SHORT TERM FUNCTIONAL OUTCOME OF PATIENTS WITH ANTERIOR CRUCIATE LIGAMENT TEAR TREATED BY ARTHROSCOPIC ACL RECONSTRUCTION USING HAMSTRING TENDON AUTOGRAFT AT MUHIMBILI ORTHOPAEDIC INSTITUTE.

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Master of Medicine (Orthopedics and Traumatology) Dissertation

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Department of Orthopaedics and Traumatology

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By,

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A dissertation submitted in (partial) fulfillment of the requirements for the Degree of Masters of Medicine in Orthopaedics and Traumatology of

Muhimbili University of Health and Allied Sciences

October, 2018

CERTIFICATION

The undersigned certifies that, he has read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled; **"Short term functional outcome of patients with anterior cruciate ligament tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft at Muhimbili orthopedic institute (MOI)"** Submitted in partial fulfillment of the requirements for the degree of Master of Medicine in Orthopedics and Traumatology of Muhimbili University of Health and Allied Sciences.

_____

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Supervisor

_____

Date

THE DECLARATION
AND
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I, **Restus Valentine**, declare that, this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for similar or any other degree award.

Signature…….....Date…….

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DEDICATIONS

This dissertation is dedicated to my beloved wife **Ednae Gaudence Nzigo**,
my daughters **Nuru** and **Franca** and my son **Melchizedeck** for their love, courage, support and commitment.
You have always stood by me and dealt with all of my absence from many family occasions and problems with a smile.

ABSTRACT

The anterior cruciate ligament (ACL) is the most frequently injured knee ligament, accounting for about 50% of all knee ligament injuries. The majority of injuries occur during sports activities, soccer being one of the sports with the highest prevalence of ACL injury. Other causes are motor traffic crush and falling from height.

Currently arthroscopic ACL reconstruction is the recommended standard treatment for anterior cruciate ligament deficient knees in most tertiary hospitals worldwide.

Arthroscopic ACL reconstruction was first done at Muhimbili Orthopaedic Institute (MOI) in 2011, since then the number of patients treated by this procedure has been growing (total of 624 patients to date) but the surgical outcome has not yet established.

Objectives: To determine the short term functional outcome of patients with anterior cruciate ligament tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft at MOI.

Materials and Methods: A prospective hospital based descriptive study involving adult patients with anterior cruciate ligament tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft, was conducted at MOI for a period of twelve months from May 2017 to June 2018. A total of 47 patients met inclusion criteria and were all enrolled for the study. The patients were assessed and scored using Lysholm Functional Knee Scoring Scale (LFKSS) before treatment, and at 2^{nd}, 6^{th}, 12^{th} and 16^{th} weeks post treatment. Flexion/extension angles was obtained on each visit by using a goniometer.

At 2^{nd} week the wound was assessed for infection and stitches removed. Data was collected, guided by structured questionnaire. At 16^{th} week the scores were compared with those before treatment. The data obtained were analyzed using SPSS version 20.

Results

A total of 47 patients with anterior cruciate ligament tear were enrolled at MOI for the study from May 2017 to December 2017 and all were followed up for functional outcome. 4 patients were lost to follow up, and only 43 patients were analyzed at 16th week. Among 43 patients, 32 (74.4%) were male and 11(25.6%) were female with male to female ratio of 2.9:1. Out of the 43 patients 38 (88.4%) were below 40years whereas 5 (11.6%) were above 40years; with a mean age of 30.09±6.99SD

Majority 35(81.4%) were treated 3months after their injury whereas 8(18.6%) were treated less than 3months after injury.

The leading cause of ACL tear was sports-related activities which accounted for 36(83.7%), followed by Road traffic accidents which accounted for 7(16.3%).

The mean flexion angle was 78.44±16.22˚SD before treatment and 134.58±4.18˚SD degrees at 16 weeks post treatment. (p value =0.001). The median Lysholm score was 55.98±12.24SD before treatment and 97.19± 3.14 SD at sixteenth week post treatment (p value=0.001).

Functional outcome at sixteenth week postoperatively assessed and graded by (LFKS) was excellent in 34(79.1%) patients and good in 9(20.9%) patients. Outcome was not affected by age (p=0.686), sex (p=0.843) or duration of symptoms (p=0.294).

Conclusion

Anterior cruciate ligament tear is more common in young males (less than 40years) who are actively engaging in sports-related activities which is actually the leading cause of anterior cruciate ligament tear. Arthroscopic ACL reconstruction has shown good outcome in this study as many participants had good and excellent outcome at 16^{th} week, and knee flexion angle has improved to almost normal.

Recommendations

Arthroscopic ACL reconstruction has to be promoted more at MOI as the findings of this study has revealed good to excellent outcome.

Further prospective studies with large sample size are needed to further discern the findings of this study.

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ABBREVIATIONS

Acronym	Definition of Abbreviations
ACL	Anterior Cruciate Ligament
STG	Semitendinosus and gracilis
BPTB	Bone patella tendon bone
NWI	Notch width index
ICF	International classification of functioning
MOI	Muhimbili Orthopaedic Institute
ROM	Range of Movement
LFKSS	Lysholm Functional Knee Scoring Scale
MUHAS	Muhimbili University of Health and Allied sciences
PCL	Posterior Cruciate Ligament
SD	Standard Deviation
SPSS	Statistical Program Software for Social Sciences

DEFINITIONS OF KEY TERMS

Hamstring tendons: These are the tendons of the semitendinosus, gracilis and Sartorius muscles.

Autograft: A tissue harvested from and implanted into the same individual

Disability: Defined by WHO" as any restriction or lack of the ability to perform in the manner or within the range considered normal.

Arthroscopy: Is an examination of the interior of a joint using an endoscope that is inserted into the joint through a small incision.

Short term outcome: Sixteen weeks period of follow up of clinical functional outcome.

Functional outcomes: is measured from recovery from pain, early return to regular activities and sports, knee stability and range of knee motion of greater than 135^{o} flexion following surgery.

CHAPTER ONE

1.1 INTRODUCTION AND BACKGROUND INFORMATION

The anterior cruciate ligament (ACL) is most commonly injured during sports-related activity, with a minority of ACL injuries occurring in high-energy trauma or activities of daily living.(1) ACL injury consists of a noncontact deceleration mechanism, usually occurring with a sudden stopping, cutting, or jumping maneuver. A pop is usually felt or heard, and the patient may describe a hyperextension injury. Contact injuries are more likely to result in multiligament injuries. The majority of ACL injuries are sustained in sports activities, with basketball, soccer, and skiing predominating in contact injuries. Contact injuries are frequently described in football players.(2) Exaggerated hyperextension is most common in both low and high velocity mechanisms.(3)

1.1.1 Relevant Anatomy:

The anterior cruciate ligament (ACL) originates posterolaterally in the femoral notch and inserts onto the tibial eminence. It provides anterior knee stability in the sagittal plane.(3) The anterior cruciate ligament is composed of longitudinally oriented bundles of collagen tissue arranged in fascicular subunits within larger functional bands. The ligament is surrounded by synovium, thus making it extrasynovial.(4) The ligament is 31 to 35 mm in length and 31.3 mm^2 in cross section.

The primary blood supply to the ligament is from the middle geniculate artery, which pierces the posterior capsule and enters the intercondylar notch near the femoral attachment. Additional supply comes from the retropatellar fat pad via the inferior medial and lateral geniculate arteries. The posterior articular nerve, a branch of the tibial nerve, innervates the anterior cruciate ligament.(4) The ACL has been described as having an anteromedial band which is tighter in flexion and a posterolateral band which is tighter in extension. ACL is the primary restraint to anterior translation of the tibia on the femur and to hyperextension. It functions as a secondary restraint to varus or valgus angulation at full extension. It also resists internal and external rotation mostly near full extension than in early flexion.(5)

1.1.1.0 Diagnosis

Diagnosis is made by a positive Lachman's test and a positive pivot shift test.(5) The Lachman test is the most sensitive test for anterior tibial displacement (95% sensitivity).(4) In the Lachman test, the distal femur is held securely in one hand while the examiner translates the tibia anteriorly with the other hand. A sense of increased movement and lack of a solid end point are indicative of ACL injury. The pivot-shift test is pathognomonic for ACL injury (best in the chronic setting). This test begins with the knee in full extension, and the knee is then flexed while applying a valgus movement.(1)

Plain radiographs may show an avulsion of the insertion of the ACL or a Segond fracture which is a lateral capsular avulsion fracture from the margin of the lateral tibial plateau that is often associated with an ACL injury.(5) The Segond fracture, or avulsion fracture of the lateral capsule, is pathognomonic of an anterior cruciate ligament tear.(4)

MRI has an overall accuracy of approximately 90% in assessing the ACL. MRI also shows bone abnormalities not seen on conventional radiographs. These include bone bruises seen in approximately 60% of ACL injuries, the significance and long-term sequelae of which have yet to be determined. Examination under anaesthetic and arthroscopy is only required if there is still doubt after clinical examination and/or MRI scan.(5)

1.1.1.1 Treatment options for ACL tear:

The treatment options available include nonoperative management, repair of the anterior cruciate ligament (either isolated or with augmentation), and reconstruction with either autograft or allograft tissues. Nonoperative treatment is a viable option for a patient who is willing to make lifestyle changes and avoid the activities that cause recurrent instability.(4)

Nonsurgical treatment involves rehabilitation to strengthen hamstrings and quadriceps, as well as proprioceptive training. Activity modification is also an important part of nonsurgical management, as patients who avoid cutting and pivoting sports are at lower risk for knee instability.(1)

1.1.1.2 ACL reconstruction

Rupture of the anterior cruciate ligament is a common injury that is associated with permanent sequelae affecting knee stability and function. Symptoms of instability resulting from increased anteroposterior motion of the tibia relative to the femur often limit the activities of a patient who has an untreated anterior cruciate ligament rupture. Surgical reconstruction of the ruptured anterior cruciate ligament has become a widely accepted method for minimizing the symptoms of instability.(6)

Several studies have shown, however, that instability after rupture of the ACL may lead to recurrent episodes of giving way, an increased risk of meniscal injury and premature degenerative changes.(7) It is known that reconstruction of the ACL reduces the incidence of meniscal tears. Studies have shown that delayed reconstruction in the young was associated with a higher incidence of medial meniscal tears.(8)

However, there are no clear guidelines regarding the timing of reconstruction with regard to reducing the rate of meniscal pathology, timing remains controversial.(9)

1.1.2 Operative technique and indications of ACL reconstruction.

Many different techniques have been used to restore stability to the ACL-deficient knee, but several have produced poor long-term results. These include direct repair, extra-articular procedures and intra-articular prostheses.(10) The two most commonly used autografts for intra-articular reconstruction of the ACL are the central one-third of the patellar tendon (PT) and the combined semitendinous and gracilis tendons (STG).(8) However arthroscopic ACL reconstruction is now a known and documented approach in treating ACL deficient knees as several studies have proven beyond reasonable doubt that patients regain their pre injury state and most of symptoms are wiped out. The traditional way of open surgery and ACL reconstruction is now losing its popularity and advancement is shifting to arthroscopic ACL reconstruction which has shown better outcome. (11) Open surgery has shown to be associated with more complication like knee pain, stiffness and infection compared to arthroscopic surgery.(9)

At MOI reconstruction by using hamstring tendon autograft (combined semitendinous and gracilis tendons) is the most commonly used technique as majority of patients presenting to MOI with ACL tear are not professional athletes. A bone-patellar tendon-bone autograft have a lower rerupture rate than a hamstring tendon autograft, but the bone-patellar tendon-bone procedure is associated with more postoperative pain from the donor site and a higher risk of postoperative anterior knee pain, particularly when the patient kneels.(1)

The PT autograft is secured by interference screw fixation of the bone blocks and gives enough stability to allow intensive rehabilitation. It is the current 'gold standard' for ACL reconstruction in professional athletes despite having a complication of knee pain from donor site as it restores much stability compared to hamstring autograft .(7) A single-bundle reconstruction is performed using one single femoral and one single tibial tunnel. Double bundle techniques aim to reconstruct both bundles and this provide superior construct which would reduce rates of failure and improve the functional outcome with better rotatory stability.(10) Graft choices include autologous bone-patellar tendon-bone, autologous hamstring tendons, autologous quadriceps tendon, and allograft tissue. Clinical outcomes appear to be almost similar for all.(11)

1.1.3 Complications:

Complications in ACL surgery can be disastrous, as the majority of reconstructions are often performed on young patients. While surgical treatment can predictably restore stability and improve function in 85% to 90% of patients, extrapolation of these results suggest a 10% to 15% failure rate. (11)
Complications of anterior cruciate ligament (ACL) reconstruction may, as with any other surgical procedure, be operative or postoperative.

Operative complications can be related to the three stages in the operation: graft harvest, graft placement and graft fixation.(12) It is possible to violate the patellar tendon when making the preliminary arthroscopy portals. Graft placement is of prime importance to replace the ACL anatomically so that its function can be reproduced as closely as possible.

If the tibial tunnel is positioned too far forwards, extension will be limited.(13) Infection, Painful hardware at the proximal tibia near the tibial tunnel may occur following ACL reconstruction.(1)

1.2 LITERATURE REVIEW

1.2.1 Socio-demographic factors of ACL tear

The majority of ACL ruptures occur in adolescents and young adults(14) The risk of an ACL tear is 2-10 times higher in female athletes than in their male counterparts. This is due to anatomic factors such as the width of the intercondylar notch, as well as neuro-muscular function, and physiological factors such as hormonal regulation.(15) Due to male being engaging in sports activities more than female, men have higher incidence of ACL tear as compared to women. The study by Prodromos et al demonstrated a female-to-male injury ratio of 1:2.67 in soccer and 1:3.5 in basketball (14) In youth soccer, Lindenfeld et al reported that 80% of ACL injuries occurred in females, even though female athletes represented only 43% of the total exposure.

The study by Barber et al comparing ACL reconstructions in patients 40-years old and older with those under 40-years old, divided into two groups, Group 1 had 33 patients with an average age of 44 years (range, 40 to 52 years).and Group 2 had 170 patients with an average age of 27 years (range, 16 to 39 years), Using Lysholm criteria, in group 1, 89% had excellent/good results, and 11% fair/poor results. This was not statistically different from group 2, which showed 91% excellent/good results and 9% fair/poor results at 24-month follow-up examination(16).

Schmitz et al demonstrated that women exhibit less knee stiffness than do men. The increased stiffness of male knees may be partially protective against ACL injury, especially when impulsive loads are transmitted across the knee joint. Knee recurvatum may be another risk factor in female athletes. Boden et al initially reported significantly more knee recurvatum at 10° and 90° of hip flexion in patients with ACL injury. Ramesh et al, also reported knee hyperextension in 79% of athletes with ACL injury, compared

with 37% of control subjects. In an MRI study assessing the geometry of the tibial plateau, female subjects were found to have a steeper posteriorly directed tibial slope laterally (by 30%) than do male subjects (7.0° versus 5.4°).

It has been proposed that a narrower notch corresponds to a smaller ACL, which is more predisposed to tear.(17) Souryal et al attempted to determine if intercondylar notch width was a predisposing factor for bilateral ACL tears. Notch width index (NWI) was measured using tunnel view radiographs. The NWI was identifed as the ratio of the width of the intercondylar notch to the width of the distal femur at the level of the popliteal groove. The authors reported that the NWI was significantly smaller in the group that suffered bilateral ruptures of their ACL when compared with the group with normal knees and that which suffered unilateral ACL ruptures. Higher-than-average body mass index is an ACL injury risk factor for women in the United States Military Academy cadet population, this finding was not observed among the male cadets.(16)

1.2.2 Time lag from injury to treatment

Patients with ACL-deficient knee often have chronic rotational and translation instability that can cause giving way episodes as well as further knee damage including meniscal tears, osteochondral defects, and ligament tears.(18) However there are no clear guidelines regarding the timing of reconstruction in regard to reducing the rate of meniscal pathology, and timing remains controversial. In general, early rather than late reconstruction has been recommended to minimise the risk of meniscal tears.

In the study of 121 young adults by Frobel et al on outcome among early and delayed reconstruction; 59 patients were assigned to early ACL reconstruction(<3months) and 62 were assigned to the option of having a delayed ACL reconstruction(>/=3months), at 12 months follow up no significant difference between group were seen in mean Lysholm score (p=0.45).((18).

Also in the study by Meighan et al of 31 patients with ACL tear, one group was treated less than 8weeks and the other at 8-12 weeks and the mean range of motion and Lysholm

score were not statistically different at 24months follow up (19). A study by Bernstein et al showed that the early surgery strategy was associated with fewer meniscal tears, a finding consistent with a prior review of 6576 active-duty army personnels.(20) Smith et al concluded from their systematic review that there were no differences in clinical outcomes between early (less than 3 weeks) and delayed (greater than 3 weeks) ACL reconstruction.

Passler et al assessed complications associated with timing of surgical intervention in 283 patients. The study by Griffin et al revealed that, 18% of individuals that had surgery within 7 days of injury developed arthrofibrosis, compared to only 6% of patients who waited at least 4 weeks(18). Rao reported best clinical outcome were observed in patients who were operated within 3month after injury (81.25%) excellent and good results, the overall scoring showed 76.06% showing excellent and good results in Lysholm scoring method.(21)

1.2.3 Mechanism of ACL injury

One of the major causes of ACL injury is sport participation, since body contact as well as sudden deceleration of the body seems to increase risk.(21) A study by Garrett et al reported majority of ACL tear were due to sports-related activities in about -81 % (51 patients); followed by motor traffic crash and others(22). A study done by Tournoux et al assessing 293 patients with ACL tear reported that, sports was the leading cause of ACL injuries accounting for 231(79%) patients. (20)

Nearly three quarters of anterior cruciate ligament (ACL) injuries are noncontact pivoting injuries. Several theories and risk factors have been proposed to explain the mechanism of noncontact ACL injury, including impingement on the intercondylar notch, quadriceps contraction, the quadriceps-hamstring force balance and, more recently, axial compressive forces on the lateral aspect of the joint.(17). Olsen et al prospectively studied elite Norwegian handball players to determine if ACL injury rate was affected by wooden versus synthetic indoor floors. The risk of ACL injury was 2.35 times higher on synthetic

floors for female athletes.(21) The dynamic knee valgus was one of the highest-risk actions against the injury. Other biomechanical studies also suggested the valgus knee has an injury risk due to the torque applied to the knee joint.(16). The study by Koshida et al results showed an ACL injury occurred more often during a competition than during a practice(22).

The study by Kobayashi et al showed that noncontact cases were the most common in both the male and the female subjects than the contact ones. The ratio of the noncontact injuries in the female subjects was about 70%, which was significantly higher than that of the noncontact injuries in the male subjects and that of the injuries other than the noncontact injuries in the female subjects. Previous studies also reported a relatively high ratio of the noncontact ACL injury in female athletes, ranging from 64% to 80%.(22)

Approximately 30% of all ACL injuries result from direct contact with another player or object. In the 70% of ACL injuries that do not result from direct contact, the basic mechanism for this injury still eludes us. Activities that appear to be associated with significant risk include decelerating and pivoting, awkward landings, and out of control play.(23).

1.2.4 Functional outcome of arthroscopic ACL reconstruction

Arthroscopic anterior cruciate ligament reconstruction has remained a treatment of choice for anterior cruciate ligament deficient knees, since majority of non-operative procedures have resulted in functionally unacceptable outcomes.(25). This technique is ideal for semi-professional athletes whereby the bone-patella tendon-bone is ideal for professional athletes. A study done in China assessing functional results in middle aged semi-professional athletes with ACL tear, the average flexion angle was 116.01±12.03, the Lysholm score was 63.95±5.45 preoperatively, the results postoperatively was average flexion angle of 136.77±18.56, and the Lysholm score was 87.84±5.16 and therefore arthroscopic reconstruction by using hamstring tendon autograft showed good functional outcome. (22) Study done in Netherlands, on professional athletes with isolated ACL tear,

who underwent reconstruction by using BPTB autograft, 84% were able to return to sports at a mean time of 24 weeks. (19)

Subjective and functional outcomes according to the International Classification of Functioning, Disability and Health (ICF) have been suggested as appropriate criteria with which to evaluate the effectiveness of rehabilitation for athletes after ACL injury.(24)
A group of 250 patients who underwent ACL reconstruction had a mean Lysholm score of 56 (SD 9) pre- operatively and 89 (SD 11) at two years' follow-up.(26)

In the study by Satish et al on arthroscopic anterior cruciate ligament reconstruction by using a patellar tendon autograft and interference screw fixation, the preoperative Lysholm knee scores were poor, with a median of 61.54 (6 to 95), as would be expected after injury. The median Lysholm score at 12 months post surgery was 95.46 (70 to 100) and at 24 months 95 (26 to 100). The mean Lysholm score was 94 at 12 months and 93 at 24 months with 69 patients (90%) scoring good or excellent (≥84) at 24 months and the mean flexion angle was 100.11±1123SD to135.06±3.14SD at 24month.(7) The previous studies comparing the results of BPTB arthroscopic reconstructions with those of STG reconstructions have used outcomes such as knee range of motion, pain, strength, joint laxity, subjective questionnaires and radiographic assessments.

To obtain a more complete assessment of function following arthroscopic ACL reconstruction, it has been suggested that batteries of functional tests that provide an indication of muscle strength and power, as well as neuromuscular control, should be used.(24) In a study by Harris et al that assessed outcomes in patients aged 40 years and older treated with arthroscopic ACL reconstruction the Clinical laxity assessment showed good outcomes, with nearly 86% of patients having grade 1 or less on the Lachman maneuver, while 79% had a negative pivot-shift test finding.(27)
The most important finding of the study by Akhbari et al was that there were differences in quadriceps strength as well as the results of the triple-hop, crossover-hop, and jump-landing tests, at the time of return to sports, between subjects who underwent arthroscopic

ACL reconstruction with a BPTB graft and those treated with an STG graft. Quadriceps muscle strength correlates with good outcome following arthroscopic ACL reconstruction, and subjects with good quadriceps torque are able to return to their previous activity earlier(28)

1.2.5 Infection rate

Infection is a relatively rare but potentially serious complication after arthroscopic anterior cruciate ligament (ACL) reconstruction. Recent studies on infection after arthroscopic ACL reconstruction have demonstrated that graft choice, smoking and obesity increases the risk of infection after ACL reconstruction. Diabetes is well known to be associated with an elevated risk of surgical site infections in a variety of surgical specialties including orthopaedics. One study of infections after arthroscopic ACL reconstruction noted that <1% of 801 patients undergoing this surgery had diabetes.(29)

The prevalence of infection was 0.3% in patients receiving BPTB autograft compared with 1.3% in patients receiving hamstring autograft and 1.0% in patients receiving other grafts following arthroscopic ACL reconstruction.(29)

1.3 PROBLEM STATEMENT

The anterior cruciate ligament (ACL) is the most frequently injured knee ligament, accounting for about 50% of all knee ligament injuries.(24) The burden of ACL tear at MOI is high, (an average of 104 patients per year); although the exact proportion is unknown. (30) Arthroscopic ACL reconstruction is currently advocated to be the treatment of choice for ACL deficient knees by many authors (19, 22, 25). It is one of the most frequently performed sports medicine surgical procedures although at MOI the outcome of treatment has not been scientifically evaluated. At MOI the prevalence of ACL tear was found to be 3%. an average number of 2-3 patients per week with ACL tear undergoing Arthroscopic ACL reconstruction(30). This study will give us light on outcome of patient with anterior cruciate ligament tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft (31)

1.4 RATIONALE OF THE STUDY

This study aimed at auditing the results achieved with regards to short term functional outcome of anterior cruciate ligament tear treated by Arthroscopic ACL reconstruction using hamstring tendon autograft at MOI and compare with results from other medical centres.

This study was also done as partial fulfillment for my award of degree of Masters of Medicine degree in Orthopaedics and Traumatology of Muhimbili University of Health and Allied Sciences

1.5 RESEARCH QUESTION

What are the short term functional outcome of patients with anterior cruciate ligament tear treated by arthroscopic reconstruction using hamstring tendon autograft at MOI?

1.6 OBJECTIVES:

1.6.1 Broad objective

To determine the short term functional outcome of patients with anterior cruciate ligament tear treated by arthroscopic reconstruction using hamstring tendon autograft at MOI from May 2017 to June, 2018.

1.6.2 Specific objectives

i. To determine socio-demographic factors among patients with anterior cruciate ligament tear treated by arthroscopic reconstruction using hamstring tendon autograft at MOI.
ii. To determine mechanism of injury of anterior cruciate ligament tear among patients treated by arthroscopic reconstruction using hamstring tendon autogrft at MOI.

iii. To determine time lag of the anterior cruciate ligament tear from injury to definitive treatment of patient treated by arthroscopic reconstruction using hamstring tendon autograft at MOI

iv. To determine the short term functional outcome of patients with anterior cruciate ligament tear treated by arthroscopic reconstruction using hamstring tendon autograft at MOI.

v. To determine the rate of infection and other complications among patients with anterior cruciate ligament tear treated by arthroscopic reconstruction using hamstring tendon autograft at MOI

CHAPTER TWO

2.0 METHODOLOGY

2.1 Study design:

This was a hospital based descriptive prospective study

2.2 Study area:

The study was conducted at Muhimbili Orthopedic Institute (MOI). MOI is an autonomous institute which provides both emergency and non emergency medical services in the field of Orthopaedics, Traumatology and Neurosurgery. The institute is situated in Dar es Salaam and it provides services to the patients in the city and from other regions in the country. The institute is also involved in carrying out researches in these fields with a view of improving the management of patients.

2.3 Study duration:

This study was conducted from May 2017 to June, 2018

2.4 Study population:

Patients aged 18 years or above admitted at MOI during study period with anterior cruciate ligament tear.

2.5 Inclusion criteria:

Patients aged 18 years or above, admitted at MOI with an isolated anterior cruciate ligament tear confirmed by MRI and/or arthroscopy, treated by arthroscopic reconstruction and consented to participate in the study

2.6 Exclusion criteria:

i. Infection around the knee.
ii. Multiligamentous knee injuries
iii. Associated tibial plateau or distal femoral fractures
iv. Bilateral knee injuries

v. Non ambulatory patients prior to injury.
vi. Prior limb deformity.(e.g. contractures)
vii. Patients not willing to participate
viii. Patients lost to follow up

2.7 Sample Size Estimation:

- Sample size will be estimated by using the following formula where P was calculated from a pilot survey conducted at MOI from the period of Jan-December 2016. Prevalence of ACL tear was found to be 3%.(30)

$N = Z^2/d^2 (p (100-p))$

95% confidence interval (Z) =1.96

Error rate=d =5% and P=3%

$n = (1.96/5)^2 x (3(100-3) =27$

Hence minimum sample size = 44

Due to loss follow-up the sample size for our study = 47

The estimated sample size was 44 but using convenient sampling 47 patients were enrolled in the study and all patients met the study criteria to be studied; and at last follow up, only 43 patients were analyzed and 4 patients were lost to follow up.

2.8 Research instrument and tools.

Pre-test of data collection tool was conducted by the researcher for the purpose of finding out if it provide the required information. Necessary changes were made so as to obtain the required information. Designed questionnaires (Lysholm functional knee scores included) and Goniometer were all used as data collection tools.

2.9 Patient Recruitment and Data Collection

2.10 Pretreatment

Clinical assessment of the patient was done and diagnosis made through either MRI or diagnostic knee arthroscopy or both.

Standard structured questionnaires were used to collect information on socio-demographic characteristic of the patients, mechanism of injury and their functional outcome.
The researcher provided information about the study and interviewed prospective participants using a pretested structured questionnaire and consent was obtained from those who were willing to participate.

Social demographic data was collected and recorded in questionnaire.
Range of motion (ROM) with goniometer was also measured preoperatively.
Time lag from injury to surgery was obtained by asking the patient when he/she sustained injury or when started feeling the symptoms and the day of operation was also be recorded and the time lag obtained, and this was categorized from less than 12weeks and 12weeks and above
Mechanism of injury was obtained by asking the patient the etiology/cause of the injury, like sports- related activities, road traffic crush, falling from height, or others.
Outcomes was measured using special designed questionnaire with 8domains from Lysholm knee functional scoring scale, then graded in four levels, Excellent, Good, Fair and poor with scores of 100-95, 94-84, 83-65 and less than 64 respectively.(32) The total score is the sum of each response to the 8 items. A score of 100 means no symptoms or disability.
There were 4 levels of outcome using Lysholm Functional knee scoring method as follows.

Table 1 Domains and scores for Lysholm functional knee scores

INSTABILITY	25 points
PAIN	25 points
LOCKING	15 points
SWELLING	10 points
STAIR CLIMBING	10 points
LIMPING	5 points
SUPPORT	5 points
SQUATTING	5 points

This was measured before surgery and then compared with that after surgical intervention and assessed for improvement (outcome) [33]. Supervised physiotherapy was recommended and was used to measure the specific variables in the Lysholm Functional Knee Scoring Scale.

Post-operative infection was assessed by examining the wound and antibiotic treatment was offered for the infected wounds. Other post operative complications found were also treated accordingly.

2.11 Measurement of range of knee motion.

Knee extension was assessed with the patient in supine position with the examiner raising the patients legs off the bed while holding the medial malleoli together and observe the level of the knees. The goniometer was used to measure the degree of knee extension and then compared.

For the knee flexion the patient flexes the knee as far as possible in supine position. The Goniometer is placed on the lateral aspect of the flexed knee to measure the degree of knee flexion then compared (39)

2.12 Treatment, post treatment and patient follow up

Arthroscopic ACL reconstruction was performed by orthopaedic surgeons to all enrolled patients with ACL tear and all intraoperative findings were documented. Antibiotic was given to all patients one hour prior to surgery, all underwent spinal anesthesia and tourniquet was applied to all patients. After 24hours the patient was to have partial weight bearing (ambulate with cratches), knee brace on, and closed chain exercises (alphabet exercises) was initiated, analgesics was given for 3days. At home the patient was instructed to continue with (physiotherapy) closed chains exercises and active knee flexion/extension. Patients were instructed to attend clinic on the 2^{nd}, 6^{th}, and 12^{th}, 16^{th} weeks.

2nd week visit

Wound was assessed and Stitches was removed. For the patients with superficial wound infection, treatment was offered by keeping them on oral antibiotics and daily wound dressing. The patient was to continue walking with crutches, knee brace on closed chains exercise, active knee flexion/extension

6thweek visit

Using Lysholm knee scoring scale, patient was assessed for pain, Instability, locking, swelling, stair climbing, Limp, support and squatting and be graded. Range of motion (ROM) was measured together with wound assessment. The patient was to continue with physiotherapy (**open chain exercises**) full weight bearing (no cratches, no brace) and active knee flexion/extension

12th week visit

Patient was assessed using Lysholm functional knee scoring scale as was done in the 6th week. Range of motion (ROM) and wound evaluation was done, and was to continue with physiotherapy

16th week visit

Last assessment was done and this determined the patient outcome.

Participants was required to complete the questionnaire on Lysholm score and the overall recovery from previous symptoms was assessed.

Range of motion (ROM) and final wound evaluation for healing was determined. Grading was then done weather excellent (100-95), good (94-84), fair (83-65) and poor (<64).

2.13 Validity and reliability of investigation tools

The Lysholm score was designed to document the patient's evaluation of function and it has been proven to be valid, reliable and responsive in evaluating patient with ACL injury.(34)

The reviewed Lysholm score (1983) added Locking as one of the domain and removed objective domain of thigh muscle atrophy, Therefore LFKSS has 8 domains of Instability (25), Pain (25), Locking (15), Swelling (10), Stair climbing (10), Limp (5), Support (5) and Squatting (5), and has demonstrated acceptable psychometric performance as outcome measures for patients with ACL tear.(35)

2.14 Data analysis

Data entry, cleaning and analysis was done by using SPSS version 20. Frequency distribution was used to describe categorical variables such as age group, sex and standard deviations for continuous variables such as constant Lysholm scores. Analysis for demographic data was conducted using Chi-square tests. A variable was considered to be statistically significant if it has P-value was less than or equal to 0.05.

2.15 Ethical Clearance and Consideration

Approval was obtained from the MUHAS Ethics review Committee. Permission to carry out the study was obtained from MOI management. Informed consent or assent was obtained from the patient, Participant anonymity, confidentiality and willingness to withdraw from the study were respected and refusal to be enrolled in the study did not affect the patient's treatment quality and follow up. Registration numbers instead of names was used for confidentiality purposes.

CHAPTER THREE

3.0 RESULTS

During the study period(May, 2017 to December 2017) a total of 52 participants with anterior cruciate ligament tear were recruited, 4(7.69%) had multiligamentous injuries and therefore excluded, 1(1.92%) had associated tibia plateau fracture, and finally 47 participants who were treated by arthroscopic ACL reconstruction using hamstring tendon autograft met the study inclusion criteria and were enrolled, at the end of follow up(at 16th week) only 43 patients were analyzed and 4(7.69%) were lost to follow up.

Table 2 Baseline socio-demographic data (age and sex distribution)

		Frequency	**Percentages**
Age groups in years	**<40**	38	88.4%
	≥40	05	11.6%
Sex	**M**	32	74.4%
	F	11	25.6%
Total		43	100%

Many participants were male accounting 32 (74.4%) with female to male ratio 1:2.9, also majority were below 40yr with a mean age of 30.09±6.989SD. Other findings are shown in table above

Table 3 Frequency distribution table showing duration from injury to treatment

		Frequency	Percentages
Duration from injury to treatment	≥ 3month	35	81.4%
	< 3month	08	18.6%
	Total	43	100%

Many participants were treated ≥ 3months from injury which accounted for 35(81.4%). The mean duration of symptoms to treatment was 15.70±21.61SD months.

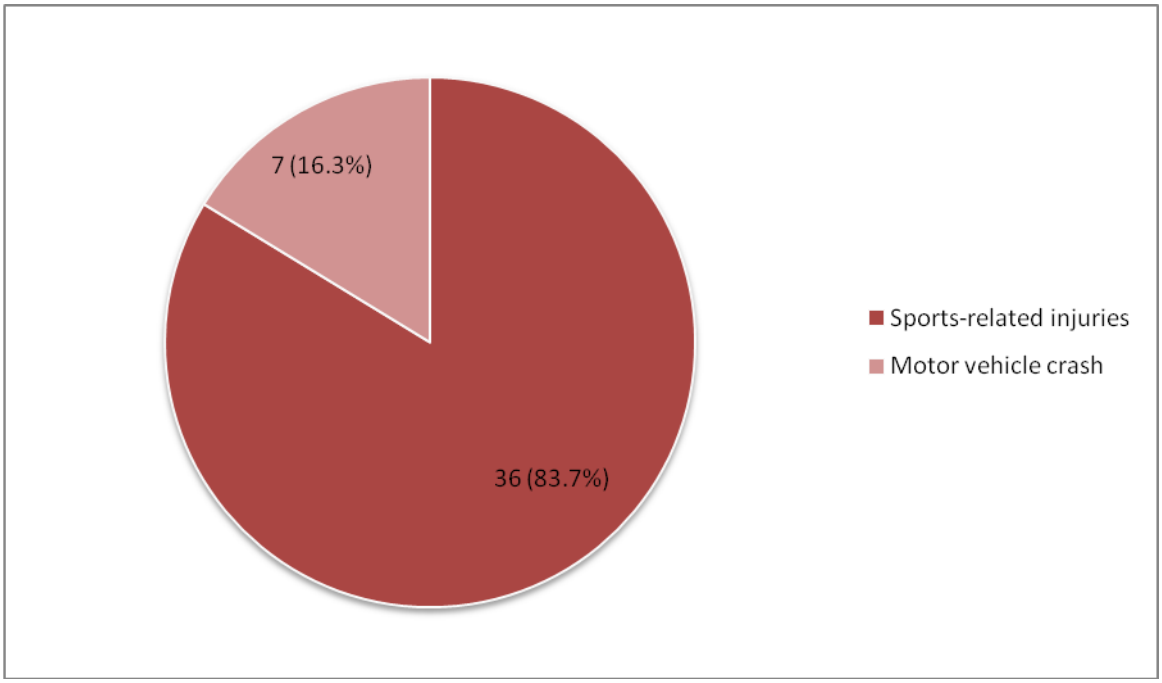


Figure 1 Distribution of mechanisms of injury expressed in percentages (%)

- The leading cause of ACL tear was sports related activities which accounted for 36 (83.7%), followed by motor vehicle crash.

Table 4 Effects of age, sex and duration of symptoms on the knee functional outcome at 16th week follow up.

Parameter		Lysholm score at 16th week		P value
		Good	excellent	
Age	<40	7(18.4%)	31(81.6%)	0.686
	>40	0(0%)	5(100%)	
Sex	M	5(15.6%)	27(84.4%)	0.843
	F	2(18.2%)	9(81.8%)	
Duration	<3month	0(0%)	5(100%)	0.294
	≥3month	7(18.4%)	31(81.6%)	
Infection	Present	1(100%)	0(0%)	0.034
	Absent	7(16.7%)	35(83.3%)	

- Age, sex and time lag from injury to treatment appear to have no effect on the functional outcome at 16th weeks (p value >0.01)
- Majority of patients had no infection 35(83.3%) and results were statistically significant ($p<0.05$) as shown in table 4.

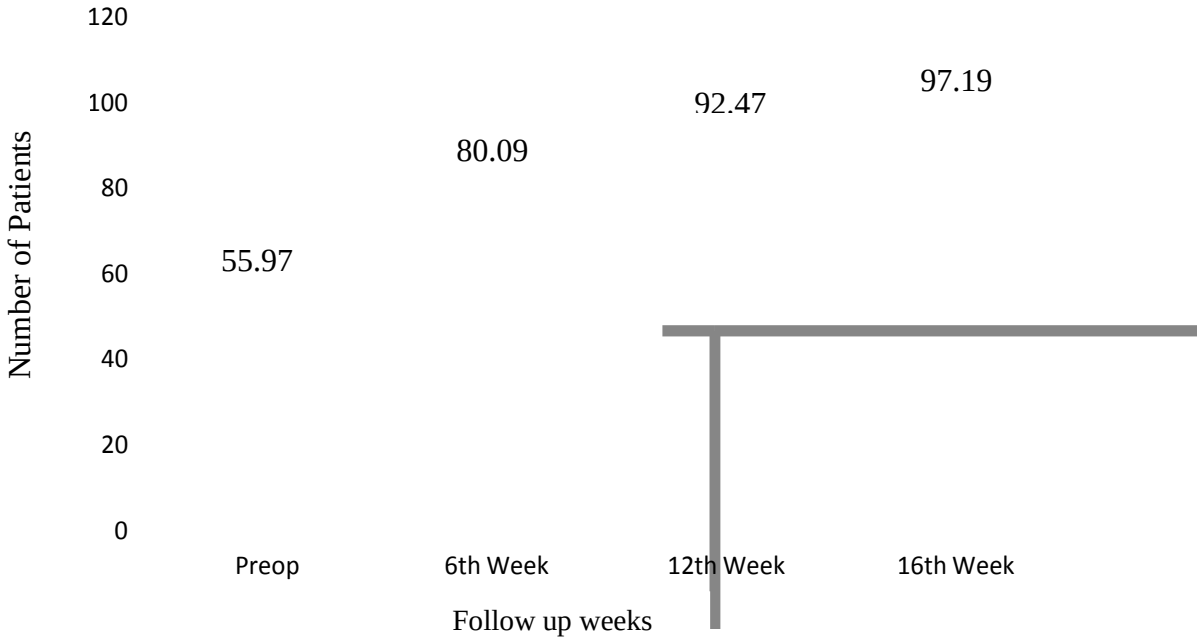


Figure 2 Median Lysholm functional knee scores at pretreatment, 6th, 12th and 16th week

- Majority of patients returned to their pre injury level of activity at 16th weeks post reconstruction.
- Lysholm score improved significantly at 16th week post reconstruction (97.19±3.14 SD) compared with that of pre-treatment Lysholm score which was (55.98±12.24 SD) as shown in figure 4 above. (p value <0.01).

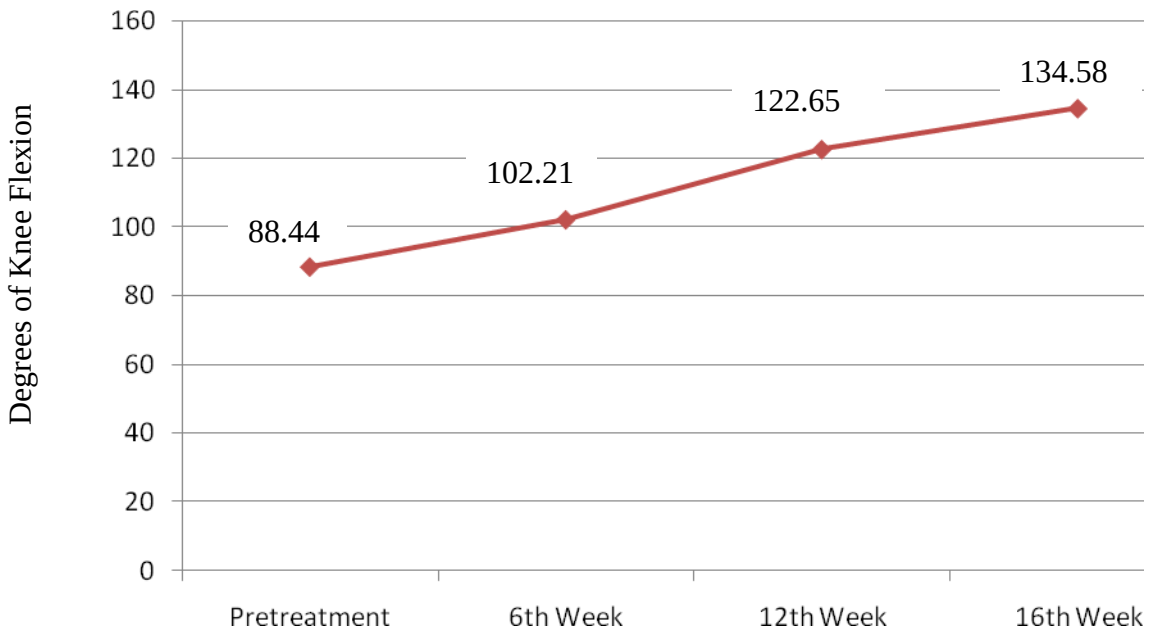


Figure 3 Mean degree of knee flexion at pretreatment, 6th 12th and 16th week (degrees)

- There is statistical significant improvement of degree of knee flexion at 16th weeks post operatively (134.58± 4.18SD) compared to degree of knee flexion of 88.44±16.22SD before treatment (p value <0.01).
  - Majority of patients (34(79.1%) had Lysholm functional outcome score of excellent at 16th week

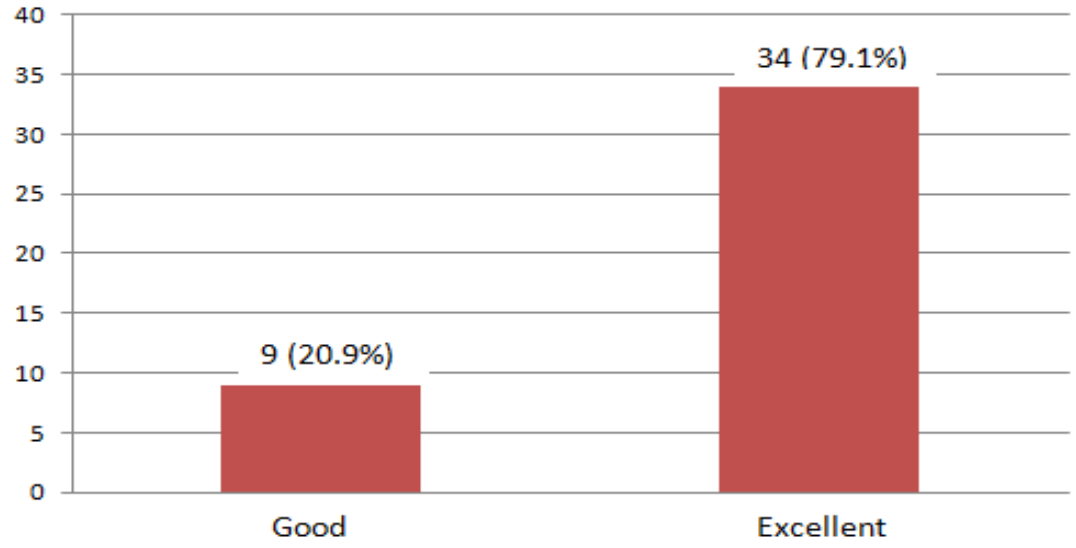


Figure 4 Lysholm knee functional outcome grades at 16th week (%)

Majority of patients (34(79.1%) had Lysholm functional outcome score of excellent at 16th week

CHAPTER FOUR

4.0 DISCUSSION

During the study period (May 2017 to December 2017) a total of 47 participants with anterior cruciate ligament tear who were treated by arthroscopic ACL reconstruction at MOI were enrolled; and followed up for a period of 16 weeks each. At the end of study (16^{th} week), only 43 participants were available for analysis, and 4 participants were lost to follow up.

Many participants in this study were male 32(74.4%) as compared to female 11(25.6%) with a male to female ratio of 3:1 (table 2). These results were similar to that reported by Smith et al, with male predominance, and likewise many authors reporting the male to female ratio of 3.5:1 (16). Females athletes have higher risk of tearing the ACL than males due to anatomic factors such as the width of the intercondylar notch, neuro-muscular function, and physiological factors such as hormonal regulation. Therefore the reason for male predominance in ACL tear was explained by men being more actively involved in sports-related and manual activities as compared to females (14). Many participants in this study were below 40 years of age 38(88.4%), This was similar to findings reported by Grossman et al whereby majority of patients (84%) were below 40years, this may also be explained by the fact that it is the young individuals who are actively engaging in sports and high risk manual activities. (15).

More than three quarters of participants in this study were treated at 3month and above from the time of injury with a mean duration of symptoms of 15 months (table 3), this findings correlated with the ones reported by Evans et al, which also categorized the time lag from injury to treatment in less than 3months and more or equal to 3months, and the functional outcome was statistically not different among the early and delayed groups(18). Some authors have grouped the time lag from injury to treatment in different groups, Kennedy categorized participant of less than 8weeks as early and those between 8-

12weeks into delayed.(19). Bernestein et al, grouped patients in less than 3weeks and more than 3weeks, and all had similar outcomes. (20).

Sports-related injuries were the leading cause of ACL tear in this study, (84%) followed by motor traffic crash (16%) (fig. 1). These results correlated to the ones reported by Kaboyashi et al and Griffin et al, which showed sports-related injuries were the leading cause of ACL tear. (22,23). Also the study by Mohammadi et al revealed that the main cause of ACL injury was sports-related activities, with soccer being the leading cause. The injuries were found to occur more often during competition rather than during practice.(24)

Functional outcome in this study expressed as the median Lysholm score, improved from 55.98 before treatment to 97.19 at 16^{th} week post treatment (ACL reconstruction) (fig. 2), and the range of motion (mean knee flexion angle) improved from 88.44˚ before treatment to 134.58˚ at 16^{th} week after treatment (fig. 3). These findings were similar to the ones reported by Satish et al where the average knee flexion angle was 100.11˚, and Lysholm score was 61.54 before treatment, then a knee flexion angle of 135.06 and Lysholm score of 95.46 after arthroscopic ACL reconstruction.(25). Majority of the patients had excellent results 34(79.1%) at 16^{th} week (fig. 4), which correlated with studies reported by Satish et al, Brown et al, Ismail et al, and Arkhbari et al; their findings where excellent to good outcome ranging from Lysholm knee functional scores of 82.65% to 96.67% (25,27,33).

Participant's age (table 4) has shown to have no effect on the outcome as most of them had good to excellent outcome at 16^{th} week follow up. This study also found that no statistical difference in the outcome in patients treated less than 3months and those treated at 3month and above. (p-value =0.686), this resembles to what was reported by Barber et al; where age at the time of reconstruction was found to have no effect on the functional outcome (28). These results are also similar to what was reported by Rao et al, where there was no significant difference between the two age groups (p = 0.67), likewise for Lysholm scores,

there was no statistical significance while comparing patients below and above the age of 40 years (p value =0.055) (36).

In this study sex of the patients (table 4) had no effect on functional outcome at16th week (p-value=0.843). More participants were male but functional outcome at 16th week were almost similar among male and female participants. Excellent results were 81.8% for female and 84.4% for male. These findings are similar to what was reported by Busam et al Griffin et al, and Prodromos et al where sex of the patients showed no significant association on the functional outcome following ACL reconstruction (11, 23, 37)

Time lag from injury to treatment (table 4) did not affect the functional outcome in this study, (p-value=0.294). This is similar to the Study reported by Frobel et al, which showed symptoms of less than 3months and greater or equal to 3months were not statistically significant on functional outcome(p=0.45) (38). Kennedy et al showed symptoms of less than 8week and 8-12weeks were not statistically significant on functional outcome(p=0.244) (19), and Smith et al showed symptoms of less than three weeks and those more than three weeks were statistically not significant (p-value= 0.281) (16). However the findings of this study are different from the studies reported by Suranigi et al and John Ryan et al where they found that very early ACL reconstruction (within 7day of injury) was associated with less satisfactory results.(34,40). This different findings in early surgery was explained by weakness of hamstring muscles as delayed surgery and exercises have shown to strengthen the muscles and hence good outcome.(40)

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Anterior cruciate ligament tear is more common in young males (less than 40years) who are actively engaging in sports-related activities which is actually the leading cause of anterior cruciate ligament tear. Arthroscopic ACL reconstruction has shown good outcome in this study as many participants had good and excellent outcome at 16^{th} week, and knee flexion angle has improved to almost normal.

5.2 Study limitations:

1. The sample size was not large enough to make a strong argument, and was not a comparative study.
2. The follow up was limited to 16 weeks, which was not adequate to fully assess the functional outcome from this treatment.

5.3 Recommendations

1. Arthroscopic ACL reconstruction has to be promoted and practiced more at MOI as the findings of this study has revealed good to excellent outcome.
2. Further prospective studies with large sample size are needed to further discern the findings of this study.
3. Anterior cruciate ligament injury has good to excellent outcome despite of delay in treatment,so operation should also be considered even in delayed clinical presentation.

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APPENDICES

6.1 Appendix I: Research Questionnaire

TITLE*:* SHORT TERM FUNCTIONAL OUTCOME OF PATIENTS WITH ANTERIOR CRUCIATE LIGAMENT TEAR TREATED BY ARTHROSCOPIC ACL RECONSTRUCTION USING HAMSTRING TENDON AUTOGRAFT AT MOI.

PART A: EVALUATION:

1. Form number……
2. Registration number……
3. Telephone number……
4. Place of residency……
5. Age……..
6. Sex 1. Male…….
   2. Female……
7. Date of injury……
8. Date of treatment……..

9. MECHANISM OF INJURY

a) Sports related injury b) Road traffic injury

c) Falling from height d) Activity of daily living

e) Others, specify……..

10. LIMPING

a) I have no limp when I walk (5)

b) I have slight or periodical limp when I walk (3)

c) I have severe and constant limp when I walk (0)

11. SUPPORT

a) I do not use cane or crutches (5)

b) I use cane or crutches with some weight bearing (2)

c) Putting weight on my hurt leg is impossible (0)

12. PAIN

a) I have no pain in my knee (25)

b) I have intermittent or slight pain in my knee during vigorous activities

c) I have marked pain in my knee during vigorous activities (15)

d) I have marked pain in my knee during or after walking more than 1 mile

e) I have constant pain in my knee (5)

13. INSTABILITY

a) My knee never gives way (25)

b) M y knee rarely gives way, only during athletics or other vigorous activities (20)

c) In turn I am unable to participate in these activities (15)

d) My knee occasionally gives way during daily activities (10)

e) My knee frequently gives way during daily activities (5)

f) My knee gives way every step I take (0)

14. LOCKING

a) I have no locking and no catching sensation in my knee (15)

b) I have catching sensation but no locking sensation in my knee (10)

c) My knee locks occasionally (6)

d) My knee locks frequently (2)

e) My knee feels locked at this moment (0)

15. SWELLING

a) I have no swelling in my knee (10)

b) I have swelling in my knee only after vigorous activities (6)

c) I have swelling in my knee after ordinary activities (2)

d) I have swelling constantly in my knee (0)

16. SQUATTING

a) I have no problems squatting (5)
b) I have slight problems squatting (4)
c) I cannot squat beyond a 90 degrees bend in my knee (2)
d) Squatting is impossible because of my knee (0)

17. STAIR CLIMBING

a) I have no problems climbing stairs (10)
b) I have slight problems climbing stairs (6)
c) I can climb stairs only one at a time (2)
d) Climbing stairs is impossible for me (0)

18. POST-OPERATIVE INFECTION

a) Present b) Absent

6.2 Appendix II: Informed Consent Form- English Version

Consent to participate in the study titled "Short term functional outcome of patients with ACL tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft at MOI"

GREETINGS: I am Dr. Valentine Restus a resident in Orthopedics and Traumatology expecting to do a study on *"*Short term functional outcomes of patients with ACL tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft at MOI*"*

PURPOSE OF THE STUDY:To determine short term functional outcomes of patients with ACL tear treated by arthroscopic ACL reconstruction using hamstring tendon autograft at MOI.

WHAT PARTICIPATION INVOLVES:If you agree to participate in this study, you will be asked questions and examined.

CONFIDENTIALITY:All the information obtained will be kept confidential and it will be entered into computer with only an identification number; your name will not be included.

RISKS: We ensure that there is no harm by involving into the study.

RIGHTS TO WITHDRAW: Taking part in this study is completely voluntary and refusal to participate or withdrawal will not involve penalty or loss of any benefits to which you are entitled. You will be treated and followed up as per the usual treatment protocol of the Institute for all patients with ACL tear treated by arthroscopic ACL reconstruction.

BENEFITS:If you agree to participate in this study, you will be assessed on the progress of your condition by the investigating doctor. We hope that the obtained information from this study will benefit others.

WHOM TO CONTACT: If you have any other questions regarding this study, feel free to contact me, the investigator, Dr. Valentine Restus, Muhimbili Orthopedics Institute, P.O. Box 65474, Dar es Salaam, Tel No 0683253745/0712253745/0767253745.

Signature

Do you agree to participate? .....

Participant does not agree……

I, ……..have read the consent form and my questions have been answered and I agree to participate in this study.

Signature of Participant……..

Signature of Investigator…….

Date of signed consent…….

6.3 AppendixIII: Informed Consent Form - Swahili Version

Ruhusa ya Kushiriki Utafiti Kuhusu kuangalia matokeo ya muda mfupi ya matibabu ya wagonjwa wenye matatizo ya kukatika ACL kwa kurekebisha sehemu iliyokatika kwa kutumia video maalum MOI, May 2017

Mimi naitwa Dr. Valentine Restus ni mwanafunzi wa uzamili chuo kikuu cha tiba Muhimbili, nachunguza matokeo ya muda mfupi ya matibabu ya wagonjwa wenye matatizo ya kukatika ACL kwa kurekebisha sehemuya iliyokatika kwa kutumia video maalum MOI, May 2017.

DHUMUNI LA UTAFITI HUU: Kupata taarifa muhimu ya matokeo ya matibabu ya kukatika ACL kwa kutumia upasuaji na kutoa mapendekezo ya uboreshaji.

USHIRIKI: Kama unakubali kushiriki kwenye utafiti huu utaulizwa maswali, utachunguzwa kwa kina na utafuatiliwa hata baada ya upasuaji katika kliniki yetu

USIRI:Taarifa zote za uchunguzi zitaingizwa kwenye kompyuta na nambari ya utambulisho; jina halitanukuliwa.

MADHARA: Tunategemea kwamba hakuna madhara yoyote yatokanayo na utafitihuu.

HAKI YA KUJITOA KWENYE UTAFITI: Kushiriki katika utafiti huu ni hiari, na kutokubali kushiriki au kujitoa hautaadhibiwa au kupoteza haki yako ya matibabu. Utatibiwa kama taratibu za hospitali zinavyoelekeza kwa mtu aliye na matatizo ya kukatika ACL

KUTOKEA KWA MADHARA: Tunategemea kwamba hakuna madhara yoyote yatokanayo na utafiti huu. Hata hivyo kama madhara ya mwili yatatokea kutokana na utafiti huu, utatibiwa kulingana na kanuni na taratibu za matibabu ya Tanzania.

FAIDA YA KUSHIRIKI KWENYE UTAFITI: Kama utakubali kushiriki kwenye utafiti huu, Faida utakazopata ni pamoja na kuonwa kwa ukaribu na daktari anayefanya utafiti. Tunatumaini kwamba taarifa zitakazopatikana zitawanufaisha wengine pia.

Kwa mawasiliano zaidi: Kama una maswali au maelezo kuhusu utafiti huu, uwe tayari kuwasiliana na mtafiti, Dr. Valentine Restus, Taasisi ya upasuaji mifupa na ubongo Hospitali ya Taifa Muhimbili , P.O. Box 65474, DSM. simu: 0683253745/0712253745/0767253745. Kama una maswali kuhusu haki yako kama mshiriki.

Saini:…….

Je umekubali kushiriki? .....

Mshiriki hajakubali kushiriki……

Mimi……. Nimesoma maelezo na kuyaelewa vizuri, na nimekubali kushiriki kwenye utafiti huu.

Sahihi ya Mshiriki……...

Sahihi ya Mtafiti…….

Tarehe ……