lower score indicates a better health outcome. A weighted and inverted conversion of scores was used such that the score of each domain is out of 100 and higher scores are indicative of better overall health status. The

minimal clinically important difference for the original version of WOMAC ranges from 9.4 to 25 points.[150–152] In patients with THA, the instrument has demonstrated good to excellent test-retest reliability across the different subdomains.[149]

2.2.2.3 The Short Form-12 Survey (SF-12)

The SF-12 is a self-report questionnaire evaluating a person's overall health-related QoL.[153,154] The instrument is divided into two components: the mental component summary (MCS) and the physical component summary (PCS) scores. The MCS evaluates mental health, social functioning, vitality, and role limitations due to emotional problems. The PCS assesses general health, physical functioning, role limitations due to physical disability, and perceived bodily pain. Both components are scored on a population-normalized scale, with higher scores indicating better health outcomes. The reported minimal clinically important difference is 5 points for both components.[155] The SF-12 has shown to be reliable and valid in older adults.[156]

2.2.3 Data analysis

Objective #1: Descriptive statistics using means and standard deviations, or frequencies and percentages were used, as appropriate, to summarize the baseline demographics, clinical, and surgical characteristics.

Objective #2: A Kaplan Meier curve of cumulative survival for time to death after the PPF surgery over a period of 12 years was plotted for the whole sample and then the sample stratified by gender. The cumulative survival time was reported using median and 95% confidence interval. A log rank test evaluated differences in the survival distributions between males and females. The death was confirmed by reviewing the clinical charts and searching through online obituary records in the

public domain. If the death was not confirmed, cases were considered censored based on their last recorded activity in the electronic database for any inpatient admission or outpatient visit at LHSC-UH from the time of the PPF surgery to the end date of the data collection for this study, which was February 29, 2020.

Objective #3: The scores on WOMAC, HHS, and SF-12 PCS and MCS from the one-year to five-years follow-up period were summarized as means and standard deviations. The scores on the HHS were graded as poor (< 70), fair (70 - 79), good (80 - 89) or excellent (90 - 100).[146] For the WOMAC and SF- 12 PCS and MCS, scores were compared with the normative data (WOMAC:[157] 2.4 (0 - 100 scale, 0 being best outcome and 100 being the worst outcome), and PCS:[158] 42.0 and MCS:[158] 54.5). Change in WOMAC, HHS, and SF-12 PCS and MCS scores was evaluated using paired t-tests for people with both one-year and two-years follow-up. The statistical significance for paired t-tests was corrected for multiple comparisons using the Holm-Bonferroni method, $p < 0.013$.

People with one-year follow-up data were stratified into fallers and non-fallers based on the mechanism of the PFF as recorded in the clinical charts and outcome measure scores were summarized with median and interquartile range (IQR). Mann-Whitney U tests were performed to compare the outcome scores at one-year post-PPF surgery between fallers and non-fallers.

In addition, comparison of the baseline demographics and surgical information was done between the patients that had at least one outcome measure score over the five-years follow-up period and the patients with no available outcome measures data during the period. Another comparison of the baseline demographics and surgical characteristics was made between the patients that died within the first postoperative period and those who were alive and had one-year outcome measures

data. Independent t-tests were used for the comparison between continuous data. Chi-square tests of homogeneity and Fisher's Exact test were used for comparison between nominal variables as appropriate. The normality of continuous data was determined by Shapiro-Wilk tests and the visual inspection of the normal Q-Q plots. Statistical significance corrected for multiple comparisons was set at $p < 0.008$ for the first comparison and $p < 0.01$ for the second comparison using the Holm-Bonferroni method.

Objective #4: The association between baseline demographic, clinical, and surgical factors on each of the one-year post-PPF surgery outcome measures of SF-12 MCS and PCS, HHS and WOMAC was modelled using linear regression. Initial analysis involved separate univariate linear regression models for each independent variable. If statistically significant in the univariate analysis, variables were included in a multivariable linear regression model. Statistical significance corrected for multiple comparisons was set at $p < 0.01$ using the Holm-Bonferroni method. Independent variables of interest were selected based on previous literature and clinical significance. The following independent variables were assessed for inclusion in the regression models: age (continuous), sex (male/female), previous lower extremity surgeries performed at our institution (yes/no), femoral bone grafting (yes/no), and the Vancouver classification. For the Vancouver classification variable, the fracture types were categorized into two groups based on the presence of inadequate bone stock surrounding the implant. The four fracture types (AG, AL, B1, and B2) were combined to form one category and fracture type B3 as another category.

SPSS version 26 (IBM Corporation, Armonk, NY) was used to analyze the data.

2.3 RESULTS

2.3.1 Baseline demographics & clinical characteristics

An initial 290 rTHAs performed due to a hip fracture were identified between 2005 - 2019 in the electronic clinical database and 509 hip procedures performed between 2016 - 2019 were extracted from the billing codes. Cases were then screened to identify the patients that had undergone a rTHA with or without ORIF due to a PPF (Appendix 2.1). A total of 130 patients were included in the analysis. At baseline, the average age was 80.6 ± 9.0 years, 55.4% (n= 72) female, and 24.6% (n= 32) had a history of previous lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side. In 66.2% (n= 86) of patients the PPF occurred after a primary THA, 15.4% (n= 20) patients had the fracture after a HA, 9.2% (n= 12) after a rTHA, and for 9.2% (n= 12) patients the primary procedures were unknown. The majority of the patients sustained PPF due to a fall (77.7%, n= 101) and 57.7% (n= 75) had a type B2 Vancouver classification fracture (Table 2.1).

2.3.2 Surgical characteristics

One hundred and twenty-eight (98.5%) patients had a rTHA and ORIF to fix the fracture, cables were used to fix 40.0% (n= 52) of PPFs, and 26.2% (n= 34) of patients had both cables and wires (Table 2.2). A trochanteric fracture occurred during the rTHA for the PPF in 1.5% (n= 2) patients and wires were used to fix this intraoperative fracture. The acetabular liner was exchanged during the rTHA for 51.5% (n= 86) of patients, and 14.6% (n= 19) had revision of both the acetabular liner and cup. In total 26.9% (n= 35) of patients had femoral bone grafting, 3.8% (n= 5) had acetabular bone grafting, and 3.1% (n= 4) had both femoral and acetabular bone grafting.

Table 2.1: Demographic and clinical characteristics of the patients who had revision total hip arthroplasty with or without open reduction and internal fixation for a periprosthetic femoral fracture. (n= 130)

Variable	**Mean ± SD, [Range] or n (%)**
Demographic Characteristics	
Age (years)	80.6 ± 9.0, [60.3 – 99.7]
Sex, Female	72 (55.4)
Clinical Characteristics	
Mechanism of the Periprosthetic Femoral Fracture	
Fall	101 (77.7)
Non-traumatic	10 (7.7)
Missing information	19 (14.6)
Vancouver classification of Periprosthetic Femoral Fracture	
AG	2 (1.5)
AG and AL	1 (0.8)
B1	5 (3.8)
B2	75 (57.7)
B3	47 (36.2)
Index Surgical Procedure of Hip	
Primary Total Hip Arthroplasty	86 (66.2)
Revision Total Hip Arthroplasty	12 (9.2)
Hemiarthroplasty	20 (15.4)
Missing information	12 (9.2)
Previous Lower Extremity Surgeries, Yes*	32 (24.6)

Note: "*" lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side.

Table 2.2: Surgical characteristics of the patients who had revision total hip arthroplasty with or without open reduction and internal fixation for a periprosthetic femoral fracture. (n= 130)

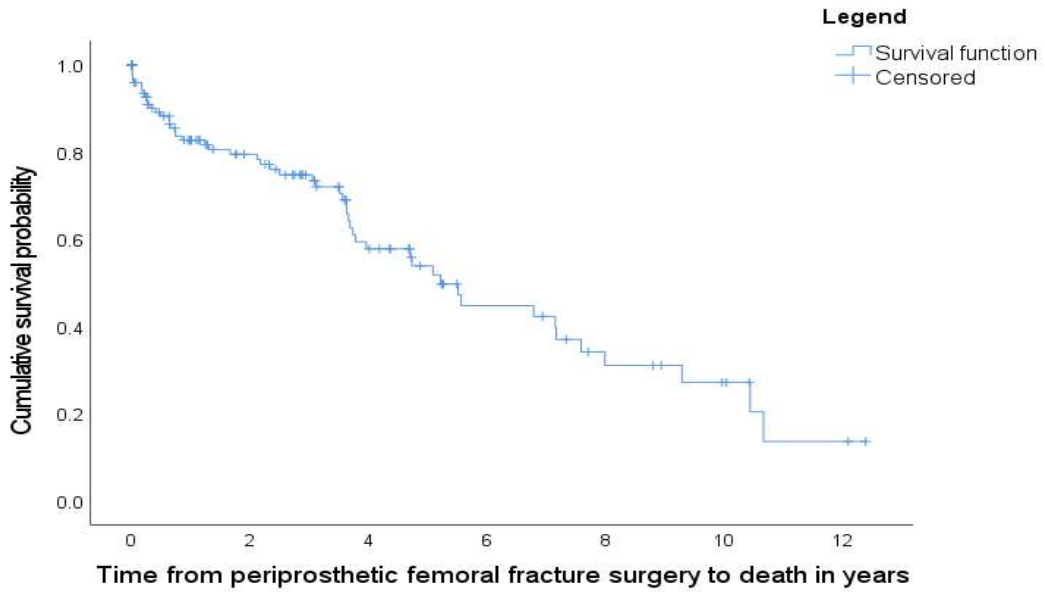
Variable	**Mean ± SD, [Range] or n (%)**
Surgical Characteristics	
Surgical Approach	
Direct Lateral	119 (91.5)
Posterior	11 (8.5)
Main Surgical Procedure for Periprosthetic Femoral Fracture	
Revision Total Hip Arthroplasty and ORIF	128 (98.5)
Revision Total Hip Arthroplasty	2 (1.5)
Periprosthetic Femoral Fracture Fixation	
Cable	52 (40.0)
Wire	33 (25.4)
Cable and Wire	34 (26.2)
Accord Cable Plate	6 (4.6)
Plate-Screw and Cable	3 (2.3)
No fixation	2 (1.5)
Types of the Special Surgical Techniques	
None	109 (83.8)
Extended Trochanteric Osteotomy	15 (11.5)
Extended Trochanteric Osteotomy and Hardware removal	1 (0.8)
Femoral Osteotomy	4 (3.1)
Hardware removal	1 (0.8)

Note: ORIF, Open Reduction and Internal Fixation.

2.3.3 Survival distribution of the study sample

For the complete sample (n= 130) over a 12-year span, a total of 40% (n= 52) patients died and 60% (n= 78, male= 30 and female= 48) were censored (Figure 2.2). The median survival time from the time of PPF surgery to death was 5.2 years (95% CI: 4.3, 6.2). The mortality rate for our study sample was 3.8% (n= 5) at 30 days, 15.4% (n= 20) at one-year, and 38.5% (n= 50) at ten-years from their surgery for the PPF.

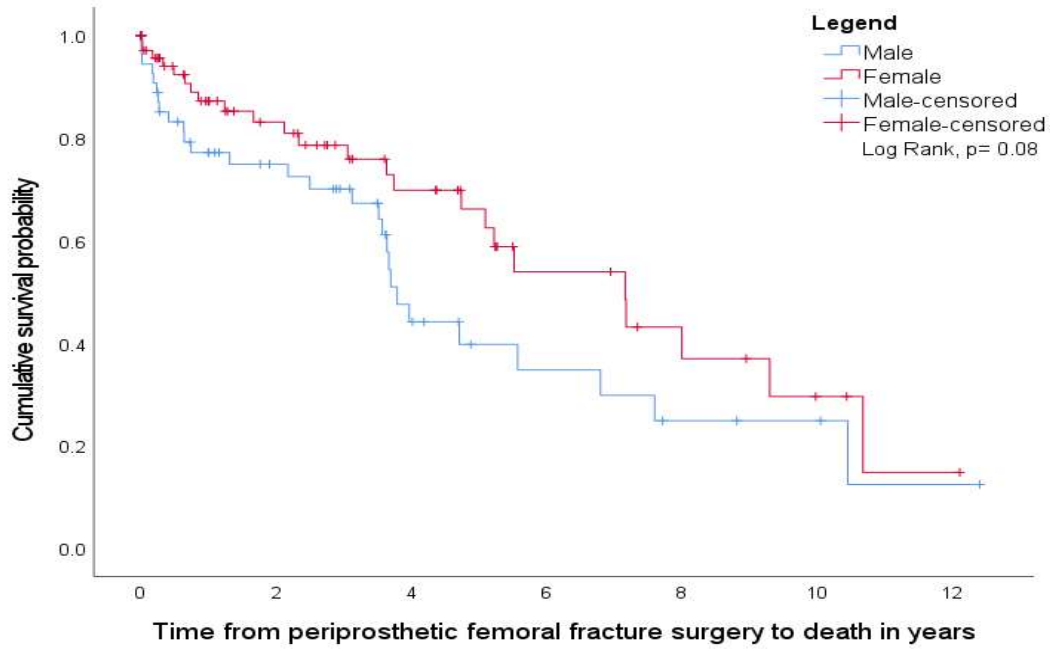
Figure 2.2: Kaplan-Meier curve of the time from the surgery for periprosthetic femoral fracture surgery to death in years. (n= 130)



When the sample was stratified by sex, 48.3% (28 of 58) of males and 33.3% (24 of 72) of females died over the 12-years after the PPF surgery (Figure 2.3). The median survival time was 3.8 years (95% CI: 3.4, 4.2) for males and 7.2 years (95% CI: 4.8, 9.5) for females. There was no statistically significant difference (p= 0.08) between the groups in survival. The comparison between the patients that died within the first-year postoperative period and the patients who were alive and had one-year outcome measures data showed a significant difference for baseline age ($p < 0.001$)

and no significant difference ($p > 0.01$) for sex, mechanism of PPF, Vancouver classification of PPF, index surgical procedure of hip, and previous history of the lower extremity surgery.

Figure 2.3: Kaplan-Meier curve comparing the difference in the survival time between male and female groups from the surgery for periprosthetic femoral fracture to death in years; 52 patients died after PPF surgery within 12 years. (n= 130)

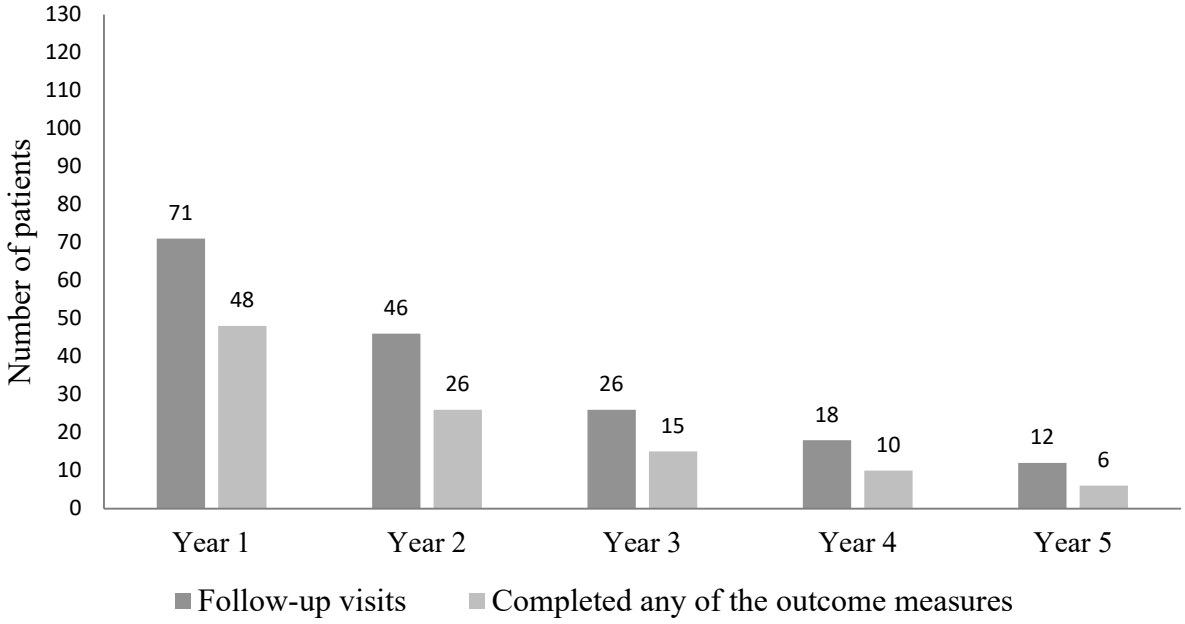


2.3.4 Functional and psychological outcomes after surgery for PPF

Only 54.6% (n= 71) of patients returned to the outpatient clinic one-year after their PPF surgery. Of these patients, 36.9% (n= 48) had data for at least one of the outcome measures of interest (Figure 2.4). At year five, only 6 (4.6%) patients returned to clinic and had at least one outcome measure score. Comparison between the patients with available follow-up outcome measures data and those with no available values for the outcome measures demonstrated no significant

differences ($p > 0.008$) on baseline age, gender, mechanism of PPF, Vancouver classification of PPF, index surgical procedure of hip, and previous history of the lower extremity surgery.

Figure 2.4: The number of patients that visited orthopaedic outpatient clinic and completed at least one outcome measure from one-year to five-years after their revision total hip arthroplasty due to periprosthetic femoral fracture. (n= 130)



2.3.4.1 Functional and psychological outcomes

The mean total score of the WOMAC was 67.9 ± 20.3 (n= 37) at one-year follow-up after a PPF surgery (detailed subdomains scores are presented in Table 2.3). Average HHS scores were 78.3 ± 15.0 at one-year post-PPF surgery, representing a fair hip joint function (detailed subdomains scores are summarized in Table 2.3). For SF-12 PCS and MCS, the mean scores at one-year after a PPF surgery were 34.6 ± 10.8 and 52.7 ± 9.1, respectively. Values for the WOMAC, HHS, and SF-12 PCS and MCS from the two-years to five-years follow-up visits were present for 2.3% to 20% of patients who were assessed during this time points and had outcome measure values (Table

2.3). Therefore, change in scores was only determined from one-year to two-years. Change in scores were non-significant for the WOMAC (n= 17) (Year-1: 70.7 ± 19.7, Year-2: 78.6 ± 15.2; p= 0.07), and HHS (n= 15) (Year-1: 77.4 ± 17.0, Year-2: 78.6 ± 20.0; p= 0.84) total scores. Additionally, there was no significant difference in scores for the SF-12 (n= 20) PCS (Year-1: 35.5 ± 11.6, Year-2: 35.2 ± 10.2; p= 0.88), and MCS (Year-1: 52.1 ± 10.4, Year-2: 51.2 ± 9.2; p= 0.80).

No statistically significant differences were found between fallers and non-fallers for the WOMAC total scores at one-year post-PPF surgery [faller (n= 25): median= 69.0 & IQR= 48.2 - 82.6, non-faller (n= 6): median= 70.0 & IQR= 63.0 - 77.0, p= 0.29], and HHS [faller (n= 24): median= 79.0 & IQR= 73.8 - 87.8, non-faller (n= 5): median= 66.0 & IQR= 66.0 - 79.0, p= 0.18]. Similarly, there was no statistically significant difference between fallers and non-fallers for the SF-12 PCS [faller (n= 32): median= 32.2, IQR= 26.2 - 43.5; non-faller (n= 7): median= 28.1 & IQR= 26.2 - 37.6, p= 0.40], and MCS [faller (n= 32): median= 52.0, IQR= 44.3 - 58.5; non-faller (n= 7): median= 55.0, IQR= 53.6 - 59.9, p= 0.29].

2.3.5 Factors associated with functional and psychological outcomes at one-year after the PPF surgery

In total, 24.6% to 35.4 % of patients with baseline data had one-year data available for linear regression modeling. In the univariate regression analyses, no significant association was found between age, gender, previous history of lower extremity surgery, the Vancouver classification, and femoral bone grafting and the outcomes of the WOMAC (Table 2.4), HHS (Table 2.5), SF-12 PCS (Table 2.6) and MCS (Table 2.7) total scores. The multivariable linear regression analyses were not performed for any of the independent variables as *a priori* univariate criteria were not met.

Table 2.3: Patient's average scores on the functional and psychological outcome measures from one-year to five-years after the revision total hip arthroplasty for a periprosthetic femoral fracture.

Domain	**Mean ± SD**				
	Year One	**Year Two**	**Year Three**	**Year Four**	**Year Five**
WOMAC scores					
Pain	76.0 ± 22.0 n= 39	87.3 ± 17.9 n= 26	72.9 ± 23.1 n= 14	80.5 ± 24.3 n= 10	82.5 ± 21.8 n= 4
Stiffness	62.5 ± 24.7 n= 39	75.0 ± 22.1 n= 26	65.2 ± 19.7 n= 14	75.0 ± 27.0 n= 10	60.0 ± 28.5 n= 5
Function	62.4 ± 24.0 n= 37	73.7 ± 18.4 n= 26	74.0 ± 18.5 n= 14	76.8 ± 22.2 n= 9	58.7 ± 27.8 n= 5
Total score	67.9 ± 20.3 n= 37	79.7 ± 15.3 n= 26	71.7 ± 18.4 n= 14	81.3 ± 18.2 n= 9	73.8 ± 22.7 n= 4
Harris Hip Scores					
Pain	39.0 ± 8.2 n= 37	39.0 ± 9.5 n= 23	38.7 ± 8.8 n= 14	38.9 ± 6.3 n= 7	38.5 ± 6.0 n= 4
Function	30.6 ± 10.4 n= 34	31.1 ± 11.6 n= 22	34.8 ± 11.1 n= 12	33.7 ± 9.9 n= 7	27.7 ± 11.2 n= 3
Total score	78.3 ± 15.0 n= 32	78.9 ± 18.7 n= 22	84.8 ± 16.7 n= 11	83.2 ± 15.2 n= 6	74.0 ± 17.4 n= 3
Short Form-12 Scores					
PCS	34.6 ± 10.8 n= 46	34.0 ± 9.9 n= 25	37.1 ± 11.1 n= 15	40.0 ± 11.3 n= 10	37.7 ± 9.7 n= 6
MCS	52.7 ± 9.1 n= 46	51.0 ± 9.2 n= 25	48.3 ± 9.5 n= 15	48.0 ± 11.9 n= 10	52.2 ± 9.8 n= 6

Note: MCS, Mental Component Summary Scale; PCS, Physical Component Summary Scale; WOMAC, Western Ontario and McMaster Universities Arthritis Index.

Table 2.4: Linear regression model examining the association between baseline patient's demographic, clinical, and surgical characteristics to the WOMAC total score at one-year after the surgery for periprosthetic femoral fracture. (n= 37)

Unadjusted Model			
	r^2	Unstandardized β (95% CI)	p-value
WOMAC total score at one-year			
Age (Years)	0	0.02 (- 0.90, 0.94)	0.97
Sex, Male	0	- 2.66 (- 16.80, 11.47)	0.70
Previous History of Lower Extremity Surgery,* Yes	0.01	- 3.51 (- 18.48, 11.47)	0.64
Vancouver Classification (AG/AL/B1/B2 or B3)			
B3	0.04	- 9.11 (- 23.81, 5.59)	0.22
Femoral Bone Graft, Yes	0	1.20 (- 13.82, 16.22)	0.87

Notes: WOMAC, Western Ontario and McMaster Universities Arthritis Index. "*" lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side. Statistical significance corrected for multiple comparisons using the Holm- Bonferroni method, $p < 0.01$.

Table 2.5: Linear regression model examining the association between patient's demographic, clinical, and surgical characteristics to the Harris Hip Score total score at one-year after the surgery for periprosthetic femoral fracture. (n= 32)

Unadjusted Model			
	r^2	Unstandardized β (95% CI)	p-value
Harris Hip Score total score at one-year			
Age (Years)	0.16	- 0.76 (- 1.41, - 0.11)	0.02
Sex, Male	0.02	- 3.80 (- 14.95, 7.34)	0.49
Previous History of Lower Extremity Surgery,* Yes	0.07	8.88 (- 2.93, 20.702)	0.14
Vancouver Classification (AG/AL/B1/B2 or B3)			
B3	0.02	4.42 (- 7.08, 15.92)	0.44
Femoral Bone Graft, Yes	0.09	10.98 (- 1.73, 23.68)	0.09

Note: "*" lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side. Statistical significance corrected for multiple comparisons using the Holm- Bonferroni method, $p < 0.01$.

Table 2.6: Linear regression model examining the association between patient's demographic, clinical, and surgical characteristics to the Short Form-12 PCS score at one-year after the surgery for periprosthetic femoral fracture. (n= 46)

Unadjusted Model			
	r^2	Unstandardized β (95% CI)	p-value
Short Form-12 Physical Component Summary Score at one-year			
Age (Years)	0.06	- 0.35 (- 0.76, 0.06)	0.09
Sex, Male	0.08	- 6.24 (- 12.54,0.07)	0.05
Previous History of Lower Extremity Surgery,* Yes	0	- 0.49 (- 7.86, 6.89)	0.90
Vancouver Classification (AG/AL/B1/B2 or B3)			
B3	0.01	1.03 (- 3.32, 5.37)	0.64
Femoral Bone Graft, Yes	0.03	3.72 (- 2.98, 10.43)	0.27

Note: PCS, Physical Component Summary Score. "*" lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side. Statistical significance corrected for multiple comparisons using the Holm- Bonferroni method, $p < 0.01$.

Table 2.7: Linear regression model examining the association between patient's demographic, clinical, and surgical characteristics to the Short Form-12 MCS score at one-year after the surgery for periprosthetic femoral fracture. (n= 46)

Unadjusted Model			
	r^2	Unstandardized β (95% CI)	p-value
Short Form-12 Mental Component Summary Score at one-year			
Age (Years)	0	- 0.07 (- 0.42, 0.29)	0.70
Sex, Male	0.05	- 3.95 (- 9.38, 1.478)	0.15
Previous History of Lower Extremity Surgery,* Yes	0	0.37 (- 5.86, 6.60)	0.91
Vancouver Classification (AG/AL/B1/B2 or B3) B3	0.04	- 2.39 (- 6.00, 1.22)	0.19
Femoral Bone Graft, Yes	0	- 0.09 (- 5.84, 5.66)	0.98

Notes: MCS, Mental Component Summary Score. "*" lower extremity surgeries performed at our institution either on the same side of the PPF surgery or the opposite side. Statistical significance corrected for multiple comparisons using the Holm- Bonferroni method, $p < 0.01$.

2.4 DISCUSSION

Patients with a rTHA due to a PPF had fair hip joint function, and poor overall physical function and psychological well-being. The one-year postoperative mortality rate for our sample was 15.4% and the study population showed a decline in survival probability over 12-years following the PPF surgery. The mechanism of the PPF (fall or non-trauma) was not associated with the functional and psychological outcomes at one-year post-PPF surgery. Despite the complexity of the surgery and recovery inherent in PPF surgery, we found no further recovery in hip joint function, physical function, or psychological well-being from one-year to two-years post-PPF surgery. Additionally, no baseline clinical or surgical characteristic were associated with any of the outcomes of interest at one-year following the PPF surgery. Our findings in this study are novel and expand the current knowledge of the long-term adverse effects of PPF surgery on the functional and psychological well-being in older adults. In addition, this is the first study to have evaluated the impact of the mechanism of the PPF (falls or non-trauma) on the functional and psychological outcomes at one-year following a rTHA due to PPF.

Previous research that measured functional outcomes[17,19–21,137] with the WOMAC, HHS or Oxford hip score and psychological outcomes[137] using the Short Form-36 MCS for PPF after THA demonstrated reduced ability in both domains following the surgery, which is comparable with our results. The study by Kinov et al.[143] reported better functional outcomes scores after PPF surgery compared to the other published studies. The difference between our findings and Kinov et al.[143] is likely related to age difference in the studies, our cohort was 13.7 years older and 30.9% of our patients with one-year functional data had a history of previous lower extremity surgery compared

to a relatively younger and healthier cohort. Our population demonstrated better psychological outcome scores than the Kinov et al.[143] cohort, yet these scores are lower than normative data for age and sex-matched Canadian general population.[158] Factors such as comorbidities and preoperative poor psychological status and disability are known to affect the psychological well-being in patients following THA and may be relevant for people after PPF surgery as well.[159] Thus, future research should evaluate these factors in the evaluation of well-being after the PPF surgery.

The mean follow-up period in existing research varied between 33.6 to 64.9 months[17,19,20,137,143] and provided a summary on outcomes rather than a detailed evaluation over discrete time frames, for example yearly, which our study was able to evaluate. In our study, patients alive at one-year post-PPF surgery with outcome measures data and those who died within a year of surgery significantly differed on the baseline age. Although these groups did not differ on any other baseline characteristics that we evaluated, it should be considered that we were constrained by the variables that were collected as part of the routine clinical practice. Therefore, we were unable to evaluate other relevant factors such as comorbidities, pre-PPF ambulatory status, and preoperative psychological outcomes scores that could confirm if the patients that were alive and had outcome measures data were healthier. Thus, there is still a potential that we might have seen a healthy survivor effect in our study. Additionally, the change in WOMAC, HHS, and SF-12 PCS and MCS was not statistically significant and did not meet a clinically relevant difference. Therefore, a dedicated prospective study that is adequately powered should be conducted to evaluate the pattern of the long-term functional outcomes following the PPF surgery.

The one-year postoperative mortality rate for our study at 15.4% was comparable with the one-year mortality rate of 17% reported by Moreta et al.[20] The study by Moreta et al.[20] had a similar

distribution of sex, mechanism of fracture and used the Vancouver classification of the fractures as well. In a retrospective study of 291 people with PPFs after THA or total knee arthroplasty, Drew et al.[138] determined advanced age at the time of the surgery as a risk factor for increased mortality at one-year after the PPF surgery. Consistent with the findings of the Drew et al.[138] study, the highest number of patients died within the first year after surgery and they were older at the time of surgery than those who survived.

In this present study, we found no significant association between age, gender, previous lower extremity surgery, the Vancouver classification, and femoral bone grafting on the functional and psychological outcomes at one-year following the surgery. Märdian et al.[137] and Moreta et al.[20] also reported no significant association between the Vancouver classification on the post-PPF surgery functional outcome in patients with PPF after THA. In contrast to our study, the Moreta et al.[20] study reported functional outcome in terms of the recovery of the pre-PPF ambulatory status and they did not evaluate the association between the Vancouver classification on the psychological outcomes of the surgery. Similar to the two mentioned studies, we had a relatively small sample size and incomplete one-year outcome measures data following the PPF surgery resulting in power issues to find a statistically significant association. Therefore, prospective cohort studies with larger sample sizes and procedures in place to limit losses to follow-up within the cohort would be beneficial.

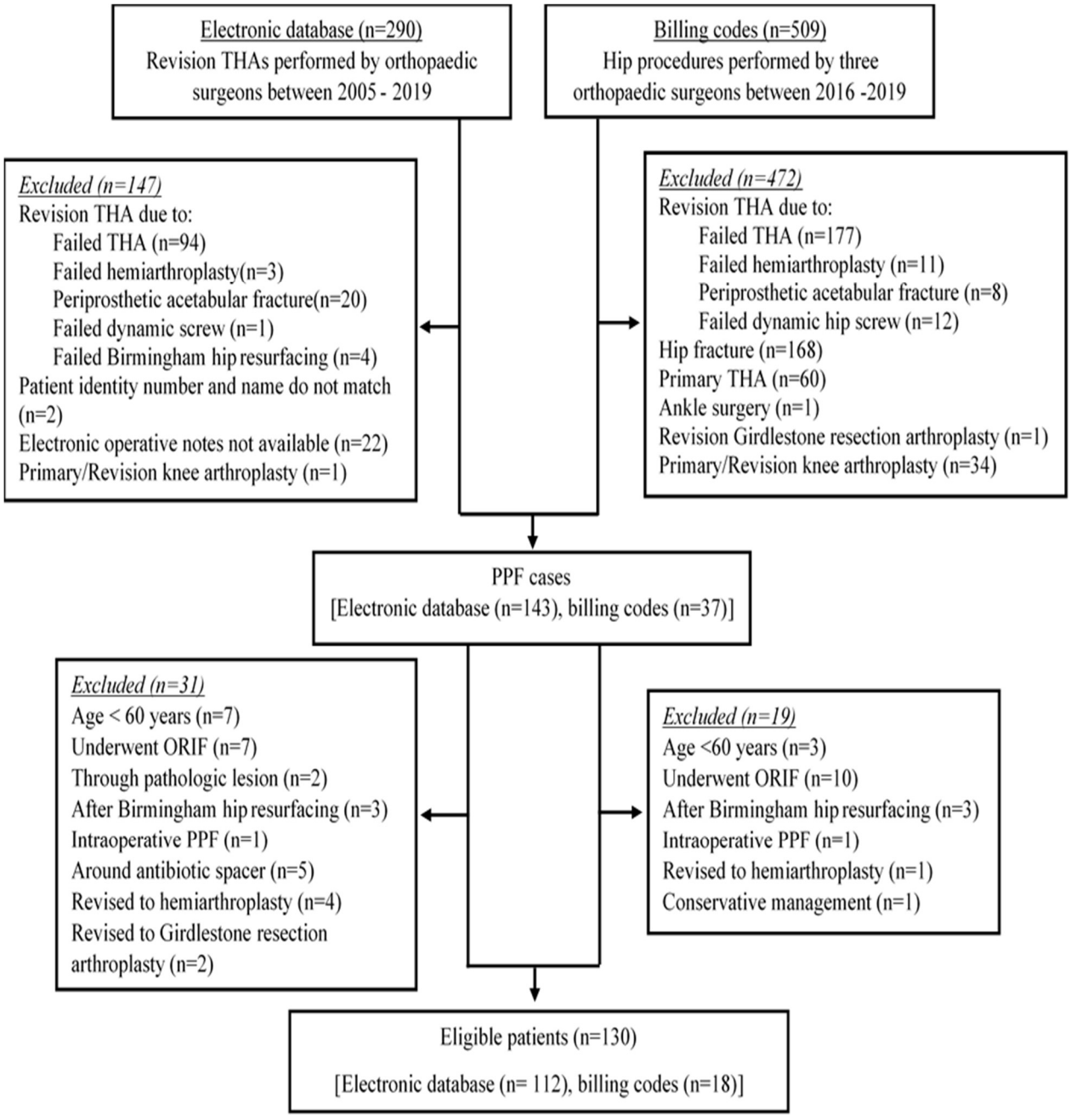
There are limitations in the study which need to be acknowledged. In this study, follow-up data was incomplete after baseline which impacts the power of the study to detect statistically significant differences. Another potential limitation was a high percentage of censored data for the survival analysis, which might have led to a conservative estimate of the overall mortality rate for

our study population. We did not evaluate people who had PPFs that were managed conservatively or by ORIF without a rTHA at our institution, thus our results are not generalizable to all the patients who sustain a PPF. Additionally, due to the unavailability of adequate preoperative values on the patient-reported outcome measures scores, the comparison between pre- and postoperative functional and psychological outcomes was not possible. In the current study, patients that died within the first postoperative year were significantly different in baseline age than the cohort of patients with one-year data that were analyzed. Therefore, our results may not be generalizable for all the patients who had PPF surgery in our study and may over-estimate functional and psychological outcomes of the population. Importantly, there are several strengths to the present study. We included all the patients that had undergone a PPF surgery at our institution within the last 14 years. Thus, providing a representation of the patient profiles that had undergone PPF surgery at our institution performed by experienced arthroplasty surgeons.

2.5 CONCLUSION

Our study found that patients with a PPF have fair hip joint function, and poor physical function and psychological wellbeing at one-year after a rTHA with or without ORIF. This study also demonstrated a high one-year mortality rate that is comparable to previous research. We found no significant changes in the functional and psychological recovery between the one and two-years following the PPF surgery. Future research should focus on assessing the functional and psychological outcomes at multiple time points and comparing against the preoperative values to have a clearer understanding of the long-term recovery trajectories of the PPF surgery among older adults.

Appendix 2.1: Flow chart for the identification of patients with a revision total hip arthroplasty after periprosthetic femoral fracture.



Note: ORIF, Open Reduction and Internal Fixation; PPF, Periprosthetic Femoral Fracture; THA, Total Hip Arthroplasty.

Chapter 3

Assessing the outcomes and risk of falling after periprosthetic femoral fracture in older adults.

3.1 INTRODUCTION

Total hip arthroplasty (THA) is a gold standard procedure used to minimize pain and improve physical function and health-related quality of life in people with advanced hip osteoarthritis;[6,86] however, gait impairments and hip muscle weakness are common after this surgery[9,87,88]. These functional deficits after THA contribute to a higher falls risk in this population[8,106] with approximately 25% to 36% of people reporting a fall within the first postoperative year[12,106,110]. Sustaining a fall after a THA has serious consequences, one in particular being a fracture around the implant known as a periprosthetic femoral fracture (PPF).[12] The current incidence of PPF ranges from 0.07% to 11% for primary THA and 1.19% to 18% for revision THA (rTHA),[116,120,125–127] and it is predicted there will be a 4.6% rise in the number of PPF cases every 10 years over the next 30 years.[127] The combination of an aging population and the higher occurrence of falls among older adults is seen as the driving force behind the expected increase in PPF.[125,127] Therefore, a better understanding of the outcomes of older adults with PPF is warranted to help guide clinical care.

Previous research on the outcomes of the PPF surgery has mainly focused on post-surgical complications[19,134–138] and mortality rate[18,20,21,138,139142]. Very limited research has evaluated functional outcomes,[17,19–21] specifically only two studies[137,143] have assessed both the functional

and psychological well-being after this surgery in the same cohort of older adults. The functional status following the PPF surgery in prior studies has mainly used patient-reported questionnaires with an emphasis on the recovery of pre-PPF ambulatory status. In a retrospective study, Moreta et al.[20] found that 52% of the patients were unable to return to their pre-PPF ambulatory status even after 2.8 years following the PPF surgery. Zheng et al.[17] demonstrated worsened hip function and walking ability at a mean postoperative follow-up period of 3.2 years after the PPF surgery when compared to the preoperative status. Despite the evidence of functional deficits after the PPF surgery in older adults,[17,19–21] no study has used objective physical performance tests to assess gait, lower extremity strength, and balance after the PPF surgery. It is well established that slower gait speed,[115,160–162] decreased lower extremity strength,[161] and balance deficits[161] are associated with the increased risk of falls among older adults. Therefore, a comprehensive physical function assessment using both subjective patient-reported and objective physical performance tests is clinically relevant as the results can be utilized for developing fall prevention interventions in this population.

A previous history of preoperative falls is associated with increased falls risk during the postoperative period after THA.[114] Considering that 70% to 81% of PPFs occur as a result of falls after THA,[119,120] older adults may remain vulnerable to future falls risk following the PPF surgery. Yet, no literature has examined the falls occurrence, future falls risk, fear of falling, and falls prevention among older adults with PPF after THA. In general, community-dwelling older adults have a low perception of personal risk of falls and limited knowledge regarding falls risk factors and falls prevention strategies.[163] Currently, it remains unknown if there is a lack of falls risk awareness among older adults after the PPF surgery. In order to tailor falls prevention education

during the postoperative rehabilitation phase in this population, it is critical to evaluate falls-related risk factor knowledge and falls prevention strategies. Moreover, being aware and knowledgeable about personal falls risk and falls prevention strategies may promote the development of self-efficacy for initiating active participation in the appropriate strategies to reduce future falls risk.

The limited information regarding the functional and psychological outcomes of PPF surgery in older adults reinforces the need for a comprehensive evaluation of falls risk and the functional and psychological impact of PPF surgery on a person's life. Bridging this gap would help health-care providers implement strategies to optimize the well-being of this patient population. The present study was a pilot study performed among people who sustained a PPF as a result of a fall after THA. The aims of our study were, 1) to determine the occurrence of falls, and to assess fear of falling, future falls risk, and general knowledge regarding falls and falls prevention strategies following a PPF surgery due to a fall, 2) to evaluate the functional outcomes of gait, balance, lower extremity strength, function and disability after a PPF surgery, and 3) to assess the psychological outcomes of depression symptomatology, social participation and overall quality of life (QoL) after a PPF surgery in older adults.

3.2 MATERIALS AND METHODS

3.2.1 Study design and participants

This was a cross-sectional study of patients who sustained a PPF after a THA due to a fall and had the following surgeries to repair the fracture: 1) a rTHA (with or without ORIF) or 2) only ORIF at the London Health Sciences Centre, University Hospital (LHSC-UH), London, Ontario, Canada. This study was approved by the University of Western Ontario Health Sciences Research Ethics

Board and the Clinical Resources Impact Committee of Lawson Health Research Institute. The study took place between April 29, 2019 to February 29, 2020.

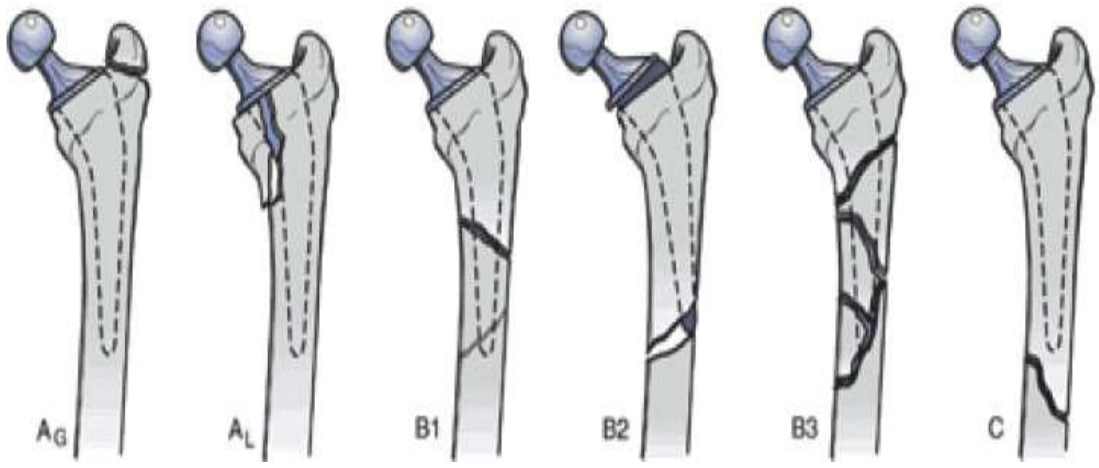
We recruited community-dwelling adults who were 60 years of age or older, had sustained a PPF due to a fall, and undergone a rTHA or ORIF due to a PPF after either THA, bipolar hip hemiarthroplasty, or Birmingham hip resurfacing at LHSC-UH, and were between 6-months to 4-years after their PPF surgery. Additionally, participants needed to be able to communicate and follow instructions in English, and be able to ambulate a minimum of 10 meters with or without the use of a mobility aid. Individuals were excluded if they had sustained a PPF after THA due to non-traumatic reasons, or had a current clinical diagnosis of dementia or cognitive impairment.

Potential participants were identified from the LHSC-UH electronic database and billing codes related to the work of three orthopaedic surgeons at our institution. A total of 51 eligible participants were contacted through letters (Appendix 3.1). Individuals who were interested and met eligibility criteria as per a phone interview were scheduled to attend the orthopaedic outpatient clinic for a routine follow-up with their surgeon and the study assessment. The study assessment took approximately 60 - 120 minutes to complete and participants were allowed to take breaks during the testing protocol as needed.

The following demographic and medical information were obtained from the participants: age, sex, height, weight, number and type of prescription medications, self-reported typical physical activity levels (very active = participating in a structured exercise program 3 times per week; moderately active = physical activity less than twice per week; inactive = leading a sedentary lifestyle), weight bearing status, mobility aid use and type, date of PPF, and time between the PPF and the fixation for PPF. Additionally, patient clinical charts were reviewed and the following

information was extracted: date and type of primary hip replacement surgery (THA/bipolar hip hemiarthroplasty/Birmingham hip resurfacing), date of PPF surgery, surgical approach of PPF surgery, type of fixation for the PPF, implant loosening present or not at the time of the PPF surgery, and radiographic evidence of healing of the PPF during the most recent follow-up visit with the surgeon. The Vancouver Classification System (Figure 3.1) was used to classify the type of fracture. This classification system, developed by Duncan and Masri in 1995, is based on the anatomic location and pattern of the fracture, the amount of bone loss and prosthesis stability.[24,121]

Figure 3.1: The Vancouver classification of periprosthetic femoral fracture.



Note: Vancouver A, Fracture around the trochanteric region (AG = Greater Trochanter, AL= Lesser Trochanter); Vancouver B, Fracture around the femoral stem (B1 = well fixed stem, B2= loose stem, B3 = loose stem with inadequate bone stock); Vancouver C, Fracture distal to the tip of femoral stem. (Adapted from Francony F, Pailhé R, Gaillot J, Saragaglia D, scidoc.org. Periprosthetic femoral fracture).

3.2.2 Outcome measures

Participants completed one cognitive test, seven self-report questionnaires and four physical performance tests during the study assessment. A specific order of assessment was maintained for all participants. Participants performed the physical performance tests in the following order: 6-meter Walk Test, Timed-Up-and-Go Test, Step Test, and lastly 30-Second Chair Stand Test.

3.2.2.1 The Montreal Cognitive Assessment (MoCA)

Global cognition was measured using the Montreal Cognitive Assessment (MoCA). The MoCA is a reliable and valid tool to evaluate global cognitive status in older adults.[164] It assesses seven cognitive domains including, short-term memory recall, visuospatial skills/executive functions, attention, concentration, working memory, language, and orientation to time and place. An additional point is given to participants with less than 12 years of education. The score ranges from 0 - 30 and a score of 25 or less indicates a mild cognitive impairment.[164]

3.2.2.2 Self-report measures

3.2.2.2.1 The Modified Cumulative Illness Rating Scale (m-CIRS)

Comorbidities were reported using the Modified Cumulative Illness Rating Scale (m-CIRS).[165] The m-CIRS covers 14 independent organ systems which are graded on severity of impairment from a 0 (no impairment) to 4 (extremely severe impairment) for each organ system. The total score is the sum of the individual scores and ranges from 0 - 56. A high score represents severe multi-organ failure. In older adults, a total score of 21 or more is associated with a high in-hospital mortality rate and requiring additional services after discharge.[166] The m-CIRS is a reliable

instrument in older adults.[167]

3.2.2.2.2 Falls questionnaire

A self-report questionnaire was administered that included 38 questions regarding falls (see Appendix 3.2 for the full questionnaire) divided into three sub-sections: 1) falls after PPF surgery (14 questions), 2) the knowledge of falls risk factors (14 questions), 3) falls prevention strategies (10 questions). In addition, five questions about the perceived functional changes and three questions about the perceived psychological changes post-PPF surgery were administered.

To quantify any fall occurrences after the PPF, a fall was defined as "an unexpected event in which the participants come to rest on the ground, floor, or lower level".[100] Participants were asked about the number of falls since the PPF surgery, time after surgery in which the falls took place, number of falls within the last 6 months from the current follow-up clinic appointment, site of injuries as a result of the falls and whether or not medical attention was sought. Injuries were classified as major or minor. Major injury was defined as any event such as fracture, dislocation, head trauma (e.g., concussion) which required medical attention, whereas minor injury denoted soft tissue injuries (e.g., bruises, lacerations) in which medical attention may or may not be required. Participants who experienced falls were asked to describe the types of activities they were involved in when falls occurred and whether or not the experience of falls affected their confidence level in performing daily life activities. Participants were also asked whether they now use a mobility aid for activities which they were able to perform without the mobility aid before PPF surgery.

The questions regarding falls risk factors were modified from the falls risk factors questionnaire developed by Braun et al.[163], which inquires on four knowledge facets: 1) physical factors, 2)

psychological factors, and 3) interior environmental factors and 4) exterior environmental factors. The wording on the questions was modified for people with a PPF surgery. Participants rated their responses on how likely each of 13 specific risk factors would make a person fall regardless of a history of PPF surgery on a 10-point Likert scale ranging from 0 (not at all likely) to 10 (most likely). Participants were also asked if they believe falls can be prevented among people who have had surgery for a PPF.

The 10 questions about falls prevention strategies implemented after PPF surgery were modified from the falls prevention strategies questions developed by Hunter et al.[168]. The wording on the questions was modified for people with a PPF surgery. Participants were asked to rate on a 10-point Likert scale the importance of falling in their life compared to their other health concerns (0 being not at all and 10 being the most important). Participants were asked if they feel unsteady when walking after PPF surgery. They were also asked if they were taught by health-care professionals about falls prevention strategies to reduce falls after PPF surgery. Participants were also asked if they believed they would fall at some point within the next 12 months. Additionally, they were asked to rate using a 5-Likert scale (strongly agree, agree, undecided, disagree, strongly disagree) if they believed they would be able to return to their current living situation if they fell and injured themselves due to the fall.

Participants were also asked three open-ended questions about any falls prevention strategies they had implemented since their PPF surgery, and strategies still to be put into place and their confidence in their ability to implement these strategies. The responses on the open-ended question were classified based on the work of Hill et al.[169] into the following five categories: 1) behavioural strategies (e.g., “pay more attention”, “do not go outside for shopping”), 2) support while

mobilizing strategies (e.g., “use handrails”, “wear well-fitted and better shoes”), 3) movement-related modifications (e.g., “moved into an apartment”, “reduced walking”), 4) physical environment modifications (e.g., “use hospital bed”, “no carpet in house”), and 5) activity and exercise engagement.

3.2.2.2.3 Perceived functional changes post-PPF surgery

Participants were asked if they had modified any daily activities after the PPF surgery. If a person responded with “yes”, they were further asked to provide the list of activities they have modified since the PPF surgery. Participants were also asked about the potential reasons (e.g., pain, reduced balance, mental fatigue, physical fatigue, lack of endurance, lack of support) for which they have modified their daily life activities after the PPF surgery.

3.2.2.2.4 Perceived psychological changes post-PPF surgery

Information was also solicited with yes/no questions for whether participants felt socially isolated and frustrated with their current situation of life since their PPF surgery. An open-ended question about the psychological impact of the surgery in their life was also asked.

3.2.2.2.5 The Activities-specific Balance Confidence (ABC) Scale

The ABC scale is a 16 item self-report measure of a person’s level of confidence in performing various functional activities without falling or experiencing a sense of unsteadiness.[170] Each item is rated on a scale ranging from 0% (no confidence) to 100% (completely confident). The total score is calculated by adding the responses of each item and dividing it by the total number of

items. The ABC scale has high retest reliability and internal consistency in community-dwelling older adults.[170]

3.2.2.2.6 The Falls Risk for Older People-Community setting (FROP-Com)

The FROP-Com is a questionnaire that assesses 25 risk factors that are associated with increased fall risk in older adults. There are 28 self-report questions ranked on either a dichotomous scale (yes or no) or an ordinal scale of 0 to 3 (0 being better outcome and 3 being worst outcome). The question "does the home appear safe" on the FROP-Com was excluded from the calculation of total score as the study assessment was completed outside the home, and no home assessment was performed. The overall score is the sum of each question for a maximum score of 60. Participants with scores of 0 - 11 are considered to have mild falls risk, 12 - 18 are considered of moderate falls risk and 19 - 60 scores are indicative of high falls risk. The FROP-Com has excellent intra-rater reliability and good inter-rater reliability in older adults.[171]

3.2.2.2.7 The Late Life Functional and Disability Instrument (LLFDI)

The LLFDI is a self-report measure of functional and disability outcomes in older adults. LLFDI has two components, the functional component (FC)[172] and the disability component (DC)[173].

LLFDI-FC assesses the degree of difficulty in performing 32 socially defined life tasks. The FC is comprised of an overall function domain and three subdomains: 1) upper extremity (7 items), 2) basic lower extremity (14 items), and 3) advanced lower extremity functions (11 items). There are eight additional items for assistive device users. The score for each question ranges from 1 to 5, with higher scores representing less difficulty in performing that activity. The raw score of the overall function domain (sum of the 32 items and 40 items for assistive device users) and each

subdomain's score are transformed into a scaled score (0 - 100). Participants with high scores have a high level of functional ability in performing socially defined life tasks.

LLFDI-DC has 16 questions that assess the degree to which a person can perform (disability) socially defined life tasks. Each question has two disability dimensions, frequency and limitation. The frequency dimension focuses on how often personal (7 items) and social (9 items) role activities are performed, whereas the limitation dimension focuses on the limitation in performing instrumental (11 items) and management (4 items) role activities. Each question is rated on a 5-point Likert scale ranging from 1 to 5 (1 being never and 5 being very often) in the performance frequency dimension and 1 to 5 (1 being not at all and 5 being completely) for the limitation dimension. To calculate the raw score, items from each dimension or their role domains are summed. The raw scores are transformed into a 0 - 100 scale. Participants with high scores are considered to have less disability and those with low scores indicate more disability in performing socially defined life tasks.

For each item in LLFDI-FC and LLFDI-DC, a question was added to the questionnaires to ask participants if performance on that activity was the same, better or worse than how it was before the PPF surgery. LLFDI has shown to be reliable and valid instrument in community dwelling older adults.[172–174]

3.2.2.2.8 The Geriatric Depression Scale-Short Form (GDS-SF)

The GDS-SF is comprised of 15 questions to measure depressive symptomatology in geriatric patients.[175] The total score of five or more indicates depressive symptomatology and poorly

perceived health-related QoL in older adults.[175,176] The GDS-SF scale has a high retest reliability in older adults.[175]

3.2.2.2.9 The World Health Organization Quality of Life (WHOQOL-BREF)

The WHOQOL-BREF is a self report questionnaire to assess a person's overall QoL.[177] WHOQOL-BREF is comprised of 26 questions, 24 questions are divided into four domains (physical, psychological, social, and environmental) and two questions assess a person's overall perception of their QoL and health status. Each question is rated on a 5-point Likert scale (1= poor QoL and 5= good QoL). The mean score of the items within each domain is summed to get a raw score for that domain. The raw score of each domain is transformed into a 0 - 100 scale. Higher scores in a domain indicate better QoL in that aspect of life. In older adults, a domain score of less than 60 indicates a poorly perceived QoL in the represented domain.[178,179] The instrument items have demonstrated high test-retest reliability in general population.[180]

3.2.2.3 Physical function measures

3.2.2.3.1 6-Meter Walk Test

Spatiotemporal gait parameters were collected using wireless accelerometers (LEGSys™, Biosensics LLC, Watertown, MA) during the performance of the 6-Meter Walk Test. The main parameter of interest was gait speed since a velocity of less than 1.0 m/s is associated with increased falls risk.[160,181] Five sensors were placed on each participant with Velcro straps, with one sensor around the back of the waist, two sensors at the midpoint of both thighs anteriorly, and two sensors at the mid-calf of each leg anteriorly. Participants were instructed to walk a 6-meters distance at their usual comfortable walking speed using their preferred mobility aid as needed.

3.2.2.3.2 Timed-Up-and-Go Test (TUG)

The TUG measures a person's functional mobility (i.e., gait and balance involved in normal daily life activities).[182] Participants began the test by sitting in a standard height chair with armrests (seat height 46 cm and arm height 65 cm). When asked, participants stand and walk 3 meters at their usual comfortable pace, turn around, walk back to the chair and return to the initial seated position. Time to complete the TUG is recorded to the nearest hundredths of a second using a stopwatch. The participants were allowed to use their assistive device while performing the test if required. The participants with the highest scores (i.e., longer time to complete) were considered to have poorer functional mobility. The TUG shows a moderate predictive validity for the occurrence of the falls in community dwelling older adults.[183]

3.2.2.3.3 Step Test

The Step Test measures dynamic balance during an activity that requires weight-shifting and movement while in single-leg stance.[184] Participants were provided a step measuring 15 cm in height, placed 5 cm in front of their foot. Participants began the test by placing both feet parallel and 15 cm apart on the floor. On the instruction of the examiner, participants placed one foot on the step and back down to the floor. Participants were required to repeat the process as many times as possible within the 15 seconds. Each leg was examined separately. The score was the number of steps completed within the 15 seconds for each leg. The Step Test has good test re-test and inter-rater reliability for measuring balance of lower extremity in older adults with hip OA with inter-rater reliability.[185]

3.2.2.3.4 30-Second Chair Stand Test (30sec CST)

The 30sec CST is a performance test for measuring the lower extremity strength in older adults.[186] The participants were instructed to begin the test from sitting in a chair (seat height of 45 cm from the floor) with a straight back and arms folded across their chest. At the examiner's signal "Go", participants stood up from the chair and returned to the initial position immediately; repeating the task as many times as possible in 30 seconds. During this test participants were not permitted to use a gait aid. The number of repetitions was recorded. The 30sec CST is a reliable and valid indicator of lower extremity strength in older adults with good test-retest reliability.[186]

3.2.3 Data analysis

Participant demographics, clinical, and surgical characteristics, and the data from the outcome measures (MoCA, m-CIRS, falls questionnaire, ABC, FROP-Com, LLFDI, GDS-SF, WHOQOL-BREF, 6-Meter Walk Test, TUG, Step Test, and 30sec CST) were summarized using median and inter-quartile range (IQR) or frequencies and percentages, as appropriate. Reponses on the open-ended questions in the falls questionnaire were categorized into five themes by two authors (R.I, S.W.H). Frequency and percentages were used to summarize the responses in each category for the open-ended questions. The scores on the physical performance tests were compared with the normative data (TUG:[187] $\leq$ 12 seconds, Step Test:[188] 15.6 steps, 30sec CST:[189] male= 14.2 repetitions, female= 12.7 repetitions) for age and sex-matched community-dwelling adults, and the proportion of the sample that scored below the established normative data was calculated. SPSS version 26 (IBM Corporation, Armonk, NY) was used to analyze the data.

3.3 RESULTS

3.3.1 Demographic, clinical, and surgical characteristics

In total, ten people participated in the study. The median age was 75.5 years (IQR: 70.0 to 81.3 years), six (60.0%) were male, and the median time from the PPF surgery was 2.8 years (IQR: 2.2 - 3.1 years) (Table 3.1). The median m-CIRS total score was 6.5 (IQR: 5.8 - 12.0), indicating all the study participants exhibited some degree of impairment in the 14 major organ systems. The majority of the participants (70.0%) reported current use of a mobility aid since the PPF surgery (cane: 40.0% and walker: 30.0%), and five (50.0%) reported using the mobility aid for all daily life activities. Seven (70.0%) participants had hip implant loosening at the time of the PPF surgery and nine (90.0%) had a rTHA to fix the fracture (Table 3.2).

Table 3.1: Demographic and clinical characteristics of older adults with periprosthetic femoral fracture surgery. (n= 10)

Variable	**Median, [IQR] or n (%)**
Age (Years)	75.5 [70.0 – 81.3]
Sex, Male	6 (60.0)
Body Mass Index (kg/m^2)	26.2 [23.8 – 33.6]
Physical Activity Level	
Seldom Active	2 (20.0)
Moderately Active	5 (50.0)
Very Active	3 (30.0)
Full Weight Bearing Status	10 (100.0)
Number of Prescription Medications	7.0 [2.8– 10.8]
Modified Cumulative Illness Rating Scale, Total Score	6.5 [5.8 – 12.0]
Montreal Cognitive Assessment Score	26 [23.8 – 27.3]

Table 3.2: Surgical characteristics of older adults with periprosthetic femoral fracture surgery. (n= 10)

Variable	**Median, [IQR] or n (%)**
Index Hip Procedure	
Total Hip Arthroplasty	9 (90.0)
Birmingham Hip Resurfacing	1 (10.0)
Vancouver Classification	
B1	3 (30.0)
B2	4 (40.0)
B3	3 (30.0)
Implant Loosening at the time of the surgery, Present	7 (70.0)
Evidence of Radiographic Healing during study assessment,* Present	10 (100.0)
Time (days) between the PPF and the surgical fixation for the fracture	5 [2 – 10]
Surgical Procedure for fixation of PPF	
Revision Total Hip arthroplasty	3 (30.0)
Revision Total Hip arthroplasty & ORIF	6 (60.0)
ORIF	1 (10.0)
Surgical Side, Right	6 (60.0)
Surgical Approach, Direct Lateral	10 (100.0)

Note: ORIF, Open Reduction and Internal Fixation; PPF, Periprosthetic Femoral Fracture. '*' indicates radiographic evidence of healing of the periprosthetic femoral fracture during the most recent follow-up visit with the surgeon.

3.3.2 Falls occurrence of the study sample

Five (50.0%) participants had experienced at least one fall since the PPF surgery, one of them (10.0%) sustained two falls after the PPF surgery and one (10%) reported sustaining a shoulder fracture due to falling which required medical treatment to fix the fracture. The majority of the

falls (40.0%) occurred more than one-year after their PPF surgery and only one (10.0%) experienced a fall within 6 weeks to 3 months post-PPF surgery. Additionally, three (30.0%) participants reported the fall affected their confidence level, six (60%) participants stated they are afraid of falling and had stopped performing activities that they were physically capable of doing, and four (40.0%) reported using a mobility aid to do activities that had required no mobility aid before their surgery.

3.3.3 Fear of falling

The median ABC score was 73.5% (IQR: 41.9% - 90.9%). The lowest balance confidence was reported for the following three activities: 'walking outside on icy sidewalks (Median: 10.0%, IQR: 0% - 50.0%)', 'standing on a chair and reaching for something (Median: 50.0%, IQR: 0% - 62.5%)', and 'bumping into by people when walking through mall (Median: 50.0%, IQR: 20.0% - 90.0%)'. The confidence was highest for 'reaching for a small can off a shelf at eye level (Median: 100.0%, IQR: 80.0% - 100.0%)', 'walking across a parking lot to the mall (Median: 100.0%, IQR: 77.5% - 100.0%)', and 'walking outside the house to a car parked in the driveway (Median: 100.0%, IQR: 70.0% - 100.0%)'.

3.3.4 Future falls risk: Falls Risk for Older People - Community setting Questionnaire (FROP-Com)

The median FROP-Com score was 9 (IQR: 7 to 13 points), indicating mild falls risk after their PPF surgery. A total of 18 risk factors associated with future falls were identified with median number of risk factors of 6.5 (IQR: 4.8 - 9.5). The most identified risk factors were 'number of medical conditions affecting balance (100%)', and 'number of prescription medication (90%)' and

the least identified risk factors were ‘observed behaviours during activities of daily living and mobility (10.0%)’, and ‘prior to fall, how much assistance required in activities of daily living (10.0%)’.

3.3.5 Falls risk factors knowledge

The majority (60.0%) of the participants believed falls among people who have had a PPF surgery could be prevented. Risk factors for falls given the highest scoring were: ‘walking on icy sidewalks (Median: 10.0, IQR: 9.8 - 10.0)’, ‘doing unsafe or risky activities (Median: 10.0, IQR: 7.3 - 10.0)’, ‘balance/coordination problem (Median: 9.5, IQR: 6.5 - 10.0)’ and ‘not paying attention to surroundings (Median: 9.0, IQR: 7.3 - 10.0)’. Participants rated ‘being forgetful (Median: 5.0, IQR: 3.5 - 8.5)’, ‘taking many medications (Median: 6.0, IQR: 4.3 - 9.3)’, and ‘rugs and furniture (Median: 6.5, IQR: 5.0 - 10.0)’ as the lowest factors leading to an increased risk of falls in older adults.

3.3.6 Falls prevention measures

The median rating on the importance of falling compared to their other health concerns was 8 (IQR: 5 - 10) out of 10. Four (40.0%) rated falling the most important compared to their other health concerns. The majority of the participants (70.0%, n= 7) reported being taught by health-care professionals about prevention of falls after the PPF surgery and only three (30.0%) participants reported that they expect to fall sometime within the next 12 months period. When asked if they believe they can return to their current living condition if they sustained a falls-related injury, eight (80.0%) participants agreed and two (20.0%) participants were undecided.

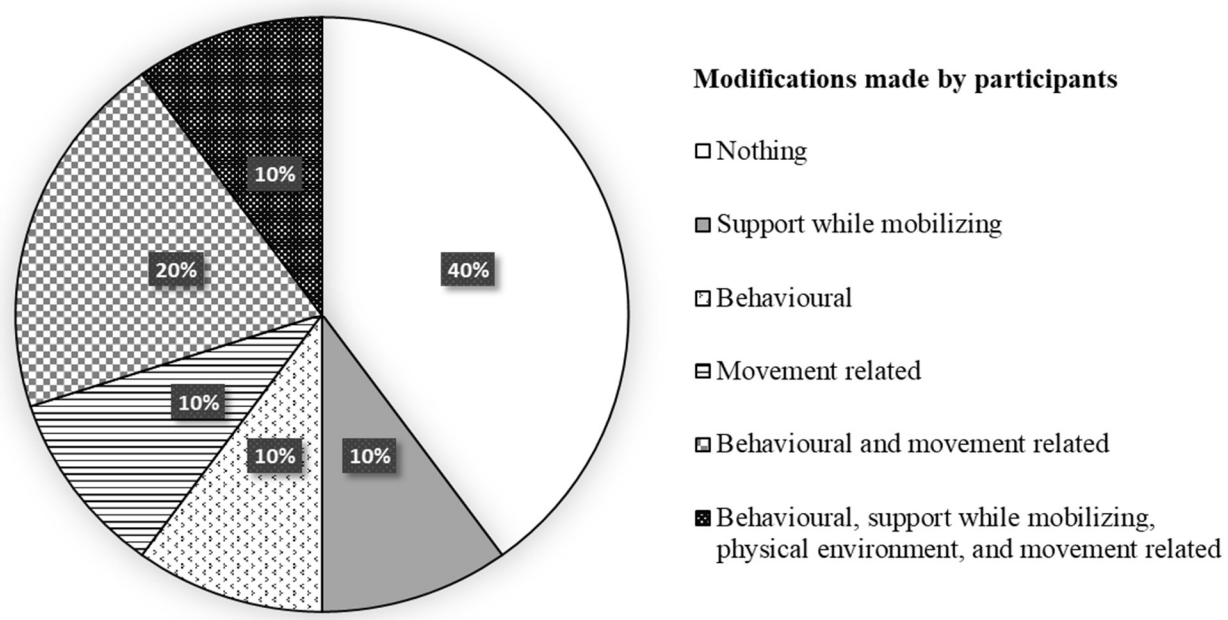
A total of 11 modifications for in-home/daily life activities were made by six (60.0%) participants to reduce the falls risk after PPF surgery. The median number of modifications was one (IQR: 0 - 3.3). The majority of the modifications were made in their physical environment (40.0%), such as installing grab bars in the bathroom (20.0%), using a commode chair for toilet seat (10.0%), modifications in the height of table (20.0%) and chair (20.0%), using a hospital bed (10.0%), keeping a light on at night time and for dark places at home (10.0%), removing tripping hazards (10.0%), keeping a spare mobility aid in different locations (20.0%), and installing a chairlift on the stairs (10.0%). The behavioural modifications included being attentive to the surroundings (10.0%). The modifications adopted to provide support while walking were wearing well-fitted shoes (10.0%) and using the handrails to climb stairs (20.0%). Only two (20.0%) participants had plans to make modifications in their daily life activities in near future. In total, seven (70.0%) participants expressed an interest in learning about the falls prevention measures.

3.3.7 Functional outcomes after PPF surgery

3.3.7.1 Perceived functional changes post-PPF surgery

Six participants (60%) reported that they had to modify their daily life activities as a result of their PPF surgery (Figure 3.2). The most reported reasons for modifying their daily life activities after PPF were physical pain (50.0%) and reduced balance (50.0%). Other listed reasons for the modifications in daily life activities were mental fatigue, physical fatigue, lack of endurance, lack of support, due to other health conditions, fear of being alone or in a compromised situation, and fear of falling.

Figure 3.2: Distribution of modifications made to daily life by participants as a result of periprosthetic femoral fracture surgery. (n= 10)



3.3.7.2 Spatiotemporal gait parameters

The 6-Meter Walk Test was completed by eight (80.0%) participants, with four (40%) participants using their mobility aid during the test. The median gait velocity for our study sample was 0.8 m/s (IQR: 0.6 - 0.8 m/s), and the majority of the participants (7, 87.5%) walked at speeds slower than 1.0 m/s.

3.3.7.3 Functional mobility, lower extremity balance and strength

The median time to complete the TUG test (n= 10) was 12.0 seconds (IQR: 9.7 - 18.6). In total, five (50.0%) participants had slower TUG times by 0.5 - 19.3 seconds when compared to age and sex-matched normative values. In total, seven (70%) and eight (80%) participants participated in

the Step Test and 30sec CST, respectively. Three (30%) participants were excluded from the Step Test and two (20%) from 30sec CST due to a reported lack of confidence to perform the test without their mobility aid. The median scores on the Step Test for the affected side and non-affected side for our study sample were 10 (IQR: 9 - 14) and 12 (IQR: 10 - 12), respectively. Seven (100.0%) participants had lower scores in both the affected and non-affected sides for the Step Test compared to the age and sex-matched normative values. The median number of stands in 30sec CST test was 11.5 (IQR: 10.0 - 15.8). In total, five (62.5%) participants had scores below age and sex-matched normative values.

3.3.7.4 The Late Life Functional and Disability Instrument (LLFDI)

The median score for the functional component of the LLFDI was 49.6 (IQR: 37.2 - 59.3). Median scores for the basic and advanced lower extremity subdomains were 57.0 (IQR: 42.8 - 64.6) and 29.4 (IQR: 14.7 - 48.2), respectively. The median number of activities considered as worse performance compared to the patient's status before PPF surgery was 11.5 (IQR: 4.3 - 18.3) out of 32. Participants scored 46.6 (IQR: 40.7 - 51.2) and 66.9 (IQR: 59.2 - 83.4) in the frequency and limitation dimensions of the LLFDI-DC component, respectively. Overall, 2.5 (IQR: 0 - 6.5) of items in DC were rated as worse performance compared to the status before PPF surgery.

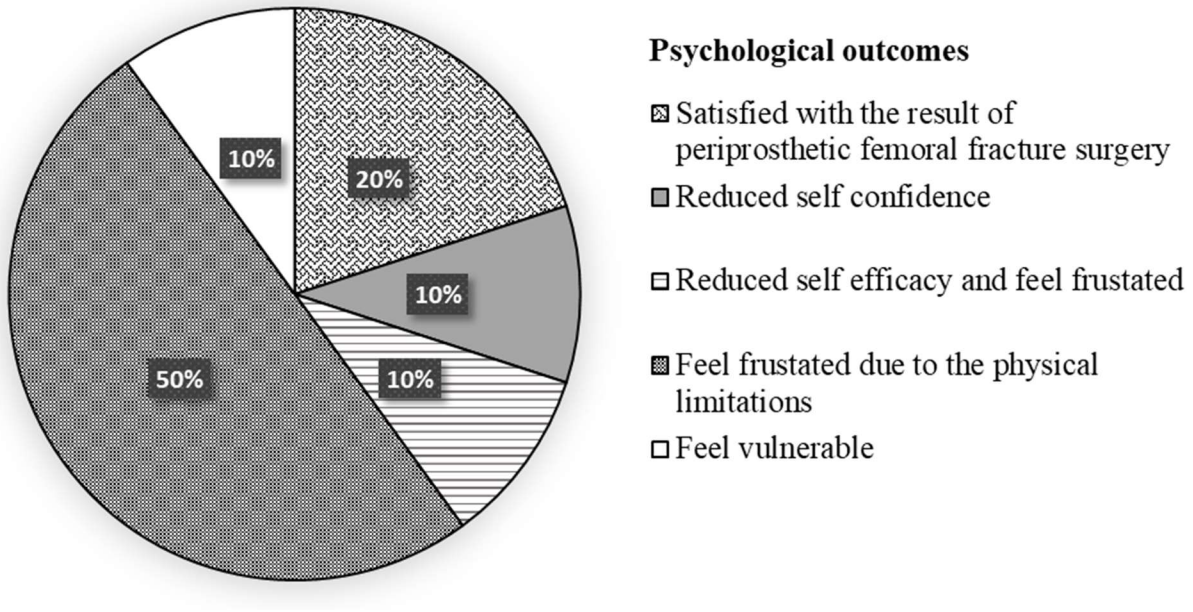
3.3.8 Psychological outcomes and overall quality of life after PPF surgery

3.3.8.1 Psychological outcomes after PPF surgery

Half of the study sample (50.0%) felt socially isolated and was frustrated about the current situation after their PPF surgery. When asked an open-ended question regarding the psychological impact of PPF surgery, five (50.0%) participants reported frustration over their physical limitations as a

result of the PPF surgery (Figure 3.3). The median GDS-SF scores was 2.0 (IQR: 0.8 - 3.0), indicating no depressive symptomatology. The responses on the GDS-SF that represented depression were notable for six (60.0%) participants who felt a lack of energy in life after the PPF surgery, five (50%) preferred being at home rather than going out, and three (30%) participants had dropped many of their activities after their surgery and were feeling bored.

Figure 3.3: Responses in people after periprosthetic femoral fracture surgery on question "How has the periprosthetic femoral fracture surgery impacted your life psychologically?". (n= 10)



3.3.8.2 Quality of life: The World Health Organization Quality of Life-BREF (WHOQOL-BREF)

There were eight (80.0%) participants who completed all the items within the questionnaire. The majority of the participants (90%) rated their general QoL good or very good. Participants scored lower on the physical and psychological domains with a median score of 57.1 (IQR: 46.4 - 62.5)

and 58.3 (IQR: 50.0 - 66.7), respectively, indicating a perceived poor QoL in these domains. The score on the environmental domain was the highest (Median: 78.1, IQR: 71.9 - 84.4), representing a higher perceived satisfaction with the environmental conditions. The social domain score was calculated for 8 (80.0%) participants with a score of 62.5 (IQR: 58.3 - 72.9).

3.4 DISCUSSION

Even after years from the PPF surgery, participants reported functional difficulty and reduced functional ability to perform socially defined daily life activities. Participants also stated that their performance on the majority of the activities had decreased compared to their pre-PPF surgical status. In the physical performance tests, the majority of the participants demonstrated slower gait speed, and deficits in functional mobility, dynamic balance, and leg strength compared with age and sex-matched healthy older adults. Half the sample reported at least one fall since the PPF surgery and most falls occurred after the first year. Moreover, participants demonstrated a lack of awareness of falls risk factors and limited implementation of falls prevention strategies in their daily life after the PPF surgery. We found no depressive symptomatology; however, social isolation and frustration over the physical limitations as a result of the PPF surgery were common in our study sample. Participants also perceived a poor QoL in their physical and psychological facets of life after the PPF surgery. To the authors' knowledge, the findings of this study are novel and add valuable information on the understanding of the impact of the PPF surgery on the well-being of older adults.

Participants in our study reported difficulty in activities that required greater physical ability and endurance, walking, standing, and stooping. Participants also reported a reduction in daily life

activities. Compared to their pre-surgical status participants reported worse performance after their PPF surgery for most of the activities. Our findings are consistent with existing research that found functional deterioration[17,19,20,137] and poorer walking ability[17,20] were common post-surgery for PPF when compared to preoperative status, even years after the event. In contrast to previous studies that collected surgeon-reported disease specific outcome measures, our use of a patient-reported measure provides a novel and more holistic view of the impact of the PPF surgery on daily life activities of older adults.

Falls risk in older adults is multifactorial and is dependent upon the interaction between intrinsic and extrinsic risk factors.[101] A recent meta-analysis identified the intrinsic factors of balance deficits, and fear of falling, and the extrinsic factor of prescription medications as important determinants for falls risk after THA.[111] Specifically, this study reported that the odds of falling were 4.09 times larger in patients taking medications after THA compared to those not taking any medications post-THA.[111] Consistent with this body of literature, the FROP-Com identified balance deficits and the higher number of prescription medications as the most common falls risk factors in our sample. Additionally, the balance confidence measured by the ABC scale was 73.5%, previous research in community-dwelling older adults found a score less than 80% is indicative of functional decline and increased fall risk requiring an intervention.[190] The use of objective physical performance tests in our study identified a large proportion of our sample had deficits in lower extremity strength, balance and functional mobility. However, of the physical performance tests used in our study only gait speed has robust predictive validity for future falls risk.[160,182] The majority of our study participants walked at a gait speed of < 1.0 m/s which in older adults is associated with an increased risk of falls.[115,160,162] Although we used portable wireless

accelerometers to measure the gait speed, it can also be measured using a stopwatch to time walking a 6-meter distance. Therefore, a quick gait assessment during the postoperative evaluation may aid health-care professionals in identifying the people that are at high risk of future falls post-PPF surgery.

The falls occurrence in our sample was higher (50% versus 36%) compared to the reported falls occurrence within 2 to 7.8 years after a primary THA reported by Ikutomo et al.[106] This is likely due to the difference in the time reference, postoperative functional status, and the age group of the study samples. We captured all the falls that occurred post-PPF surgery in an older sample with a higher functional impairment, whereas Ikutomo et al.[106] reported falls that occurred within the past year in a relatively younger and healthier cohort. Considering most of our sample's falls occurred after the first year, we suggest that falls risk assessment should be performed beyond the immediate one-year postoperative period. Despite perceiving the importance of falling as a health issue, participants had a lack of understanding of the personal risk of falling and underestimated the negative consequences of the falls. Participants also demonstrated diverse perceptions of knowledge regarding established falls risk factors, which reflected on their application of falls prevention strategies. While the highest-rated falls risk factors were behavioural, most modifications reported were within their physical environment. Structured exercise is the most effective falls prevention intervention in older adults;[191] however, none of the participants in the present study adopted such modification to prevent falls post-PPF surgery. Our findings on falls knowledge indicate that better communication is needed between the health-care professionals and the participants to help them implement proven falls prevention strategies.

Participants in our study indicated being dissatisfied with their physical and psychological well-being after PPF surgery but adequately satisfied with social and environmental aspects of life. This might be explained by the fact that the physical and psychological aspects of the WHOQOL cover the relevant areas (e.g., pain, physical function, acceptance of the bodily appearances) of the functional and psychological limitations from the PPF surgery. On the other hand, the social and environmental components mainly focus on satisfaction over personal relationships, home environment, transportation, and access to health services. Märdian et al.[137] reported a poor QoL in patients after PPF surgery (mean postoperative follow-up period: 3.8 years), which are comparable with our results. Conversely, the study by Kinov et al.[143] found higher values of health-related QoL in patients at a mean follow-up of 5 years after PPF surgery compared to other studies. The discrepancy between results of our study and Kinov et al.[143] may be related to the difference in the study designs and the age group of the study samples. Specifically, participants in the retrospective study by Kinov et al. were relatively younger compared to our older sample. The contradictory results found between these studies and the present study reinforce the need for more research to assess the QoL in this population.

There are limitations in this study that need to be acknowledged. In this study, we did not include people that sustained a PPF due to non-traumatic reasons and the findings are not generalizable to all the people who sustain a PPF. Another limitation was the retrospective report of falls over a duration of 4-years. The reporting of falls occurrence based on the recall memory of the study participants has a potential for under-reporting of falls.[100] Thus, the falls occurrence in this study may be a conservative estimate. To provide a more accurate occurrence of falls, future research is recommended to minimize recall bias through the use of a daily falls calendar and follow-up calls

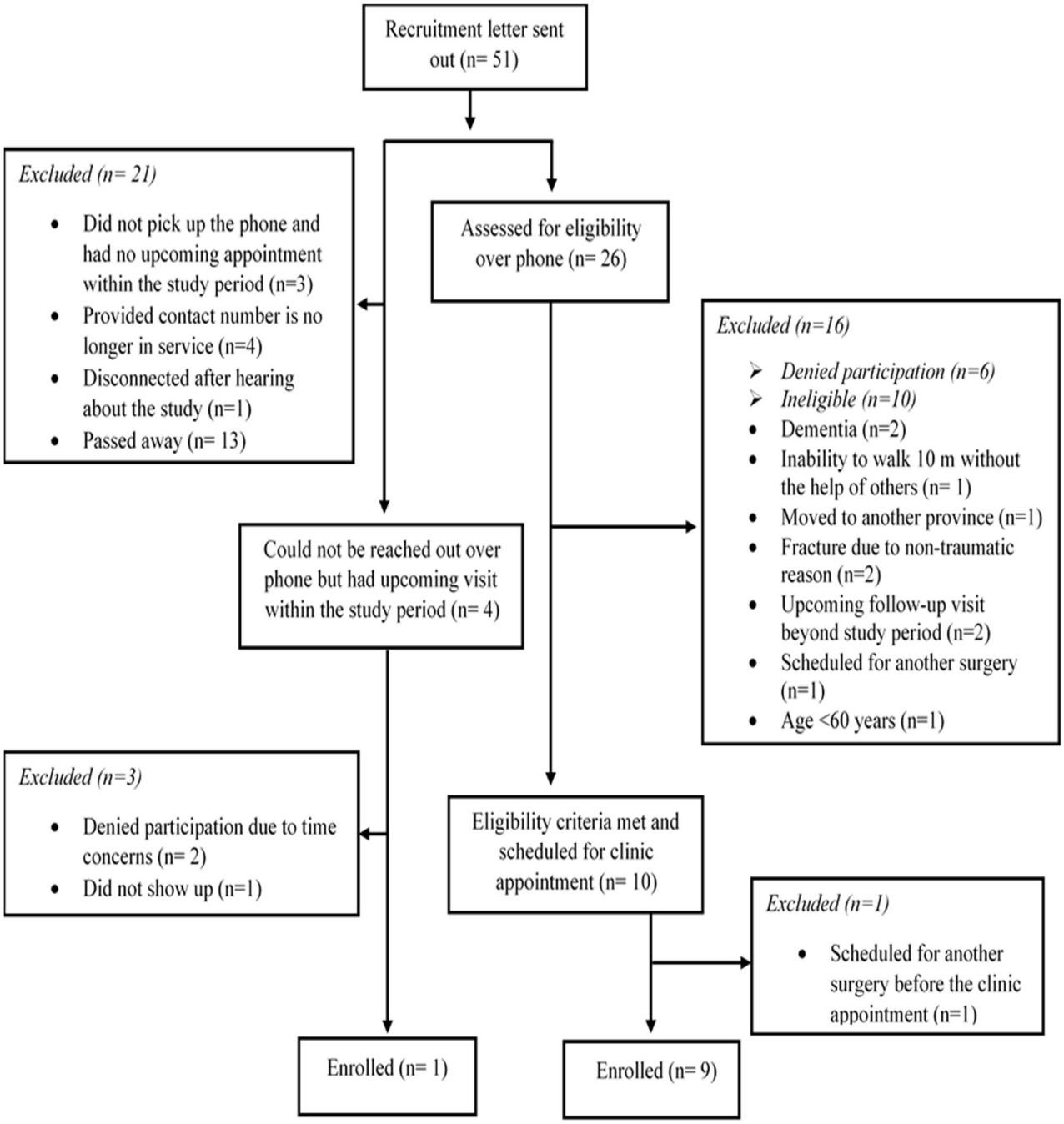
over a prospective time frame. Additionally, there are no established normative data in the literature for the LLFDI instrument which prevented us from comparing our data with age and sex-matched normative values. There are several strengths of the study that should be acknowledged. The main strength of the study is the in-depth evaluation of functional status after the PPF surgery using both physical performance tests and patient-reported outcome measures. This is the first study that has evaluated the falls occurrence and falls knowledge among older adults with a PPF surgery, adding valuable information for clinicians that can be utilized to adjust the falls prevention education delivered during the rehabilitation phase to minimize the falls occurrence in this population. In this study, we included the participants whose PPF surgery was performed by three certified orthopaedic surgeons with a specialization in THA surgery. These surgeons performed the majority of the PPF surgery within the last four-years, providing a representation of the patient profile that had undergone PPF surgery at our institution during this period.

3.5 CONCLUSION

The current study found functional impairment in the performance of daily life activities well beyond the one-year postoperative period among older adults with a PPF due to falls after THA. Deficits were demonstrated in gait, functional mobility, dynamic balance, and lower extremity strength compared to age and sex-matched healthy adults. Social isolation and poor perception of QoL in physical and psychological facets of life were common in this population. Additionally, falls occurrence in this sample was higher than that reported in primary THA cohorts. Our in-depth evaluation of falls knowledge indicated a knowledge gap regarding known risk factors and effective falls prevention strategies exists. More studies should be conducted that evaluate functional status utilizing both patient-reported outcome measures and physical performance tests

and also the subjective evaluation of psychological outcomes to improve the quality of life of this population.

Appendix 3.1: Flow chart of enrolled participants.



Appendix 3.2: Falls Questionnaire.

Falls Information

1. Have you had any falls since having your PFF surgery? (This includes from the day of your surgery to this follow-up clinic appointment today)
   - ☐ Yes
   - ☐ No
2. How many falls have you had since your surgery?
   - ☐ One
   - ☐ Two
   - ☐ Three or more
3. At what time after your surgery did you fall? (CHECK ALL THAT APPLY)
   - ☐ During hospital stay right after the surgery
   - ☐ Discharge from hospital to 6 weeks after the surgery
   - ☐ 6 weeks to 3 months after the surgery
   - ☐ 3 months to 6 months after the surgery
   - ☐ 6 months to 12 months after the surgery
   - ☐ More than 12 months after the surgery
4. Did you sustain any other fracture(s) other than the periprosthetic femoral fracture after your PFF surgery?
   - ☐ Yes (Go to question # 5)
   - ☐ No (Go to question # 7)
5. What kind of fracture(s) did you have after your PFF surgery? (Please list the site and side of the fracture(s))

   _____

   _____

   _____

6. Did you seek any medical attention because of the fracture(s) mentioned in question # 5?

- Yes
- No

7. Have you had any falls within the last 6 months?

   - Yes (Go to question # 8)
   - No (Go to question # 14)

8. How many falls have you had within the last 6 months?
   - One
   - Two
   - Three or more
9. Did you injure yourself from any of the falls in the last 6 months?
   - Yes (Go to question # 10)
   - No (Go to question # 11)
10. Where did you injure yourself? (CHECK ALL THAT APPLY)
    - Head /Neck □Yes □No
    - Trunk □Yes □No
    - Arm □Yes □No
    - Leg □Yes □No
11. Did you seek any medical attention because of the fall(s) in the last 6 months?
    - Yes
    - No
12. Please describe the activity you were doing when you fell. (Refer back to question # 2)

    _____

    _____

    _____

13. Did the fall affect your confidence?

    - Yes
    - No

14. Are you afraid of falling, such that you have stopped doing activities you are physically capable of doing?

    □ Yes

    □ No

15. If you answer 'Yes' to the question # 14, please describe the activities you have stopped due to <u>fear of falling</u> since the PFF surgery (e.g., climbing stairs, driving, walking on uneven surfaces)

_____

_____

_____

16. Do you now use a gait aid/accompaniment to do activities you could do before your surgery without the aid?

    □ Yes

    □ No

Functional outcome measures:

17. Did you have to modify any of your daily activities after PFF surgery?

    □ Yes (Go to question # 18)

    □ No (Go to question # 22)

18. If you answer 'Yes' to the question # 17, please list the activities you have modified (e.g., moved to ground floor, stopped driving, stopped climbing stairs, stopped walking on uneven surfaces) since the surgery?

_____

_____

_____

19. Have you modified any of your daily activities after the PFF surgery due to the following reasons?

    □ Pain □ Reduced balance □ None (Go to question # 20)

□ Physical fatigue □ Lack of endurance

□ Mental fatigue □ Lack of support

20. Are there any other reasons that are not included in question #19, for which you had to modify your daily activities after the PFF surgery?

□ Yes (Go to question # 21)

□ No (Go to question # 22)

21. If you answer 'Yes' to the question # 20, please list the potential reasons for which you had to modify your daily life activities after the PFF surgery?

_____

_____

_____

Falls Knowledge

22. Do you believe that falls among people who have had a PFF surgery can be prevented?

□ Yes

□ No

For each of the next 13 questions, please rate how important each of these scenarios are in making a person more likely to fall, whether they have had a PFF surgery or not.

23. People are likely to fall because things such as rugs and furniture get in the way.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

24. People are likely to fall because grab bars are not present or are not in a helpful position in their house or apartment.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

25. People are likely to fall because sidewalks and streets are not clear of ice and snow.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

26. People are likely to fall because sidewalks and streets are poorly maintained (e.g. cracked or irregular pavement).

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

27. People are likely to fall because handrails are not present or are poorly positioned in public places.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

28. People are likely to fall because they have a coordination or balance problem.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

29. People are likely to fall because they do not have enough muscle strength or endurance in their legs.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

30. People are likely to fall because their bones are weakened with age (osteoporosis).

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

31. People are likely to fall because they have poor vision.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

32. People are likely to fall because they do unsafe or risky things.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

33. People are likely to fall because they do not always pay close attention to their surroundings.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

34. People are likely to fall because they are forgetful.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

35. People are likely to fall because they take many medications.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

36. On a scale from 0 to 10, where 0 means "not at all important" and 10 means "most important", how important is falling compared with your other health concerns?

0 1 2 3 4 5 6 7 8 9 10

Not at all important Most important

37. Do you feel unsteady when walking?

- Yes
- No

38. Do you think you will fall at some time in the next 12 months?

- Yes
- No

39. If you fell and seriously injured yourself (defined as injury such as fracture, dislocation, head trauma that required medical attention), do you think you would be able to return to your current living situation?

Strongly agree Agree Undecided Disagree Strongly disagree

40. After your PFF surgery, do you remember being taught by any health care professionals about strategies to prevent falls after the surgery?

- Yes
- No

41. Please describe any things <u>you have modified</u> in your daily activities and/or home to reduce the risk of falling since having your PFF surgery.

_____

_____

_____

42. Please list any things that <u>you plan to modify</u> in your daily activities and/or home to reduce the risk of falling

_____

_____

_____

43. Do you feel confident you will be able to make the changes you have listed in question #42?

- ☐ Yes
- ☐ No

44. Is there something that might make it difficult for you to do the changes you listed in question #42 are?

_____

_____

_____

45. I am very keen to lower my risk of falling by using the strategies I listed in question #42.

Strongly agree Agree Undecided Disagree Strongly disagree

46. I am interested in learning more about how to prevent falls.

Strongly agree Agree Undecided Disagree Strongly disagree

Psychological Outcome Measures:

47. Do you feel socially isolated after the PFF surgery?

- ☐ Yes
- ☐ No

48. Do you feel frustrated with your current situation?

- Yes
- No

49. How has PFF surgery impacted your life psychologically?

_____

_____

_____

Chapter 4: GENERAL SUMMARY

The main objective for the present thesis was to have a better understanding of the functional and psychological outcomes following the PPF surgery in older adults. In study 1, a fair hip joint function and poor overall physical function and psychological well-being was demonstrated by patients at one-year following their PPF surgery. The one-year mortality rate was high, though comparable to previous studies. We found no significant changes in the functional or psychological outcomes between one and two-years post-surgery. Additionally, we found no significant association between baseline clinical and surgical characteristics and functional and psychological outcomes at one-year following the surgery.

To better understand the functional and psychological outcomes and future falls risk post-PPF surgery, study 2 evaluated both subjective and objective measures of physical function, subjective psychological status, overall QoL, falls occurrence, and falls knowledge in older adults after the PPF surgery. Subjectively, participants reported reduced functional ability to perform most of their daily life activities. Objectively, and in agreement with subjective physical function results, participants demonstrated deficits in gait, functional mobility, dynamic balance, and lower extremity strength compared to age and sex-matched normative data. Additionally, social isolation and a poor satisfaction with the physical and psychological aspects of life were reported. Approximately half of the sample experienced a fall after the PPF surgery, which is higher than after primary THA. People also had a low perception of personal falls risk and underestimated the negative consequences of falls. Participants also demonstrated a lack of knowledge regarding known falls risk factors and effective falls prevention strategies.

The findings of these studies are novel and add valuable information to better understand the impact that PPF surgery has on the well-being of older adults. It is without a doubt, that patients with PPF experience low physical and psychological well-being after their surgery with no change being observed over an extended period of recovery for those survive. This suggests that the evaluation of rehabilitation protocols for functional and psychological recovery is warranted to achieve better outcomes in this population. Our findings also suggest that falls risk assessment and fall prevention education should be delivered in more effective ways during the postoperative rehabilitation process in this population.

Chapter 5: FUTURE DIRECTIONS

Future research should involve using a prospective cohort study design with an adequately powered sample size to evaluate the primary outcomes from these studies. Additionally, future studies should also assess recovery beyond two-years after PPF surgery. Although difficult to collect, assessment of pre-PPF surgical status to compare to postoperative evaluation will provide fuller understanding of the recovery trajectories. Comorbidities and preoperative poor psychological status and disability are factors known to affect the psychological well-being in patients post-THA and may also be relevant for people after PPF surgery.[159] Therefore, future research should evaluate these factors in the evaluation of psychological well-being in this population. Utilizing both subjective and objective physical function measures has been found beneficial in capturing the physical deficits (e.g., balance deficits, muscle weakness) that may remain unidentified by self-reported questionnaires.[87] To provide a more accurate occurrence of falls, future research is recommended to minimize recall bias through the prospective use of a daily falls calendar and follow-up calls over the duration of the study. Additionally, it would be relevant

to assess the differences in the functional and psychological outcomes between the people who experience a fall and those do not post-PPF surgery as falls can lead to the reduced health-related QoL in older adults.[104,105] Given the knowledge gap regarding effective falls prevention strategies in this patient population, it should also be a priority to assess if different educational interventions (e.g., internet-based workshops, brochures delivered during outpatient clinics) help patients to implement effective strategies.

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Appendix A: Ethics Approval Notice

LAWSON FINAL APPROVAL NOTICE

LAWSON APPROVAL NUMBER: R-19-201

PROJECT TITLE: Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults

PRINCIPAL INVESTIGATOR: Dr. Susan Hunter

LAWSON APPROVAL DATE: 29/04/2019

ReDA ID: 6436

Overall Study Status: Active

Please be advised that the above project was reviewed by Lawson Administration and the project:

Please provide your Lawson Approval Number (R#) to the appropriate contact(s) in supporting departments (eg. Lab Services, Diagnostic Imaging, etc.) to inform them that your study is starting. The Lawson Approval Number must be provided each time services are requested.

Dr. David Hill
V.P. Research
Lawson Health Research Institute

Appendix B: Letter of Information and Consent

School of Physical Therapy

Letter of Information

Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults

Study Principal Investigator: Dr. Susan Hunter PT PhD

Co-Investigators: Dr. Brent Lanting, Dr. James L. Howard, Dr. Edward M. Vasarhelyi,

Dr. Lyndsay Somerville

Introduction

You are being invited to participate in a research study because you had a surgery for a fracture around your hip/knee joint replacement. Fracture around hip/knee joint replacement is known as a periprosthetic femoral fracture (PFF). This study is for the MSc thesis of Rifat Islam in the School of Physical Therapy at the University of Western Ontario.

The study will be looking at how a PFF affects a person's overall quality of life in terms of both physical and psychological well-being, and future risk of falls after this fracture.

The purpose of this letter is to provide you the details of the study to help you with making a decision about participation in this study. It is important that you know about the purpose of the study and what it will involve. Please take your time to make a decision about participation, and discuss this proposal with your orthopedic surgeon, family members and friends. Participation in this study is voluntary.

Description of study

After a PFF most people develop limitations in their daily life activities due to problems with walking, balance, and weakness in the leg muscles. Accidental falls are the most common cause of PFFs.

Falls in older adults are common and a significant public-health concern as one third of people over the age of 65 will fall each year. Falls can cause serious injuries such as fractures and injuries to the head. Problems with walking, balance and leg strength after PFF can result in an increased risk of future falls. At this moment, we know very little about the falls that occur and the future falls risk after PFF.

PFF can have physical and psychological effects on a person. There are very few studies that have looked at future falls risk, and the physical and psychological effects that a PFF has on a person's life. It is important for health care providers to understand the impact of this kind of

injury in a person's life in order to put in place interventions to improve quality of life and prevent future fall risk in older adults.

If you agree to participate in this study, information will be collected by interview and review of your medical charts related to total hip/knee joint replacement surgery and PFF surgery. You will also be asked information about any falls that have occurred since your PFF surgery. You will be asked to complete the following questionnaires and physical function tests as part of the study assessment.

List of questionnaires:

Questionnaire:	Purpose
1	To test your memory
2	To assess your health status
3	To assess your functional status after your PFF surgery
4	To determine future falls risk after your PFF surgery
5	To assess fear of falling after your PFF surgery
6	To evaluate overall quality of life after your PFF surgery
7	To assess psychological impact of PFF surgery

List of physical function tests:

Physical function test:	Purpose of the test	Description of the test
1	To test walking	We will ask you to walk a 6-meter distance at your comfortable walking pace wearing 5 small accelerometers (size- 4×5 cm), a device that will be attached with Velcro straps around your arms and legs to record information on your walking.
2	To test functional mobility	You will be asked to rise out of a chair and walk 3 meters before turning around and returning to the chair.
3	To test balance	While in standing, you will be asked to repeatedly place one foot at a time on a step to test your balance (repeated for left and right foot).
4	To test leg strength	You will be asked to rise out of a chair as many times as possible in a 30 second time period to test your leg strength.

You will be able to use your usual mobility aid during the walk and functional mobility tests. If you are unable to perform the other two physical function tests without the support of your

mobility aid, you will not be asked to do these tests for safety purposes. The graduate student, Rifat Islam will be present at all times to ensure a safe environment and prevent any falls. Participation in the study requires only one visit that will take place in the orthopedic surgery outpatient clinic of the London Health Sciences Centre – University Hospital at the same time as your appointment to see the orthopaedic surgeon. The study assessment will take approximately 45-60 minutes to complete.

Participation

We are looking for 100 volunteers who are 60 years of age or older, who had surgery for a PFF at London Health Sciences Center - University Hospital due to a fall, and who are between 6 months to 4 years after the PFF surgery. Volunteers must be able to walk independently with or without a mobility aid (e.g., cane or walker) for 10 meters without assistance and be able to provide informed consent for themselves. However, there are certain conditions that would exclude you from participating in this study. These conditions are as follows: unable to provide informed consent and follow instructions in English, unable to walk 10 meters without the assistance of another person, and current diagnosis of cognitive impairment. If you are unsure whether any of these situations applies in your case, please feel free to ask the research staff.

Withdrawal

Participation in this study is voluntary. You may refuse to participate, refuse to answer any of the questions, or withdraw from the study at any time with no effect on your future care. If you choose to withdraw from the study, any information that was provided will not be used for any study purposes.

Risk and Benefits

Risks

The risks associated with taking part in this study are minor. The physical tests involve movements that are common in daily activities and thus do not pose any extra risk beyond these levels of activity. There is a risk of falls. All tests will be conducted by the graduate student, Rifat Islam with experience in the assessment of physical function in older adults. Safety belts will be used, and Rifat Islam will always remain within arms' reach to ensure safety should you lose your balance. You will be able to have rest breaks during the assessment should you get tired. In case of any study related injury, medical care will be provided at no cost under the supervision of your orthopaedic surgeon. As with any research there is the risk of breach of patient confidentiality. To reduce the risk of this breach, all identifiable data will be de-identified and only study team members will have access to it.

Benefits

You may not benefit directly from your participation in this study.

Reimbursement for Participation in the study

You will not be paid to participate in this research project.

Cost

We anticipate that the study procedure may add up to 45-60 mins to your regular clinic visit. If your clinic visit is longer than anticipated, additional parking will not be reimbursed.

Confidentiality

All records and research materials that would identify you will be held confidential and, to the extent permitted by the applicable laws and regulations, will not be made publicly available. If you agree to participate in this study, you will be assigned a unique identification number that will be used on all the documents related to this study. This unique number will be linked to your name and contact information on another "master list" of participants. This master list will be kept separately from the other research information in a locked office. All information collected will be kept for a period of 15 years. If the results of this study were to be published in the medical literature, your identity will not be revealed. Lawson Health Research Institute and Western Health Sciences Research Ethics Board (HSREB) will retain the right to access data collected in this study in accordance with the Quality Assurance Evaluation Program (QAEP).

Version Date: 19th July 2019

School of Physical Therapy

Consent Form

Study Title: Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults

Principal Investigator: Dr. Susan Hunter PT PhD

I have read the *Letter of Information*, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

_____
Participant's Name (Printed)

_____ _____
Participant's Signature *Date (dd/mm/yyyy)*

I confirm that I have explained the nature, purpose, and foreseeable effects of the trial to the participant whose name is printed above. The participant consented to participate by his/her personally signed signature.

_____ _____
Name of Person Obtaining Consent *Role in Study*

_____ _____
Signature of Person Obtaining Consent *Date (dd/mm/yyyy)*

Version Date: 19th July 2019

Appendix C: Letter to Recruit

(Date)
Dear _____,

Enclosed please find the letter of information for a study being conducted in the Department of Orthopaedic Surgery at London Health Sciences Centre (LHSC) with patients who had surgery for a fracture around their hip/knee joint replacement implant, known as a periprosthetic femoral fracture (PFF). The study is called "Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults". Our research team for this study is comprised of Principal Investigator-Dr. Susan Hunter and Co-Investigators- Dr. Brent Lanting, Dr. James L Howard, Dr. Edward M Vasarhelyi, and Dr. Lyndsay Somerville.

You are being contacted because you have an upcoming visit and I have identified you as being potentially eligible to participate in this study. This letter of information describes the research study and your role if you decide to participate. The purpose of the study is to evaluate how a PFF affects a person's life both physically and psychologically, and evaluate the risk of future falls. The graduate student, Rifat Islam, will contact you by phone within a month of you receiving this letter to see if you would like to participate. We will attempt to contact you on three occasions within the one-month time period. There is no obligation to speak with Rifat Islam and all study participation is voluntary. All information used for the research study will be kept confidential and you will not be identified personally in any publications or communications resulting from this study. You do not waive any legal rights by agreeing to participate in this study.

Please do not hesitate to contact us at the numbers listed in the letter of information if you have any questions or concerns. Thank you for taking the time to consider this study.

Yours truly,
Dr. Lanting, Brent
Orthopaedic Surgeon at LHSC-University Hospital
339 Windermere Rd, London, ON, N6A 5A5
Version Date: 15th April 2019

London Health Sciences Centre

(Date)
Dear _____,

Enclosed please find the letter of information for a study being conducted in the Department of Orthopaedic Surgery at London Health Sciences Centre (LHSC) with patients who had surgery for a fracture around their hip/knee joint replacement implant, known as a periprosthetic femoral fracture (PFF). The study is called "Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults". Our research team for this study is comprised of Principal Investigator-Dr. Susan Hunter and Co-Investigators- Dr. Brent Lanting, Dr. James L Howard, Dr. Edward M Vasarhelyi, and Dr. Lyndsay Somerville.

You are being contacted because you have an upcoming visit and I have identified you as being potentially eligible to participate in this study. This letter of information describes the research study and your role if you decide to participate. The purpose of the study is to evaluate how a PFF affects a person's life both physically and psychologically, and evaluate the risk of future falls. The graduate student, Rifat Islam, will contact you by phone within a month of you receiving this letter to see if you would like to participate. We will attempt to contact you on three occasions within the one-month time period. There is no obligation to speak with Rifat Islam and all study participation is voluntary. All information used for the research study will be kept confidential and you will not be identified personally in any publications or communications resulting from this study. You do not waive any legal rights by agreeing to participate in this study.

Please do not hesitate to contact us at the numbers listed in the letter of information if you have any questions or concerns. Thank you for taking the time to consider this study.

Yours truly,

Dr. Howard, James L
Orthopaedic Surgeon at LHSC-University Hospital
339 Windermere Rd, London, ON, N6A 5A5

Version Date: 15th April 2019

London Health Sciences Centre

(Date)

Dear _____,

Enclosed please find the letter of information for a study being conducted in the Department of Orthopaedic Surgery at London Health Sciences Centre (LHSC) with patients who had surgery for a fracture around their hip/knee joint replacement implant, known as a periprosthetic femoral fracture (PFF). The study is called "Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults". Our research team for this study is comprised of Principal Investigator-Dr. Susan Hunter and Co-Investigators- Dr. Brent Lanting, Dr. James L Howard, Dr. Edward M Vasarhelyi, and Dr. Lyndsay Somerville.

You are being contacted because you have an upcoming visit and I have identified you as being potentially eligible to participate in this study. This letter of information describes the research study and your role if you decide to participate. The purpose of the study is to evaluate how a PFF affects a person's life both physically and psychologically, and evaluate the risk of future falls. The graduate student, Rifat Islam, will contact you by phone within a month of you receiving this letter to see if you would like to participate. We will attempt to contact you on three occasions within the one-month time period. There is no obligation to speak with Rifat Islam and all study participation is voluntary. All information used for the research study will be kept confidential and you will not be identified personally in any publications or communications resulting from this study. You do not waive any legal rights by agreeing to participate in this study.

Please do not hesitate to contact us at the numbers listed in the letter of information if you have any questions or concerns. Thank you for taking the time to consider this study.

Yours truly,

Dr. Vasarhelyi, Edward M

Orthopaedic Surgeon at LHSC-University Hospital

339 Windermere Rd, London, ON, N6A 5A5

Version Date: 15th April 2019

Appendix D: Telephone Call Screening Tool

Study: Quantifying the functional and psychological outcomes after Peri-Prosthetic Femoral Fracture in association with Total Hip Arthroplasty and Total Knee Arthroplasty in older adults

Telephone Call Screening Tool

Date (DD/MM/YYYY): _____
Recruitment Identifier:_____

Screening Questions		
	Yes	No
1. Are you 60 years of age or older?		
2. Are you able to understand English?		
3. Do you have any problems following instructions in English?		
4. Are you able to provide signed informed consent for yourself?		
5. Are you able to walk for 10 meters with or without a mobility aid and without the help of another person?		
6. Did you have a fracture around your hip/knee replacement implant due to falls?		
7. Did you have your surgery for this fracture at London Health Sciences Centre, University Hospital?		
8. Are you between 6 months to 4 years from this surgery?		
9. Do you have a current diagnosis of dementia or any other conditions that might affect your cognition or how you think?		

(The use of the word "you" refers to the person who had peri-prosthetic femoral fracture surgery being asked the question directly. Responses in grey boxes indicate an exclusion criterion has been met)

_____ _____
Signature Date
Version Date: 19th July 2019

Appendix E: Outcome Measures

Your Full Name: _____ **Today's Date:**
_____/_____/_____
Month Day Year

WOMAC OSTEOARTHRITIS INDEX

1. **The following questions concern the amount of pain you are currently experiencing in your knees. For each situation, please enter the amount of pain you have experienced in the past 48 hours.**

		None	mild	moderate	severe	extreme
A. Walking on a flat surface	A.	☐	☐	☐	☐	☐
B. Going up or down stairs	B.	☐	☐	☐	☐	☐
C. At night while in bed	C.	☐	☐	☐	☐	☐
D. Sitting or lying	D.	☐	☐	☐	☐	☐
E. Standing upright	E.	☐	☐	☐	☐	☐

2. **Please describe the level of pain you have experienced in the past 48 hours for each one of your knees.**

		None	mild	moderate	severe	extreme
A. Right knee	A.	☐	☐	☐	☐	☐
B. Left knee	B.	☐	☐	☐	☐	☐

3. **How severe is your stiffness after first awakening in the morning?**

None	mild	moderate	severe	extreme
☐	☐	☐	☐	☐

4. **How severe is your stiffness after sitting, lying, or resting later in the day?**

None	mild	moderate	severe	extreme
☐	☐	☐	☐	☐

5. **The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities, please indicate the degree of difficulty you have experienced in the last 48 hours, in your knees.**

What degree of difficulty do you have with:

		None	mild	moderate	severe	extreme
A. Descending (going down) stairs	A.	☐	☐	☐	☐	☐
B. Ascending (going up) stairs	B.	☐	☐	☐	☐	☐
C. Rising from sitting	C.	☐	☐	☐	☐	☐
D. Standing	D.	☐	☐	☐	☐	☐
E. Bending to floor	E.	☐	☐	☐	☐	☐
F. Walking on a flat surface	F.	☐	☐	☐	☐	☐
G. Getting in/out of car	G.	☐	☐	☐	☐	☐
H. Going shopping	H.	☐	☐	☐	☐	☐
I. Putting on socks/stockings	I.	☐	☐	☐	☐	☐
J. Rising from bed	J.	☐	☐	☐	☐	☐
K. Taking off socks/stockings	K.	☐	☐	☐	☐	☐
L. Lying in bed	L.	☐	☐	☐	☐	☐
M. Getting in/out of bath	M.	☐	☐	☐	☐	☐
N. Sitting	N.	☐	☐	☐	☐	☐
O. Getting on/off toile	O.	☐	☐	☐	☐	☐
P. Heavy domestic duties (mowing the lawn, lifting heavy grocery bags)	P.	☐	☐	☐	☐	☐
Q. Light domestic duties (such as tidying a room, dusting, cooking)	Q.	☐	☐	☐	☐	☐

Harris Hip Score

Hip ID:

Study Hip: ☐ Left ☐ Right

Examination Date (MM/DD/YY): / /

Subject Initials: |___|___|___|

Medical Record Number:

Interval: _____

Harris Hip Score

Pain *(check one)*

- ☐ None or ignores it (44)
- ☐ Slight, occasional, no compromise in activities (40)
- ☐ Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- ☐ Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- ☐ Marked pain, serious limitation of activities (10)
- ☐ Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- ☐ None (11)
- ☐ Slight (8)
- ☐ Moderate (5)
- ☐ Severe (0)

Support

- ☐ None (11)
- ☐ Cane for long walks (7)
- ☐ Cane most of time (5)
- ☐ One crutch (3)
- ☐ Two canes (2)
- ☐ Two crutches or not able to walk (0)

Distance Walked

- ☐ Unlimited (11)
- ☐ Six blocks (8)
- ☐ Two or three blocks (5)
- ☐ Indoors only (2)
- ☐ Bed and chair only (0)

Sitting

- ☐ Comfortably in ordinary chair for one hour (5)
- ☐ On a high chair for 30 minutes (3)
- ☐ Unable to sit comfortably in any chair (0)

Enter public transportation

- ☐ Yes (1)
- ☐ No (0)

Stairs

- ☐ Normally without using a railing (4)
- ☐ Normally using a railing (2)
- ☐ In any manner (1)
- ☐ Unable to do stairs (0)

Put on Shoes and Socks

- ☐ With ease (4)
- ☐ With difficulty (2)
- ☐ Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

- Less than 30° fixed flexion contracture ☐ Yes ☐ No
- Less than 10° fixed abduction ☐ Yes ☐ No
- Less than 10° fixed internal rotation in extension ☐ Yes ☐ No
- Limb length discrepancy less than 3.2 cm ☐ Yes ☐ No

Range of Motion (**indicates normal*)

- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

SF-12 Health Survey

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. **Answer each question by choosing just one answer.** If you are unsure how to answer a question, please give the best answer you can.

1. In general, would you say your health is:

☐1 Excellent ☐2 Very good ☐3 Good ☐4 Fair ☐5 Poor

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	YES, limited a lot	YES, limited a little	NO, not limited at all
2. **Moderate activities** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf.	☐1	☐2	☐3
3. Climbing **several** flights of stairs.	☐1	☐2	☐3

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	YES	NO
4. **Accomplished less** than you would like.	☐1	☐2
5. Were limited in the **kind** of work or other activities.	☐1	☐2

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	YES	NO
6. **Accomplished less** than you would like.	☐1	☐2
7. Did work or activities **less carefully than usual**.	☐1	☐2

8. During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)?

☐1 Not at all ☐2 A little bit ☐3 Moderately ☐4 Quite a bit ☐5 Extremely

These questions are about how you have been feeling during the past 4 weeks.
For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks…

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
9. Have you felt calm & peaceful?	☐1	☐2	☐3	☐4	☐5	☐6
10. Did you have a lot of energy?	☐1	☐2	☐3	☐4	☐5	☐6
11. Have you felt down-hearted and blue?	☐1	☐2	☐3	☐4	☐5	☐6

12. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

☐1 All of the time ☐2 Most of the time ☐3 Some of the time ☐4 A little of the time ☐5 None of the time

Patient name: Date: PCS: MCS:

Visit type (circle one)
Preop 6 week 3 month 6 month 12 month 24 month Other:_____

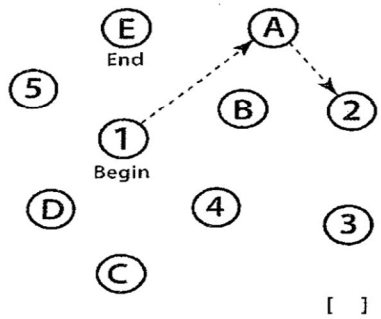
ID #_____

MONTREAL COGNITIVE ASSESSMENT (MOCA)

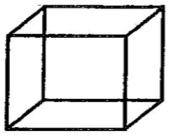
Version 7.1 Original Version

DATE : _____

VISUOSPATIAL / EXECUTIVE



Copy cube



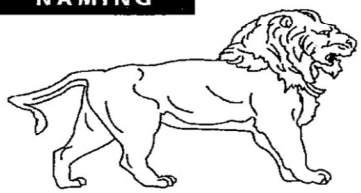
[ ] [ ]

Draw CLOCK (Ten past eleven) (3 points)

[ ] Contour [ ] Numbers [ ] Hands

POINTS ___/5

NAMING



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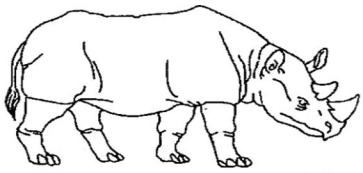

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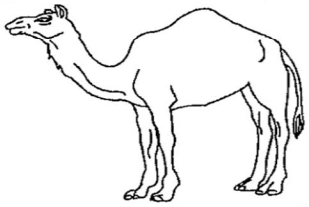

[ ] ___/3

MEMORY

Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

ATTENTION

Read list of digits (1 digit/ sec.).

Subject has to repeat them in the forward order [ ] 2 1 8 5 4

Subject has to repeat them in the backward order [ ] 7 4 2 ___/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B ___/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt** ___/3

LANGUAGE

Repeat : I only know that John is the one to help today. [ ]

The cat always hid under the couch when dogs were in the room. [ ] ___/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words) ___/1

ABSTRACTION

Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler ___/2

DELAYED RECALL

Optional

Has to recall words WITH NO CUE	FACE [ ]	VELVET [ ]	CHURCH [ ]	DAISY [ ]	RED [ ]	Points for UNCUED recall only
Category cue						
Multiple choice cue						

___/5

ORIENTATION

[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City ___/6

www.mocatest.org

Normal ≥ 26 / 30

TOTAL ___/30

Add 1 point if ≤ 12 yr edu

Administered by: _____

Study ID#_____ Date _____ dd/mm/yyyy

Cumulative Illness Rating Scale (CIRS)

Scale

0. No problem affecting that system
1. Current mild problem or past significant problem
2. Moderate disability or morbidity and/or requires first-line therapy
3. Severe problem and/or constant and significant disability and/or hard-to-control chronic problems
4. Extremely severe problem and/or immediate treatment required and/or organ failure and/or severe functional impairment

Ratings

Rated 0

- No problems or healed minor injuries
- Past childhood injuries (eg, chickenpox)
- Minor surgery (eg, amygdalectomy)
- Uncomplicated healed fractures
- Other past problems healed without sequel (eg, pneumonia)

Rated 1

- Current medical problem with mild discomfort or disability, or occasional exacerbations (eg, occasional heartburn relieved with PRN antiacids)
- Minor impact on morbidity
- Past significant medical problems not currently an issue (eg, passage of a kidney stone)
- Major surgery (eg, hysterectomy)

Rated 2

- Medical condition that requires daily treatment (first-line therapy; eg, steroids – asthma, H2 blockers – acid reflux)
- Moderate disability or morbidity

Rated 3

- Chronic conditions that are not controlled with first-line therapy (eg, asthma needing continuous corticosteroid therapy)
- Constant significant disability
- Severe problem

Rated 4

- Extremely severe problem
- Any acute condition that requires immediate treatment (eg, severe bronchospasm, unstable angina)
- Organ failure (eg, end-stage renal disease/dialysis, O_2 for COPD)
- Severe sensory impairment (eg, almost complete blindness or deafness, wheelchair-bound)
- Quality of life severely affected, severe functional impairment

Rating Malignancies

Rated 1

- Cancer diagnosed in the remote past without evidence of recurrence or sequel in the past 10 years or skin cancer operated in the past without major sequel (other than melanoma)

Rated 2

- No evidence of recurrence or sequel in the past 5 years

Rated 3

- Required chemotherapy, radiation, or hormonal therapy in the past 5 years

Rated 4

- Recurrent malignancy, metastasis, or palliative treatment stage

System/Description	Rating/Score

Cardiac

0 1 2 3 4

- Any cardiac problem? (angina, myocardial infarction, arrhythmia, valve problems)
- Any medications take for above?
- Any heart surgery in the past?

Vascular

0 1 2 3 4

- Any circulatory problem? (peripheral atherosclerotic disease, aneurysm of the abdominal aorta)
- Any hypertension or cholesterol problem?
- If yes, any medication taken for these problems?
- Any vascular surgery in the past? (bypass graft surgery of lower limbs, carotid endarterectomy)

Hematological

0 1 2 3 4

- Any blood problem? (anemia, leukemia, hypercoagulability, or any other problem affecting the blood, blood cells, spleen, or lymphatic system)
- If yes, any medication taken for these problems?

Respiratory

0 1 2 3 4

- Any respiratory problem? (asthma, emphysema, bronchitis, pulmonary embolism)
- If yes, any medication taken for these problems? (eg, pressurized aerosols)
- Any lung surgery?
- Cigarette smoking? How many packs per day? For how long?

Pack years = number of packs per day x the number of years smoked
(example: 1 pack per day for 20 years = 20 pack years)
Smoker up to 20 pack years: Rated 1
Smoker from 21–40 pack years: Rated 2
Smoker over 40 pack years: Rated 3

EENT (eye, ear, nose, throat, larynx)

0 1 2 3 4

- Any problem with eyes (glaucoma, cataract, important loss of vision), ears (includes important hearing impairment), nose, throat, or voice?
- Any medication taken for these problems?

Note: Vertigo and dizziness are included in this section, unless they are of neurological origin.

Upper GI

0 1 2 3 4

- Any problem with stomach or digestion? (includes the esophagus, stomach, and duodenum)
- If yes, any medication taken for these problems?
- Any surgery for the stomach or the esophagus?

Lower GI

0 1 2 3 4

- Any intestinal problem? (includes intestinal hernias, constipation, anal problems, incontinence)
- If yes, any medication taken for these problems?
- Any surgery for the abdomen?

Hepatic and Pancreatic

0 1 2 3 4

- Any problem in the liver or the pancreas?
- Any medication taken for these problems?
- Any surgery for the liver or the pancreas?

Note: Cholecystectomy is rated in this section

Renal

0 1 2 3 4

- Any problem in the kidneys? (impairment in function, infection)
- If yes, any medication taken for these problems?
- Any surgery for the kidneys?

Genitourinary

0 1 2 3 4

- Any urinary problem? (lithiasis, incontinence)
- If yes, any medication taken for these problems?
- Any surgery for the urinary bladder, for renal lithiasis?

Musculoskeletal

0 1 2 3 4

- Any problem in the skin, joints, bones, or muscles? (includes arthrosis, osteoporosis, carpal tunnel, and any other skin or musculoskeletal problem)
- Any medication, anti-inflammatory drugs? Infiltrations? Creams prescribed by a doctor?

Note: Fibromyalgia is rated in this section, but it may also be rated in Psychiatric if necessary.

Neurological

0 1 2 3 4

- Any neurological problem? (cerebrovascular accident, peripheral neuropathy, headaches)
- If yes, any medication taken for these problems?
- Any surgery for these problems?

Endocrine-Metabolic

0 1 2 3 4

- Any problem of the thyroid gland, obesity, diabetes, or any other hormonal problem?
  For obesity:
  - Body mass index (BMI) ≥ 30: Rated 1
  - BMI ≥ 30 + medication or moderate disability: Rated 2
  - BMI ≥ 45: Rated 3
- Any medication? Surgery for any of these problems?
- Any problem with breasts? (dysplasia, cancer)
- Surgery for these problems?
- Menopause? (or andropause in men) Any hormone? (the same for men in andropause)
  Menopause or andropause:
  - Without hormonotherapy or symptoms: Rated 0
  - Symptomatic or with hormonotherapy: Rated 1

Psychiatric/Behavioral

0 1 2 3 4

- Any problem of depression, anxiety, alcohol, drug abuse, or other problems?
- Any medication taken for these problems?

Note: Personality problems are rated in this section, but the patient's chart should be checked.

Total Score

- **(0–56) = sum of score for all scales**
- **Only 1 score is given for each system**

Study ID: _____ Date: _____

The Activities-specific Balance Confidence (ABC) Scale*

Instructions to Participants: For each of the following activities, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady from choosing one of the percentage points on the scale from 0% to 100% If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports.

0% 10 20 30 40 50 60 70 80 90 100%

No Confidence Completely Confident

How confident are you that you will not lose your balance or become unsteady when you…

1. …walk around the house?_____%
2. …walk up or down stairs?_____%
3. …bend over and pick up a slipper from the front of a closet floor?_____%
4. …reach for a small can off a shelf at eye level?_____%
5. …stand on your tip toes and reach for something above your head?_____%
6. …stand on a chair and reach for something?_____%
7. …sweep the floor?_____%
8. …walk outside the house to a car parked in the driveway?_____%
9. …get into or out of a car?_____%
10. …walk across a parking lot to the mall?_____%
11. …walk up or down a ramp?_____%
12. …walk in a crowded mall where people rapidly walk past you?_____%
13. …are bumped into by people as you walk through the mall?_____%
14. …step onto or off of an escalator while you are holding onto a railing?_____%
15. …step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing?__%
16. …walk outside on icy sidewalks?_____%

Total ABC Score:_____

Scoring: Total ABC Score / 16 =_____% of self confidence

Falls Risk for Older People – Community setting (FROP-Com)

Personal details
Name: _____
Study ID:
Personal Code #:
Date of Assessment: / /

Address: _____

DOB: _____ **Telephone:** _____

Marital Status:
Single / Married (defacto) / Widowed / Divorced (separated) / Unknown (circle)

Usual living arrangements: _____

Recent health / community services use:

1. Community Aged Care Packages/Services	Y/N	2. Community Rehabilitation	Y/N
3. Doctors Appointment	Y/N	4. Doctor Home Visit	Y/N
5. Home Help	Y/N	6. Home Modifications	Y/N
7. Home Rehabilitation	Y/N	8. Linkages Package	Y/N
9. Meals on Wheels	Y/N	10. OT Home visit	Y/N
11. Outpatient Appointment	Y/N	12. Other	Y/N
13. Post Acute Care	Y/N	14. Personal Care	Y/N
15. Respite Care	Y/N	16. District Nursing Services	Y/N
17. Physiotherapist Appointment	Y/N	18. Dietician	Y/N
19. Podiatrist	Y/N	20. Personal Alarm	Y/N
21. Day Centre	Y/N	22. Falls and Balance clinic	Y/N

Comments _____

_____

• Is English the individuals preferred language? If not, what is?	o Yes o No
• Does the individual have functional English?	o Yes o No

History of falls *(0-3points)*		**SCORE**
1. Number of falls in the past 12 months?	o No falls (0) o 1 fall (1) o 2 falls (2) o 3 or more (3)	[ ]
2. Was an injury sustained in any of the fall/s in the past 12 months? *(rate most severe injury due to a fall in the past 12 months)*	o No (0) o Minor injury, did not require medical attention (1) o Minor injury, did require medical attention (2) o Severe injury (fracture, etc) (3)	[ ]
3. Describe the circumstances of the most recent fall in the past 12 months. **Time of fall**: AM / PM *(please circle)* **Location of fall**: inside home / outside home / community **Direction of fall**: left / right / forward / backward / down / can't remember / other **Cause of fall**: trip / slip / loss of balance / knees gave way / fainted / feeling dizzy or giddy / alcohol or meds / fell out of bed / unknown Comments: **Injuries**:		
	Sub total for this page	[ ]

Medications *(0-3 points)*		
4. List all medications currently taken.	+ + + + + + + + + + + + + + + +	
5. Number of prescription medications.	o No medication (0) o 1–2 medications (1) o 3 medications (2) o 4 or more medications (3)	[ ]
6. Does the individual take any of the following type of medication? o sedative o antidepressant o anti-epileptics o central acting analgesic o digoxin o diuretics o type 1a antiarrythmic o vestibular suppressant	o None apply (0) o 1–2 apply (1) o 3 apply (2) o 4 or more apply (3)	[ ]
Medical conditions *(0-3 points)*		
7. Does the individual have a chronic medical condition/s affecting their balance & mobility? o Arthritis o Respiratory condition o Parkinson's Disease o Diabetes o Dementia o Peripheral neuropathy o Cardiac condition o Stroke o Other neurological conditions o Lower Limb Amputation. o Osteoporosis o Vestibular Disorder o Other dizziness o Back pain o lower limb joint replacement	o None apply (0) o 1-2 apply (1) o 3-4 apply (2) o 5 or more apply (3) Osteoporosis: o Unknown o does not have	[ ]
Sensory loss		
8. Does the client have an uncorrected sensory deficit/s that limits their functional ability?	Vision Somato Sensory o no (0) o no (0) o yes (1) o yes (1)	[ ]
Feet & footwear		
9. Does the client have foot problems, e.g. corns, bunions, swelling etc.	o no (0) o yes (1) (specify):	[ ]
10. Does the client have inappropriate, poorly fitting or worn footwear?	o no (0) o yes (1) (specify):	[ ]
Cognitive status*: (score 0-3 points).*		
11. AMTS score o Age o Time to the nearest hour o Address to recall – 42 West St o Current year o Current location (where are we?) o Recognition of two persons (Dr, nurse) o Date of birth o Years of first World War o Name of current prime minister o Count backwards from 20 by ones	Number of correct responses: o 9-10 (0 point) o 7-8 (1 point) o 5-6 (2 points) o 4 or less (3 points) Score: ...../ 10	[ ]
Continence:		
12. Is the individual continent?	o Yes (0) o No (1)	[ ]
13. Does the individual regularly have to go to the toilet in the night (3 or more times)?	o No (0) o Yes (1) (if uses a bottle, rate as 0)	[ ]
	Sub total for this page	[ ]

Nutritional status *(score 0-3 points)*		
14. Has the individual's food intake declined in the past three months due to a loss of appetite, digestive problems, chewing or swallowing difficulties?	o No (0) o Small change, but intake remains good (1) o Moderate loss of appetite (2) o Severe loss of appetite / poor oral intake (3)	[ ]
15. Weight loss during the last 3-12 months.	o Nil (0) o Minimal (<1 kg) or unsure (1) o Moderate (1-3kg) (2) o Marked (>3kg) (3)	[ ]
16. Number of alcoholic drinks consumed in the past week	o Nil (0) o 1-3 (1) o 4-10 (2) o 11+ (3)	[ ]
Environment *(score 0-3 points)*		
17. Did the home environment appear safe? *(NOTE: only rate if undertaking a home visit assessment, leave blank otherwise)*	o Yes (0) o Minimal environmental hazards (1) o Moderate environmental hazards requiring modification (2) o Extremely unsafe environment (3)	[ ]
Functional Behaviour *(score 0 –3 points)*		
18. Observed behaviours in Activities of Daily Living and Mobility indicate	o Consistently aware of current abilities /seeks appropriate assistance as required (0) o Generally aware of current abilities /occasional risk-taking behaviour (1) o Under-estimates abilities / inappropriately fearful of activity (2) o Over-estimates abilities/frequent risk-taking behaviour (3)	[ ]
Function *(score 0-3 points)*		
19. Prior to this fall, how much assistance was the individual requiring for personal care activities of daily living (eg dressing, grooming, toileting)? *(NOTE: If no fall in last 12 months, rate current function)*	o none (completely independent) (0) o supervision (1) o some assistance required (2) o completely dependent (3)	[ ]
20. Has this changed since the most recent fall? *(leave blank if no falls in 12 months)*	o No (0) o Yes (1) (specify):	[ ]
21. *Prior to this fall, how much assistance was the individual requiring for instrumental activities of daily living (eg shopping, housework, laundry)? (NOTE: If no fall in last 12 months, rate current function)*	o none (completely independent) (0) o supervision (1) o some assistance required (2) o completely dependent (3)	[ ]
22. Has this changed since the most recent fall? *(leave blank if no falls in 12 months)*	o No (0) o Yes (1) (specify):	[ ]
	Sub total for this page	[ ]

Balance *(score 0-3 points)*		
23. Does the individual, upon observation of walking and turning, appear unsteady or at risk of losing their balance? *(NOTE: Rate with usual walking aid. Tick one only, if level fluctuates, tick the most unsteady rating)*	o No unsteadiness observed (0) o Yes, minimally unsteady on walking or turning (1) o Yes, moderately unsteady on walking or turning (needs supervision) (2) o Yes, consistently and severely unsteady on walking or turning (needs constant hands on assistance (3)	[ ]
Gait / Physical Activity *(score 0-3 points)*		
24. Can the individual walk safely around their own home?	o Independent, no gait aid needed (0) o Independent with a gait aid (1) o Safe with supervision / physical assistance (2) o Unsafe (3)	[ ]
25. Can the individual walk safely in the community?	o Independent, no gait aid needed (0) o Independent with a gait aid (1) o Safe with supervision / physical assistance (2) o Unsafe (3)	[ ]
26. If a walking aid is used, list the aid and when it is used.	Aid..... o indoors o outdoors Comments:	
27. How physically active is the individual?	o Very active (exercises 3 times per week) (0) o Moderately active (exercises less than twice per week) (1) o Not very active (rarely leaves the house) (2) o Inactive (rarely leaves one room of the house) (3)	[ ]
28. Has this changed since the most recent fall?	o No (0) o Yes (1) (specify):	[ ]
	Sub total for this page	[ ]
	Sub total for page 1	[ ]
	Sub total for page 2	[ ]
	Sub total for page 3	[ ]
	Total Risk Score	[ ]

Grading of falls risk:

o Mild falls risk	0 –11	Implement actions for identified individual risk factors, & recommend health promotion behaviour to minimise future ongoing risk (eg – increased physical activity, good nutrition)
o Moderate falls risk	12-18	Implement actions for identified individual risk factors
o High falls risk	19-60	Implement actions for identified individual risk factors, and implement additional actions for high

Late Life FDI: Function Component

Study ID#_____ Date_____dd/mm/yyyy

Function Questions

How much difficulty do you have….? (Remember this is without the help of someone else and without the use of any assistive walking device.)	None	A little	Some	Quite a lot	Cannot do	compared to the status before PFF surgery, how would you describe your performance during...?		
						Better	Same	Worse
F1. Unscrewing the lid off a previously unopened jar without using any devices	5	4	3	2	1	3	2	1
F2. Going up & down a flight of stairs inside, using a handrail	5	4	3	2	1	3	2	1
F3. Putting on and taking off long pants (including managing fasteners)	5	4	3	2	1	3	2	1
F4. Running 1/2 mile or more	5	4	3	2	1	3	2	1
F5. Using common utensils for preparing meals (e.g., can opener, potato peeler, or sharp knife)	5	4	3	2	1	3	2	1
F6. Holding a full glass of water in one hand	5	4	3	2	1	3	2	1
F7. Walking a mile, taking rests as necessary	5	4	3	2	1	3	2	1
F8. Going up & down a flight of stairs outside, without using a handrail	5	4	3	2	1	3	2	1
F9. Running a short distance, such as to catch a bus	5	4	3	2	1	3	2	1
F10. Reaching overhead while standing, as if to pull a light cord	5	4	3	2	1	3	2	1
F11. Sitting down in and standing up from a low, soft couch	5	4	3	2	1	3	2	1
F12. Putting on and taking off a coat or jacket	5	4	3	2	1	3	2	1
F13. Reaching behind your back as if to put a belt through a belt loop	5	4	3	2	1	3	2	1
F14. Stepping up and down from a curb	5	4	3	2	1	3	2	1
F15. Opening a heavy, outside door	5	4	3	2	1	3	2	1
F16. Rip open a package of snack food (e.g. cellophane wrapping on crackers) using only your hands	5	4	3	2	1	3	2	1
F17. Pouring from a large pitcher	5	4	3	2	1	3	2	1
F18. Getting into and out of a car/taxi (sedan)	5	4	3	2	1	3	2	1

Study ID#_____ Date_____dd/mm/yyyy

Function Questions, continued

How much difficulty do you have….? (Remember this is without the help of someone else and without the use of any assistive walking device.)	None	A little	Some	Quite a lot	Cannot do	Compared to the status before PFF surgery, how would you describe your performance during...?		
						Better	Same	Worse
F19. Hiking a couple of miles on uneven surfaces, including hills	5	4	3	2	1	3	2	1
F20. Going up and down 3 flights of stairs inside, using a handrail	5	4	3	2	1	3	2	1
F21. Picking up a kitchen chair and moving it, in order to clean	5	4	3	2	1	3	2	1
F22. Using a step stool to reach into a high cabinet	5	4	3	2	1	3	2	1
F23. Making a bed, including spreading and tucking in bed sheets	5	4	3	2	1	3	2	1
F24. Carrying something in both arms while climbing a flight of stairs (e.g. laundry basket)	5	4	3	2	1	3	2	1
F25. Bending over from a standing position to pick up a piece of clothing from the floor	5	4	3	2	1	3	2	1
F26. Walking around one floor of your home, taking into consideration thresholds, doors, furniture, and a variety of floor coverings	5	4	3	2	1	3	2	1
F27. Getting up from the floor (as if you were laying on the ground)	5	4	3	2	1	3	2	1
F28. Washing dishes, pots, and utensils by hand while standing at sink	5	4	3	2	1	3	2	1
F29. Walking several blocks	5	4	3	2	1	3	2	1
F30. Taking a 1 mile, brisk walk without stopping to rest	5	4	3	2	1	3	2	1
F31. Stepping on and off a bus	5	4	3	2	1	3	2	1
F32. Walking on a slippery surface outdoors	5	4	3	2	1	3	2	1

Study ID#_____ Date_____dd/mm/yyyy

Function Questions
For those who use walking devices

The following are questions only for people using canes, walkers, or other walking devices.

When you use your cane, walker, or other walking device, how much difficulty do you have…?	None	A little	Some	Quite a lot	Cannot do	Compared to the status before PFF surgery, how would you describe your performance during…?		
						Better	same	Worse
FD7. Walking a mile, taking rests as necessary	5	4	3	2	1	3	2	1
FD8. Going up & down a flight of stairs outside, without using a handrail	5	4	3	2	1	3	2	1
FD14. Stepping up and down from a curb	5	4	3	2	1	3	2	1
FD15. Opening a heavy, outside door	5	4	3	2	1	3	2	1
FD26. Walking around one floor of your home, taking into consideration thresholds, doors, furniture, and a variety of floor coverings	5	4	3	2	1	3	2	1
FD29. Walking several blocks	5	4	3	2	1	3	2	1
FD30. Taking a 1 mile, brisk walk without stopping to rest	5	4	3	2	1	3	2	1
FD32. Walking on a slippery surface, outdoors	5	4	3	2	1	3	2	1

Late Life FDI: Disability Component

Study ID#_____ Date:_____dd/mm/yyyy

Disability Questions

	How often do you…?					To what extent do you feel limited in …?					Compared to the status before PFF surgery, how would you describe your performance during…?		
	Very Often	Often	Once in a while	Almost never	Never	Not at all	A little	Somewhat	A lot	Completely	Better	Same	Worse
D1. Keep (Keeping) in touch with others through letters, phone, or email.	5	4	3	2	1	5	4	3	2	1	3	2	1
D2. Visit (Visiting) friends and family in their homes.	5	4	3	2	1	5	4	3	2	1	3	2	1
D3. Provide (Providing) care or assistance to others. This may include providing personal care, transportation, and running errands for family members or friends.	5	4	3	2	1	5	4	3	2	1	3	2	1
D4. Take (Taking) care of the inside of your home. This includes managing and taking responsibility for homemaking, laundry, housecleaning and minor household repairs.	5	4	3	2	1	5	4	3	2	1	3	2	1
D5. Work (Working) at a volunteer job outside your home.	5	4	3	2	1	5	4	3	2	1	3	2	1
D6. Take (Taking) part in active recreation. This may include bowling, golf, tennis, hiking, jogging, or swimming.	5	4	3	2	1	5	4	3	2	1	3	2	1
D7. Take (Taking) care of household business and finances. This may include managing and taking responsibility for your money, paying bills, dealing with a landlord or tenants, dealing with utility companies or governmental agencies.	5	4	3	2	1	5	4	3	2	1	3	2	1
D8. Take (Taking) care of your own health. This may include managing daily medications, following a special diet, scheduling doctor's appointments.	5	4	3	2	1	5	4	3	2	1	3	2	1

Study ID#_____ Date:_____dd/mm/yyyy

Disability Questions, continued

	How often do you…?					To what extent do you feel limited in …?					Compared to the status before PFF surgery, how would you describe your performance during…?		
	Very Often	Often	Once in a While	Almost never	Never	Not at all	A little	Somewhat	A lot	Completely	Better	Same	Worse
D9. Travel (Traveling) out of town for at least an overnight stay.	5	4	3	2	1	5	4	3	2	1	3	2	1
D10. Take (Taking) part in a regular fitness program. This may include walking for exercise, stationary biking, weight lifting, or exercise classes.	5	4	3	2	1	5	4	3	2	1	3	2	1
D11. Invite (Inviting) people into your home for a meal or entertainment.	5	4	3	2	1	5	4	3	2	1	3	2	1
D12. Go (Going) out with others to public places such as restaurants or movies.	5	4	3	2	1	5	4	3	2	1	3	2	1
D13. Take (Taking) care of your own personal care needs. This includes bathing, dressing, and toileting.	5	4	3	2	1	5	4	3	2	1	3	2	1
D14. Take (Taking) part in organized social activities. This may include clubs, card playing, senior center events, community or religious groups.	5	4	3	2	1	5	4	3	2	1	3	2	1
D15. Take (Taking) care of local errands. This may include managing and taking responsibility for shopping for food and personal items, and going to the bank, library, or dry cleaner.	5	4	3	2	1	5	4	3	2	1	3	2	1
D16. Prepare (Preparing) meals for yourself. This includes planning, cooking, serving, and cleaning up.	5	4	3	2	1	5	4	3	2	1	3	2	1

Geriatric Depression Scale (Short Form)

Study ID# _____ Date: _____ dd/mm/yyyy

Instructions: Choose the best answer for how you felt over the past week. Note: when asking the patient to complete the form, provide the self-rated form (included on the following page).

No.	Question	Answer	Score
1.	Are you basically satisfied with your life?	YES / ***NO***	
2.	Have you dropped many of your activities and interests?	***YES*** / NO	
3.	Do you feel that your life is empty?	***YES*** / NO	
4.	Do you often get bored?	***YES*** / NO	
5.	Are you in good spirits most of the time?	YES / ***NO***	
6.	Are you afraid that something bad is going to happen to you?	***YES*** / NO	
7.	Do you feel happy most of the time?	YES / ***NO***	
8.	Do you often feel helpless?	***YES*** / NO	
9.	Do you prefer to stay at home, rather than going out and doing new things?	***YES*** / NO	
10.	Do you feel you have more problems with memory than most people?	***YES*** / NO	
11.	Do you think it is wonderful to be alive?	YES / ***NO***	
12.	Do you feel pretty worthless the way you are now?	***YES*** / NO	
13.	Do you feel full of energy?	YES / ***NO***	
14.	Do you feel that your situation is hopeless?	***YES*** / NO	
15.	Do you think that most people are better off than you are?	***YES*** / NO	
		TOTAL	

(Sheikh & Yesavage, 1986)

Study Id#_____ Date:_____dd/mm/yyyy

WHOQOL-BREF

The following questions ask how you feel about your quality of life, health, or other areas of your life. I will read out each question to you, along with the response options. **Please choose the answer that appears most appropriate.** If you are unsure about which response to give to a question, the first response you think of is often the best one.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life **in the last four weeks.**

		Very poor	Poor	Neither poor nor good	Good	Very good
1.	How would you rate your quality of life?	1	2	3	4	5

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
2.	How satisfied are you with your health?	1	2	3	4	5

The following questions ask about **how much** you have experienced certain things in the last four weeks.

		Not at all	A little	A moderate amount	Very much	An extreme amount
3.	To what extent do you feel that physical pain prevents you from doing what you need to do?	5	4	3	2	1
4.	How much do you need any medical treatment to function in your daily life?	5	4	3	2	1
5.	How much do you enjoy life?	1	2	3	4	5
6.	To what extent do you feel your life to be meaningful?	1	2	3	4	5

		Not at all	A little	A moderate amount	Very much	Extremely
7.	How well are you able to concentrate?	1	2	3	4	5
8.	How safe do you feel in your daily life?	1	2	3	4	5
9.	How healthy is your physical	1	2	3	4	5

Study Id#_____

Date:_____dd/mm/yyyy

The following questions ask about how completely you experience or were able to do certain things in the last four weeks.

		Not at all	A little	Moderately	Mostly	Completely
10.	Do you have enough energy for everyday life?	1	2	3	4	5
11.	Are you able to accept your bodily appearance?	1	2	3	4	5
12.	Have you enough money to meet your needs?	1	2	3	4	5
13.	How available to you is the information that you need in your day-to-day life?	1	2	3	4	5
14.	To what extent do you have the opportunity for leisure activities?	1	2	3	4	5

		Very poor	Poor	Neither poor nor good	Good	Very good
15.	How well are you able to get around?	1	2	3	4	5

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
16.	How satisfied are you with your sleep?	1	2	3	4	5
17.	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
18.	How satisfied are you with your capacity for work?	1	2	3	4	5
19.	How satisfied are you with yourself?	1	2	3	4	5

Study Id#_____

Date:_____dd/mm/yyyy

20.	How satisfied are you with your personal relationships?	1	2	3	4	5
21.	How satisfied are you with your sex life?	1	2	3	4	5
22.	How satisfied are you with the support you get from your friends?	1	2	3	4	5
23.	How satisfied are you with the conditions of your living place?	1	2	3	4	5
24.	How satisfied are you with your access to health services?	1	2	3	4	5
25.	How satisfied are you with your transport?	1	2	3	4	5

The following question refers to how often you have felt or experienced certain things in the last four weeks.

		Never	Seldom	Quite often	Very often	Always
26.	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	5	4	3	2	1

Data Collection Form

Participant Information:

Age: _____ Sex: Male ( ) Female ( )

Height: _____ cm / Inches Weight: _____ kg / Lb.

Types of joint replacement surgery: (CHECK BOTH IF APPLY)

- ☐ Hip replacement (Total hip arthroplasty/hip hemiarthroplasty/ Birmingham hip resurfacing): _____dd/mm/yyyy Side: L R
- ☐ Total Knee replacement: _____dd/mm/yyyy Side: L R

Date of PFF: _____ dd/mm/yyyy Side: L R

Type of PFF: _____

Date of PFF surgery: _____ dd/mm/yyyy Side: L R

Surgical approach of PFF surgery: _____

Type of the fixation for PFF: _____

Time between the PFF and the fixation for PFF: _____ Days/Weeks/Months

Implant Loosening: ☐ Present ☐ Absent

Medical Information:

Comorbidities:

CIRS Score _____ Date Completed: _____/ _____/ _____

Number of prescription medications currently taking? _____

List of medications:

_____

_____

_____

_____

General Activity Level:

Physical activity Level:

Which of the following best describes your typical activity level?

- ***Vigorously active*** for at least 30 minutes, 3 times per week (i.e., exercise program)
- ***Moderately active*** at least 3 times per week
- ***Seldom active***, prefer more sedentary activities

Weight bearing status:

□Non-Weight Bearing □Toe-Touch Weight Bearing □Partial Weight Bearing

□Weight Bearing as Tolerated □ Full Weight Bearing

Mobility Aid Use:

Use a mobility aid for walking? □Yes □ No

How often use a mobility aid? □Intermittently Please explain _____

□All the time

What type of mobility aid currently used:

□ Cane □Clutches □Walker (Type _____)

Evidence of Radiographic healing: □ Present □ Absent

Cognitive Assessment:

MoCA Score: _____ Date Completed: _____/ _____/ _____

Falls Assessment:

ABC Score: _____ Date Completed: _____/ _____/ _____

FROP-Com Score: _____ Date Completed: _____/ _____/ _____

Functional and Disability Assessment:

LLFDI Score: _____ Date Completed: _____/ _____/ _____

Lower Extremity Strength Assessment:

TUG Score: _____ Date Completed: _____/ _____/ _____

30Sec CST Score: _____ Date Completed: _____/ _____/ _____

Balance Assessment:

Step Test Score: _____ Date Completed: _____/ _____/ _____

Gait Assessment:

Gait	Completed	
Usual Gait		

PFF Outcome Measures:

Harris Hip Score: _____ Date Completed: _____/ _____/ _____
SF-12 Score: _____ Date Completed: _____/ _____/ _____
WOMAC Score: _____ Date Completed: _____/ _____/_____

Falls Information

1. Have you had any falls since having your PFF surgery? (This includes from the day of your surgery to this follow-up clinic appointment today)

   - ☐ Yes
   - ☐ No

2. How many falls have you had since your surgery?

   - ☐ One
   - ☐ Two
   - ☐ Three or more

3. At what time after your surgery did you fall? (CHECK ALL THAT APPLY)

- ☐ During hospital stay right after the surgery
- ☐ Discharge from hospital to 6 weeks after the surgery
- ☐ 6 weeks to 3 months after the surgery
- ☐ 3 months to 6 months after the surgery
- ☐ 6 months to 12 months after the surgery
- ☐ More than 12 months after the surgery

4. Did you sustain any other fracture(s) other than the periprosthetic femoral fracture after your PFF surgery?

   - ☐ Yes (Go to question # 5)
   - ☐ No (Go to question # 7)

5. What kind of fracture(s) did you have after your PFF surgery? (Please list the site and side of the fracture(s))

_____

_____

_____

_____

_____

_____

_____

6. Did you seek any medical attention because of the fracture(s) mentioned in question # 5?

   - ☐ Yes
   - ☐ No

7. Have you had any falls within the last 6 months?

   - ☐ Yes (Go to question # 8)
   - ☐ No (Go to question # 14)

8. How many falls have you had within the last 6 months?

   - ☐ One

- □ Two
- □ Three or more

9. Did you injure yourself from any of the falls in the last 6 months?

   - □ Yes (Go to question # 10)
   - □ No (Go to question # 11)

10. Where did you injure yourself? (CHECK ALL THAT APPLY)

    - Head /Neck □Yes □No
    - Trunk □Yes □No
    - Arm □Yes □No
    - Leg □Yes □No

11. Did you seek any medical attention because of the fall(s) in the last 6 months?

    - □ Yes
    - □ No

12. Please describe the activity you were doing when you fell. (Refer back to question # 2)

_____

_____

_____

_____

_____

_____

_____

13. Did the fall affect your confidence?

    - □ Yes
    - □ No

14. Are you afraid of falling, such that you have stopped doing activities you are physically capable of doing?

- ☐ Yes
- ☐ No

15. If you answer 'Yes' to the question # 14, please describe the activities you have stopped due to fear of falling since the PFF surgery (e.g., climbing stairs, driving, walking on uneven surfaces)

_____

_____

_____

_____

_____

_____

16. Do you now use a gait aid/accompaniment to do activities you could do before your surgery without the aid?

- ☐ Yes
- ☐ No

Functional outcome measures:

17. Did you have to modify any of your daily activities after PFF surgery?

- ☐ Yes (Go to question # 18)
- ☐ No (Go to question # 22)

18. If you answer 'Yes' to the question # 17, please list the activities you have modified (e.g., moved to ground floor, stopped driving, stopped climbing stairs, stopped walking on uneven surfaces) since the surgery?

_____

_____

_____

_____

_____

19. Have you modified any of your daily activities after the PFF surgery due to the following reasons?

□ Pain □ Reduced balance □ None (Go to question # 20)
□ Physical fatigue □ Lack of endurance
□ Mental fatigue □ Lack of support

20. Are there any other reasons that are not included in question #19, for which you had to modify your daily activities after the PFF surgery?

□ Yes (Go to question # 21)
□ No (Go to question # 22)

21. If you answer 'Yes' to the question # 20, please list the potential reasons for which you had to modify your daily life activities after the PFF surgery?

_____
_____
_____
_____
_____
_____
_____
_____

Falls Knowledge

22. Do you believe that falls among people who have had a PFF surgery can be prevented?

□ Yes
□ No

For each of the next 13 questions, please rate how important each of these scenarios are in making a person more likely to fall, whether they have had a PFF surgery or not.

23. People are likely to fall because things such as rugs and furniture get in the way.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

24. People are likely to fall because grab bars are not present or are not in a helpful position in their house or apartment.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

25. People are likely to fall because sidewalks and streets are not clear of ice and snow.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

26. People are likely to fall because sidewalks and streets are poorly maintained (e.g. cracked or irregular pavement).

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

27. People are likely to fall because handrails are not present or are poorly positioned in public places.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

28. People are likely to fall because they have a coordination or balance problem.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

29. People are likely to fall because they do not have enough muscle strength or endurance in their legs.

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

30. People are likely to fall because their bones are weakened with age (osteoporosis).

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Most likely

31. People are likely to fall because they have poor vision.

0	1	2	3	4	5	6	7	8	9	10
Not at all likely										Most likely

32. People are likely to fall because they do unsafe or risky things.

0	1	2	3	4	5	6	7	8	9	10
Not at all likely										Most likely

33. People are likely to fall because they do not always pay close attention to their surroundings.

0	1	2	3	4	5	6	7	8	9	10
Not at all likely										Most likely

34. People are likely to fall because they are forgetful.

0	1	2	3	4	5	6	7	8	9	10
Not at all likely										Most likely

35. People are likely to fall because they take many medications.

0	1	2	3	4	5	6	7	8	9	10
Not at all likely										Most likely

36. On a scale from 0 to 10, where 0 means “not at all important” and 10 means “most important”, how important is falling compared with your other health concerns?

0	1	2	3	4	5	6	7	8	9	10
Not at all important										Most important

37. Do you feel unsteady when walking?

- □ Yes
- □ No

38. Do you think you will fall at some time in the next 12 months?

- □ Yes
- □ No

39. If you fell and seriously injured yourself (defined as injury such as fracture, dislocation, head trauma that required medical attention), do you think you would be able to return to your current living situation?

Strongly agree Agree Undecided Disagree Strongly disagree

40. After your PFF surgery, do you remember being taught by any health care professionals about strategies to prevent falls after the surgery?

- ☐ Yes
- ☐ No

41. Please describe any things <u>you have modified</u> in your daily activities and/or home to reduce the risk of falling since having your PFF surgery.

_____
_____
_____
_____
_____
_____
_____

42. Please list any things that <u>you plan to modify</u> in your daily activities and/or home to reduce

the risk of falling

_____
_____
_____
_____
_____
_____

43. Do you feel confident you will be able to make the changes you have listed in question #42?

- ☐ Yes
- ☐ No

44. Is there something that might make it difficult for you to do the changes you listed in question #42 are?

_____

_____

_____

_____

_____

45. I am very keen to lower my risk of falling by using the strategies I listed in question #42.

Strongly agree Agree Undecided Disagree Strongly disagree

46. I am interested in learning more about how to prevent falls.

Strongly agree Agree Undecided Disagree Strongly disagree

Psychological Outcome Measures:

GDS-SF Score: _____ Date Completed: _____/ _____/_____

WHOQOL-BREF Score: _____ Date Completed: _____/ _____/_____

47. Do you feel socially isolated after the PFF surgery?

- ☐ Yes
- ☐ No

48. Do you feel frustrated with your current situation?

- ☐ Yes
- ☐ No

49. How has PFF surgery impacted your life psychologically?

_____

_____

_____

_____

_____

_____

Appendix F: Curriculum Vitae

RIFAT BINTA ISLAM

Post-secondary Education

Master of Science - Faculty of Health and Rehabilitation Sciences 2018 - 2020
The University of Western Ontario London, ON, Canada

- Thesis title: Quantifying the functional and psychological outcomes after periprosthetic femoral fracture in association with total hip arthroplasty in older adults

Bachelor of Medicine and Surgery (MBBS) 2005 - 2010
Shaheed Ziaur Rahman Medical College, Bogra, Bangladesh

Work Experience

Graduate Teaching Assistant**,** Child and Adolescent Health Sept 2018 – Dec 2018
The University of Western Ontario London, ON, Canada

Graduate Teaching Assistant**,** Health Policy Sept 2019 – Dec 2019
The University of Western Ontario London, ON, Canada.

Publications

Abstracts, Presentations to Professional Meetings (*, presenter at conference)

1. **Islam, Rifat.,*** Lanting, Brent., Hunter, Susan. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults. Health & Rehabilitation Science Conference. London, Canada. February 6, 2019. *(Poster presentation).*
2. **Islam, Rifat.,*** Lanting, Brent., Hunter, Susan., Somerville, Lyndsay. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults- Western Research Forum. London, Canada. March 22, 2019. *(Poster & Oral presentations).*
3. **Islam, Rifat.,*** Lanting, Brent., Somerville, Lyndsay., Hunter, Susan. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults: Retrospective study. Health & Rehabilitation Science Conference. London, Canada. Feb 4, 2020. *(Poster presentation).*
4. **Islam, Rifat.,*** Somerville, Lyndsay., Lanting, Brent., Hunter, Susan. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults: Retrospective study. Western Research Forum. London, Canada. March 19, 2020. Accepted for poster presentation. *(Conference postponed amid COVID-19 crisis).*
5. **Islam, Rifat.,*** Somerville, Lyndsay., Lanting, Brent., Hunter, Susan. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults:

Retrospective study. Canadian Fall Prevention Conference, Saskatoon, Canada. June 15 & 16, 2020. Accepted for poster presentation. *(Conference canceled amid COVID-19 crisis)*.

6. **Islam, Rifat.,*** Somerville, Lyndsay., Lanting, Brent., Hunter, Susan. Quantifying the physical and psychological outcomes after periprosthetic femoral fracture in older adults: Retrospective study. London Health Research Day, London, Canada. May 5, 2020. Submitted for poster presentation. *(Conference canceled amid COVID-19 crisis).*

Papers in Progress (Manuscripts in Preparation)

1. Islam, Rifat., Somerville, Lyndsay., Lanting, Brent., Hunter, Susan. Evaluating the functional and psychological outcomes following periprosthetic femoral fracture after total hip arthroplasty.
2. Islam, Rifat., Somerville, Lyndsay., Lanting, Brent., Hunter, Susan. Assessing the outcomes and risk of falling after periprosthetic femoral fracture in older adults.

Other Scholarly Activity

Health and Rehabilitation Sciences Conference, London, Canada Feb 4, 2020

- Conference planning & abstract reviewing.

Awards/Recognition

Research grant top up funding & Faculty of Health Sciences top up match 2018 - 2020