SHORT TERM OUTCOME OF PATIENTS WITH TIBIAL PLATEAU FRACTURES TREATED AT MUHIMBILI ORTHOPAEDIC INSTITUTE 2012

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SHORT TERM OUTCOME OF PATIENTS WITH TIBIAL PLATEAU FRACTURES TREATED AT MUHIMBILI ORTHOPAEDIC INSTITUTE (MOI)

By

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A Dissertation submitted in partial fulfillment of requirement for Degree of Master of Medicine in Orthopaedics and Traumatology of Muhimbili University of Health and Allied Sciences

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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 outcome of patients with tibial plateau fractures treated at Muhimbili Orthopaedic Institute (MOI)**" submitted in partial fulfillment of requirement for degree of Master of medicine in Orthopaedics and Trauma surgery of Muhimbili University of Health and Allied Sciences

_____

Dr. Anthony B. Assey

Supervisor

Date:_____

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I **Frank John** declared 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 a similar or any other degree award.

Signature: …….. Date: ……..

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DEDICATIONS

This dissertation is dedicated to my beloved wife Evelyn Malai and my daughter Emnora Frank for their love, courage, support and commitments to make sure our family are running smoothly.

ABSTRACT

Background: The management of tibial plateau fractures continues to be a challenge for orthopedics surgeons. Restoration of articular congruity and early range of motion should be the primary goal of treatment. Proper and adequate preoperative planning is essential for a good outcome. Historically the treatment of these fractures has been plagued by complications despite of better understanding of soft tissues injury and advancement in different treatment modalities.

Objectives: We evaluated the short-term outcome of patients with tibial plateau fractures treated at MOI 2012.

Methodology: A hospital based cross sectional prospective study was done on adult patients with tibial plateau fractures treated at MOI. Seventy four patients met our study inclusion criteria but 5 patients were lost follow up, so we reviewed 69 patients who completed follow ups. A researcher used a structured questionnaire to interview the participants. These patients were treated by either conservative or surgical method. Immediately post operatively control radiographs were taken. Then each patient was followed up for a minimum of 16 weeks post treatment. In the follow up visits, status of the wound, flexion of the knee, ability to bear weight without pain, fracture healing and stability of the knee were assessed. The obtained data were analyzed by SPSS version 21.

Results:

Male were affected more than females with male to female ratio 5.9:1. Majority of patients were aged from 29 to 50 years with age range of 19 to 69 and mean age of 39.5 years ± 10.7 SD. Road traffic crash was the most common cause of injury, 79.7%. Patients who were treated conservatively were 42% and those who were treated surgically were 58%. Deep wound infection occurred in 12% among patients who were treated surgically. One patient (16.7%) out of 6 patients with open fractures had infection while 4 patients (11.8%) out of 34

patients with closed fractures had infection. The overall knee flexion of less than 90 degrees was encountered in 37.9% among conservatively treated patients and 25% among surgically treated patients. Severe limitation to weight bearing by pain was encountered in 6.9% of conservatively treated patients and in 5% of surgically treated patients. By 16^{th} week 93.1% of conservatively treated patients had their fracture healed and 95% of surgically treated patients had their fracture healed. Knee instability was encountered in 3.4% in conservatively treated patients and in 5% in surgically treated patients. Time from treatment to full weight bearing between 6 and 12 weeks were encountered in 55.2% of conservatively treated patients and in 32.5% of surgically treated patients. Patients who started full weight bearing after 12 weeks were 44.8% in conservatively treated patients and in 67.5% in surgically treated patients.

Conclusion:

Both conservative and surgical methods of treatment are effective in the treatment of tibial plateau fractures depending on the type and severity of the fracture. In this study, good results in terms of knee joint flexion, stability, fracture union and ability to bear weight without pain were seen in both conservatively and surgically treated patients.

ABBREVIATIONS

Acronym		Definition of Abbreviations
ACL	-	Anterior Cruciate Ligament
ACS	-	Acute Compartment Syndrome
AO	-	Association of Osteosynthesis
DVT	-	Deep Venous Thrombosis
EF	-	External Fixation
FAS	-	Functional Activity Score
EMD	-	Emergency Medical Department
LCL	-	Lateral Collateral Ligament
LISS	-	Less Invasive Stabilization System
MCL	-	Medial Collateral Ligament
MMED	-	Masters of Medicine
MOI	-	Muhimbili Orthopaedic Institute
MUHAS	-	Muhimbili University of Health and Allied Sciences
OPD	-	Outpatient Department
ORIF	-	Open Reduction and Internal Fixation
OTA	-	Orthopaedics and Traumatology Association
MTC	-	Motor Traffic Crush
PCL	-	Posterior Cruciate Ligament
POP	-	Plaster of Paris
RTA	-	Road Traffic Accident
RTC	-	Road Traffic Crash

ROM	-	Range of Motion
SD	-	Standard Deviation
SPSS	-	Statistical Program Software for Social Sciences
USA	-	United States of America

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CHAPTER ONE

1.1 INTRODUCTION AND BACKGROUND INFORMATION

Tibial plateau fractures are fractures of the proximal 10cm of the tibia involving the epiphysis, metaphysis and the articular surface. They are always associated with soft tissue injury. They were first described in 1825 by Sir Astley Cooper [1]. They are complex injuries and difficult to treat [2].Tibial plateau fractures can occur as a result of high-energy trauma or in low-energy trauma when bone quality is poor. The most common mechanism of injury is MTC, followed by falls and sports injuries, with 40% of injuries occurring in poly-trauma patients [3]. These fractures are associated with complications especially if they are poorly managed and this pauses a significant challenge to orthopedics surgeons [4, 5].

1.1.1.0 Relevant Anatomy

Tibia bears majority of the body weight in erect position. Fibula functions in muscles attachment, the biceps femoris tendon and the lateral collateral ligament. The lateral and medial tibial plateaus are the articular surfaces of medial and lateral tibial condyles which articulate with the corresponding femoral condyles. The medial tibial plateau is larger than the lateral plateau and it is concave from anterior to posterior as well as from medial to lateral. The lateral plateau is smaller and higher than the medial, it is convex from anterior to posterior as well as from lateral to medial. The fact that the lateral plateau is higher than the medial must be remembered during internal fixation so that a screw inserted from lateral to medial does not enter the medial articulation [3].

Likewise, the articular surfaces of the tibia slope approximately 10 degrees from anterior to posterior, and placement of subchondral screws from anterior to posterior should avoid penetrating the posterior aspects of the joint**.** The articular surfaces are lined by hyaline cartilage. Both plateaus are covered by fibro cartilaginous menisci. The two plateaus are separated by a non articular intercondylar eminence which is made up of two spikes; medial

and lateral. The ACL is attached anterior to the medial intercondylar tubercle. PCL is attached posterior to the medial intercondylar tubercle and extends to the posterior surface of the metaphysis [6].

The tibial tubercle is located three centimeters distal to the articular surface anterolateral and patellar tendon attaches to it. Gerdy's tubercle is located lateral to the proximal tibia and iliotibial band is inserted there. More lateral there is articulation of hyaline cartilage between tibia and fibula. The proximal tibiofibular joint is a true synovial joint and in some individuals it communicates with the knee joint properly. It is important to remember that the fibula buttresses the lateral tibial condyle and may be used for this function as an in situ buttress plate in certain constructs when using plating and hybrid external fixation technique. On the anteromedial surface of the proximal tibia there is an insertion of the conjoined tendon of three muscles; sartorius, gracilis and semitendinosus muscles. This tendon lies superficial to the tibial insertion of MCL. The common peroneal nerve courses around the neck of the fibula before it divides into superficial and deep branches. Trifurcation of popliteal artery into anterior tibial, posterior tibial and peroneal artery occurs postero-medial in proximal tibia. The popliteal artery is a continuation of femoral artery [7, 8].

1.1.1.1 Mechanism of injury

Previously, fractures of the proximal tibia were described as bumper fracture because they resulted from low energy pedestrian versus motor vehicle accidents [7].

Currently, majority of these fractures are due to high speed motor vehicle accidents and falls from heights [9].

The tibial plateau fracture can result from; a direct force, an axial compressive force or a combination of both axial and direct forces. The direct force can be medially or laterally directed [3]. The respective femoral condyle in this mechanism of injury exerts both shearing

and compressive forces on the underlying tibial plateau. The resulting fracture is therefore most commonly a split fracture, a depression fracture, or both [7].

1.1.1.2 Associated injuries

Fractures: Tibial plateau fractures can be isolated or can occur with other fractures in the same limb. Ipsilateral fracture of the fibula is the most common, occurring in 23 – 76 % depending on the type of tibial plateau fracture. Subcondylar fracture and tibial spine fractures are also common. Associated ipsilateral fractures of the femoral neck, shaft and supracondylar region do occur [1, 3, 7].

Soft tissues: Tibial plateau fractures can be associated with severe soft tissue injury. Injury to the popliteal artery and peroneal nerve are common in medial plateau fractures as they are due to high energy [10]. Fractures of the lateral plateau are rarely associated with arterial or nerve lesions [11]. Acute compartment syndrome is common in fractures that extend into the diaphysis due to haemorrhage and oedema [12].

Tear of the menisci occur and it is particularly a peripheral detachment and account for 25% of all patients with tibial plateau fractures. Avulsion of the infrapatellar tendon together with the tibial tubercle occurs but is rare [7, 10]. Injury to the collateral ligaments has been reported to occur in 7% to 43% of tibial plateau fractures [13]. Rupture of the anterior cruciate has been reported in up to 23% of high-energy. The Segond sign (lateral capsular avulsion) and the Pellegrini-Stieda lesions (calcification along the insertion of the medial collateral ligament) are signs of LCL and MCL injury respectively [14, 15, 16].

1.1.1.3 Classification

There are numerous classification systems that have been proposed to describe tibial plateau fractures [17]. Despite the abundance of available classification systems, none fully complies with all of the requirements [7, 18, 19].

Schatzker's classification of tibial plateau fractures is currently the most widely used and was the first to make the distinction between medial and lateral plateau fractures. This classification is based on the idea that certain patho-anatomic and etiological factors as well as therapeutic features demand that certain injury types be grouped together [20].

Each increasing numeric fracture category indicates increasing severity, reflecting not only increased energy imparted to the bone at the time of injury but also an increasingly worse prognosis. Therefore, orthopedic surgeons find the Schatzker classification useful in assessing the initial injury, planning management, and predicting prognosis [21]. There are six types [3, 7]
Type I: Is a split or wedge fracture of the lateral tibial plateau without articular depression. It results from bending and axial forces. If the fragment is displaced there may be associated soft tissue disruption such as lateral meniscal tear. It is common in young people in whom the strong cancellous bone resists depression.

Type II: Is a split depressed fracture of the lateral tibial plateau. It occurs in older age group as compared to type I.

Type III: Represents a pure depression of the lateral tibial plateau. The depression is usually central. Lateral and posterior depressions are associated with knee joint instability. They are caused by valgus force.

Type IV: Is a fracture of the medial tibial plateau. It results from a varus force acting on axially loaded knee. It is a high energy injury and it is associated with soft tissue injury. It is further subdivided into type IVA which represents split fracture or type IVB which represent depression.

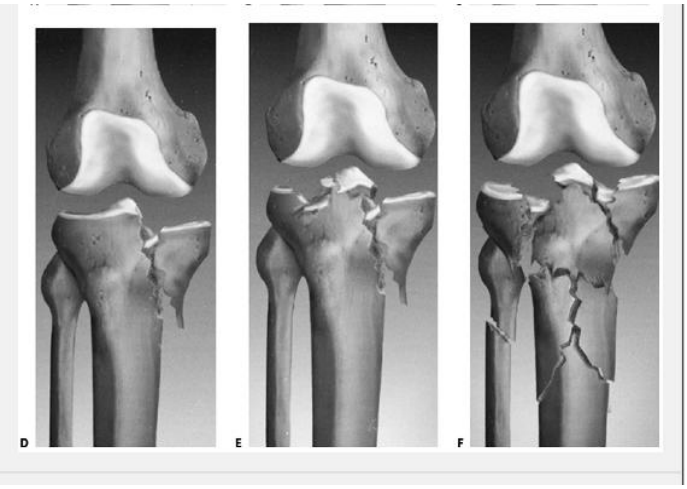
Type V: These are bicondylar fracture that result from high energy injury with significant soft tissue injury. The usual type is split fracture of the medial tibial plateau and split or spilt depression of the lateral tibial plateau.

Type VI: Is a bicondylar fracture with metaphyseal-diaphyseal dissociation. It is from high energy injury and it has been described as 'explosive fracture' [3, 7, 17, 18, 19, 20, 21].

Figure 1: Schatzker's Classification of Tibial Plateau Fractures; Rockwood & Green's Fractures in Adults, 6th Edition page 2005



I II III



IV V VI

1.1.1.4 Treatment

Tibial plateau fractures can be treated none operatively by casting, hinged brace (restricted mobilisation) and by traction [22, 23]. They can also be treated operatively by screws, plates, or external fixations [24].The goals of treatment of tibial plateau fractures are the same as for any other intra-articular fracture; to preserve joint mobility, to restore joint stability, to restore articular surface congruence, to maintain axial alignment, to provide freedom from pain and to prevent post-traumatic osteoarthritis [3, 7, 16, 25]. The indications for conservative versus surgical treatment vary widely in literature [18, 26]. Indications for conservative are; undisplaced or minimally displaced fractures, displaced lateral plateau without joint instability, unstable lateral plateau fracture in osteoporotic bone and presence of other cormobidies like diabetes and hypertension. Protected weight bearing and early knee joint motion has good outcome in conservative treatment [3, 7, 25].

Surgical treatment remains the mainstay in tibial plateau fractures. Indications for surgical treatment are; open tibial plateau fracture, displaced fractures, fracture with joint instability and tibial plateau fracture in multiply injured patients [6]. Fracture associated with compartment syndrome or neurovascular injury should be operated [27]. Choice of implant depends much on level of articular depression and degree of displacement [28]. Screws alone can be used in simple split fractures that can be reduced anatomically by closed method and in depressed fractures that can be elevated percutaneously. Also lag screw can be used in avulsed fractures with soft tissue attachment [29]. For fractures with instability, plates with screws fixation can be used. The plates have two effects; first they have buttress effect against shear forces. Second they have capacity to neutralize rotational forces [30]. Currently, in surgical treatment, the use of less extensive exposure or minimal invasive surgery is highly advocated in order to avoid compromise to the soft tissues and risk of infection [31, 32]. This can be aided by use of fluoroscopy or arthroscopic assisted techniques while fixing these fractures [33]. The percutaneous plates (low profile plates) can be placed through small incision and they have an advantage of minimal soft tissue stripping. Also its thickness is smaller than the normal

buttress plate hence it is good for the tibial plateau fractures as this area is devoid of soft tissue coverage. In these plates there is interface between the screw heads and the plate body, so they provide both angular and axial construct stability [34]. In fixation of severe tibial plateau fractures like Schatzker's V and VI, it is advocated to use two incisions technique when applying bicondylar plates or to use single locking plate as these techniques are associated with few complications [34, 35]. Angled plates are also in fixing fresh tibial plateau fractures and in non union [36]. In pure depressed tibial plateau fractures (Schatzker's III) depressed segment can be subsequently elevated through a window which is made submetaphyseally. Also autograft and calcium based cement augumentation can be used in these fractures [37, 38]. EFs are used as a temporary measure in case of severe soft tissue damage while waiting for definitive treatment [39]. However they can be used as a definitive treatment. The hybrid EF can be used in higher energy tibial plateau fractures like in Schatzker V and VI[40]. They use a combination of both half pins and the thin wires. They have various advantages; Minimal soft tissue injury as it is a form of LISS**.** Can give chance for dynamization in case of delay union and can be revised easily in case of malalignment [7, 27]. Severe tibial plateau fractures and open fractures can be treated by the concept of minimal internal fixations and EF. This involves the use of percutaneous screws to fix the articular fragments and the use of EF to fix the other fragment [6, 41].

1.1.1.5 Complications

Although there is much improvements in diagnosis and treatment of these injuries, but complications still occur. Complications are common in either type of treatment [42]. Early complications are; acute compartment syndrome, infections and thromboembolic complications [43]. Late complications are; painful hardware, loss of fixation, knee stiffness, malunion and post traumatic arthritis [3, 6, 7, 45, 46].

1.2 LITERATURE REVIEW

Reported series show that the great majority of these fractures affect lateral tibial plateau (55% to 70%). Isolated fracture to the medial plateau accounts for 10% to 20% and fractures involving both condyles are less frequently. These results were reported by Bucholz et al [7].

Accurate statistics on tibial plateau fractures are scarce and vary slightly from different parts of the world. Hohl et al in 1997 reported that, tibial plateau fractures account for 1% of all fractures and up to 8% of all fractures in adults [9].

Similar results were reported by Moore et al in 1987 whereby tibial plateau fractures account for 1.3% of all fractures in USA [11].

Tibial plateau fractures are complex intrarticular fractures difficult to treat. With either surgical or conservative treatment, complications and impaired knee function are seen depending on the type and severity of the fracture [47].

Etiologically, Moore reported that fractures in young age were due to high energy while in older age was due to low energy and males were affected more than females. Hohl reported that RTA was the commonest cause (52%) followed by fall from height (17%) and sports recreational 5% [9].

Blokker and others in 1984 did a study to analyze these fractures and they found that, these fractures cover a broad spectrum of injuries that range from low energy injuries in elderly that respond well with non operative treatment to high energy injuries in young adults that that need operative management [26].

Waddell JP and others reported an infection rate of 2% in a study done in 1981 in USA[28]. Another study which was done by Mueller KL and others in USA in 2003 showed that the infection rate was 11% [40]. In a study done by Young and Barrack in Lousiana, USA in 1994, it showed that, the infection rate was proportional to the number of implants used. There was

no infection among patients who were treated with buttress plate. For those who were treated with buttress plate and lag screws infection rate was 32% and for those treated with bicondylar plate infection rate was 87.5% [44].

Schatzker et al, in 1979 reported 70 cases of tibial plateau fractures of all types treated by conservative (56%) and surgical (44%) methods. The cases were followed up for an average period of 28 months. Acceptable results were obtained by 58% of cases treated by conservative methods and 78% by open methods. Fractures treated by open reduction and buttress plating with bone grafting achieved 88% acceptable results. Schatzker type V had only 50% acceptable results [20].

The study done by David P. et al in USA in 2004 showed that ORIF of high energy bicondylar tibial plateau fractures utilizing a two incision technique were associated with complication; among 83 patients; compartment syndrome account for 14.5%, deep wound infections was 8.4% where by 3 patients (3.6%) of these had septic arthritis of the knee joint. DVT account for 19.3% [35].

With any type of treatment, early knee joint motion and weight bearing restriction have shown good functional outcome. In a study done by P. Gaston and others in Scotland to asses functional outcome following fractures of the tibial plateaus in 63 patients. 51 patients were treated by ORIF, 5 patients ORIF + EF, and 7 none operatively. At 3 months, 52 patients (82%) had more than 100 degrees knee flexion and 39 patients (62%) had an extension deficit of less than 5 degrees. By one year, 13 patients (21%) still had an extension deficit of equal or more than 5 degrees. Also this study showed that, recovery was slower in older people more than 40 years [47].

Minimal invasive surgery has been associated with few complications. In a study done by Boldin and others in Austria (2006), patients with tibial plateau fractures were treated by LISS and followed up for 3 years. Good functional outcomes and a low complication rate were reported in 26 patients treated with LISS plate [32].

In another study done in China by Jiang et al (2008), a higher incidence of malalignment following fixation with LISS as compared to fixation with convention double plating was reported [31].

Hisaya Uchida and others did a study in short term predictors of functional outcome in tibial plateau fractures. They found that poor anatomical parameters were associated with worse outcome. They asses radiological features and clinical features in 23 patients and the overall functional grade was excellent for 11, good for 8, fair for 4, and poor for 1 of the fractures. One patient had bilateral fracture [42].

High energy tibial plateau fractures treated with illizarov EF have shown good results with minor complications. In a study done by George et al in Greece (2002 -2003), 33 patients with bicondylar tibial plateau fractures (Schatzker V and VI) treated by hybrid EF; 18 patients (55%) had excellent results, 10 patients (30%) had good results, 4 (12%) had fair results and 1 patient (3%) had poor result[2]. A similar study was done in South Africa by Ferreira and Senoge (2008/2009) and there were no major complications among 13 patients with high energy bicondylar tibial plateau fractures who were treated by Illizarov circular external fixator [48].

In 2004, Ebrahem and others did a retrospective study in Ohio USA where by 117 tibial plateau patients whom were treated by ORIF, 94 had good to excellent results, 13 had fair results and 10 had poor results [49].

1.3 PROBLEM STATEMENT

Although tibial plateau fractures account approximately for 1% of all fractures, a unified treatment has not yet been established [9].

Tibial plateau fractures are serious intra-articular fractures of the extremities with major threat to the knee joint function and stability [47].

Despite numerous recommended treatment methods and the developed new surgical techniques, outcomes remain uncertain and none of these techniques are absolutely convincing. Although, the prognosis for surgically treated tibial plateau fractures has been improved as a result of a better understanding of soft tissue handling, pre-operative planning and fixation techniques, complications still occur after operative treatment and may be serious [50].

These fractures are expected to increase in our settings because of increase in the road traffic crashes [51, 52].

In our settings very little is known regarding the management and outcome of these fractures.

1.4 RATIONALE

The study results will be utilized to improve the outcome after the management of tibial plateau fracture.

It can form a baseline data for developing protocol for treatment of tibial plateau fractures.

Identification of potential area for intervention is expected from this study.

Lastly, this is an important requirement in the completion and fulfillments of my Masters of Medicine degree in Orthopaedics and Traumatology.

1.5 RESEARCH QUESTIONS

1. What are the causes of tibial plateau fractures
2. How are the patients with tibial plateau fractures treated at MOI?
3. What are the short term outcome in terms of infection, pain on weight bearing, knee flexion, knee stability, fracture union and time from treatment to full weight bearing in patients with tibial plateau fractures treated at MOI?

1.6 OBJECTIVES

1.6.1 Broad objective

To determine the short term outcome of patients with tibial plateau fractures treated at MOI April 2012 to April 2013.

1.6.2 Specific objectives

i. To determine sociodemographic factors among patients with tibial plateau fractures treated at MOI from April 2012 to April 2013.

ii. To determine cause of injury among patients with tibial plateau fractures treated at MOI from April 2012 to April 2013.

iii. To determine type of treatment given to patients with tibial plateau fractures treated at MOI from April 2012 to April 2013.

iv. To determine the short term outcome among patients with tibial plateau fractures treated at MOI from April 2012 to April 2013.

CHAPTER TWO

2.0 METHODOLOGY

2.1 Study design

This was a hospital based cross sectional 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 improving management of patients. It is a tertiary hospital with a total bed capacity of 181beds.

2.3 Study duration

This study was conducted from April 2012 to April 2013.

2.4 Study population

Patients aged 18 years or above with tibial plateau fracture treated at MOI.

2.5 Inclusion criteria:

Patients aged 18 years or above with tibial plateau fractures treated at MOI and conseted to participate during the study period.

2.6 Exclusion criteria

i. Pathological fractures

ii. Patients having deformity of at least one lower limb i.e. Polio, major joint contractures, and amputees.

iii. Associated with fracture of the distal femur end of the femur ipsilaterally.

iv. Bilateral tibial plateau fractures

v. Fracture of contralateral tibia.

2.7 Sample size estimation and sampling technique:

Number of patients with fracture at any part of the tibia attended per month is 101, for 3 months = 303 patients[53].

Number of tibial plateau fractures per month is 5 patients, for 3 months = 15 patients [53].

Proportion of patients with tibial plateau fractures = 15/303= 4.95%.

Sample size was estimated by using the following formula,

$$n = \frac{Z^2 p (1 - p)}{e^2}$$

Where,

- n = Minimum sample size
- Z = Standard normal deviate corresponding to two sided specified significant level. This is 1.96 (at 95% confidence interval).
- e = Margin of tolerable error 0.05
- p = Proportion of patients with tibial plateau fractures (p = 0.0495)

$$\frac{n = 1.96^2 \times 0.0495 (1 - 0.0495)}{0.05^2}$$

$$n = 72$$

Hence minimum sample size = 72 patients.

Due to loss follow-up the sample size for the study was 77 patients

Consecutive patients who met the study inclusion criteria and consented to participate in the study were enrolled until our sample size reached.

2.8 Data collection process

The pre test for data collection was done by a researcher in order to find out if it provides the required information. Necessary changes were made so as to obtain the required information. The researcher and recruited research assistant gave information about the study to the study participants and obtained consent from those willing to participate. The structured questionnaires were used to collect the information. Patients were evaluated on the day of admission and after treatment. These patients were followed- up at 2nd, 6th, 12th and 16th week post treatment. During follow up, the parameters which were assessed were documented in a hand written form. The parameters were; status of the wound, knee flexion and stability, pain on weight bearing, fracture union and time from treatment to full weight bearing. The geniometer was used as research tool to measure the flexion of the knee joint.

2.9 Patients and methods

Pre treatment

All patients with tibial plateau fractures were included in this study after consent to participate. Patients were evaluated and assessed clinically. Anteroposterior and lateral views x ray of the affected limb were taken and fracture were classified by a researcher and confirmed by radiologist. The classification used was Schatzker Classification.

Treatment

Treatment method was based on type of fracture, amount of displacement, amount of depression, swelling, general condition of the skin and the general condition of the patient. Minimally displaced fractures with intact skin were treated with closed reduction and above knee POP with knee in 10 degrees of flexion.

Patients with, severely displaced fractures, depressed fractures and swelling with extensive skin problems were treated surgically. Before surgery these patients were given initial treatment either traction or backslab POP then scheduled for operation. During traction patients were advised isometric quadriceps exercise and active ankle and foot movements. ORIF were done by buttress plates, screws or screws and external fixators. Open fractures were treated on emergency basis by surgical debriment followed by trans knee external fixation. Also intravenous antibiotics were given before surgery and continued for five days after surgery. Physiotherapy was started before the patients were discharged home.

Surgical Procedure

All surgeries were performed under image intensifier except for open fractures which were done in emergency theatre where there is no image intensifier. Depending on the complexity of the fracture, the surgeries were done by registrars, residents, specialists or consultants. The surgical approaches depended on the type of fracture. Lateral parapatellar and lazy 'S' approaches were used for the fractures that involve the lateral plateau. Medial parapatellar were used for medial plateau fractures. Double incisions, lateral and medial were used for bicondylar fractures. Patients were given prophylactic antibiotics before surgery.

Post treatment care and follow up

All patients who were treated conservatively were discharged on the same day after application of POP. Immediate post operative x rays were taken for surgically treated patients. Knee joint motion was encouraged day one after surgery and non weight bearing. After being

discharged study participants were requested to attend a follow-up clinic on the 2nd week post operatively. At this visit the researcher asses the status of the wound and suture removal was done. Infection, was considered so if two or more signs of inflammation were present, (redness, oedema, tenderness), serous or pus discharge. Additional followed-up visit were scheduled at 6th, 12th and 16th weeks pos-treatment. During these visits anteroposterior and lateral X rays were taken. The fracture union was assessed by obliteration of the fracture line and the number of cortices bridged by callus for those fractures with diaphyseal involment. Also physical examination was done to assess the knee flexion, stability and pain assessment on weight bearing.

Fracture union was defined by presence of obliterated fracture line, presence of bridging callus in at least three cortices for those fractures with diaphyseal involvement and ability to bear weight without limitation by pain. Conservatively treated patients with signs of fracture union, POP was removed and started partial weight bearing and physiotherapy.

Knee joint flexion

Knee flexion was assessed by asking a supine patient to flex the knee as far as possible [54].

A goniometer is placed on the lateral aspect of flexed knee to measure the degree of knee flexion. The two sides are compared.

2.10 Pain assessments on weight bearing

Assessments of pain on weight bearing was done by using the the Functional Activity Score (FAS). Patients were asked to bear weight and then the researcher assessed in to what extent the activity (weight bearing) was impaired by pain. The FAS has three grades:

A – No limitation meaning the patient's activity is unrestricted by pain

B – Mild limitation means the patient's activity is mild to moderately restricted by pain

C - Severe limitation means the patient ability to perform the activity is severely limited by pain

Knee stability

The knee stability was assessed on 18th week. It was done by using the varus/valgus stress test. The patient's distal thigh was stabilized with one hand and then a gentle stress was applied at patient's ankle or foot. Valgus stress tests medial collateral ligament. Varus stress tests lateral collateral ligament. Any excessive translation on stress application was considered a positive test [54].

2.11 Data Management and Analysis

Data obtained were managed by statistical software (SPSS version 21). Continuous variables were summarized by mean & standard deviation and comparisons were made using student t- test. Categorical variables were summarized by frequency tables and comparisons were made using the Chi square test. The level of significance was set at 5%.

2.12 Ethical Consideration

Ethical clearance was obtained from the ethical clearance committee of MUHAS. Permission was sought from MOI. The aims of this study were explained to the patients and the patients were allowed to ask questions about the study. During and after the study, the confidentiality was maintained and the obtained information was used for research purpose only. Then the participants who agreed to participate in this study signed a consent form.

CHAPTER THREE

3.0 RESULTS

This section presents the results of short term outcome of patients with tibial plateau fractures treated at MOI from April 2012 to April 2013. During the study period, a total of 81 patients with tibial plateau fractures were treated at MOI. Among these, 74 patients met the inclusion criteria and they were recruited in the study after signing the consent. There were 5 patients (6.8%) lost to follow up, among these, 2 patients were lost to follow up after discharge from the hospital and 3 patients were lost to follow up after the 6th week visit. The remaining 69 patients completed a minimum of 16 weeks of follow up after treatment. The lost to follow up were excluded from the study.

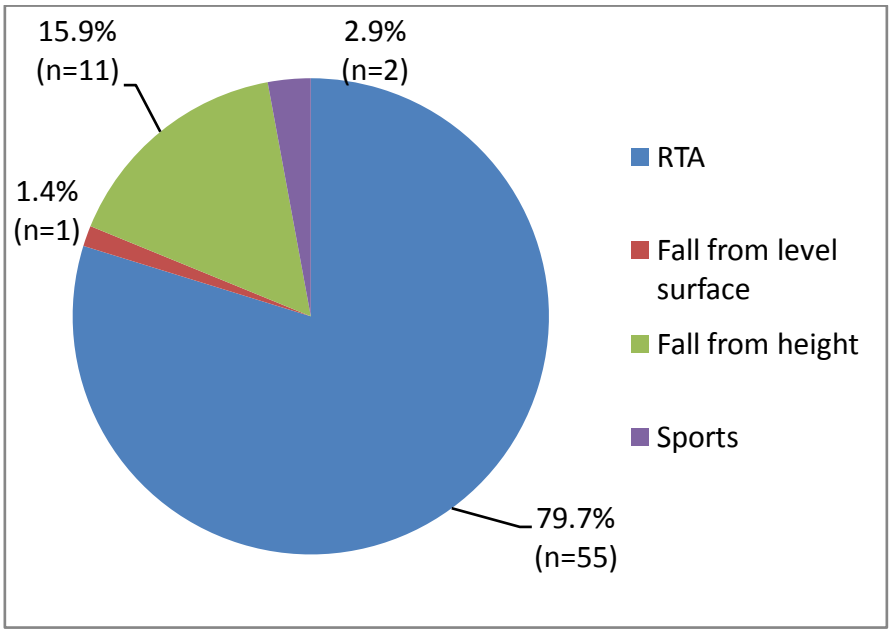
Table 1: Social demographic characteristics (n=69)

Variable	Frequency	Percentage
Age group		
18-28	9	13.0
29-39	30	43.5
40-50	20	29.0
>50	10	14.5
Sex		
Male	59	85.5
Female	10	14.5
Residence		
Ilala	14	20.3
Kinondoni	23	33.3
Temeke	16	23.2
Up country	16	23.2

The majority of patients were aged between 29 to 39 years and 40 to 50 years which accounted 43.5% and 30% respectively. The age range from 19 to 69 with mean age of 39.5 years ± 10.7 SD.

In this study 85.5% were male and 14.5% were female. Majority of the patients were Dar es Salaam residents (76.8%) and only (23.2%) came outside Dar es Salaam. **(Table 1).**

Figure 2: Distribution of sample by cause of injury (n=69)

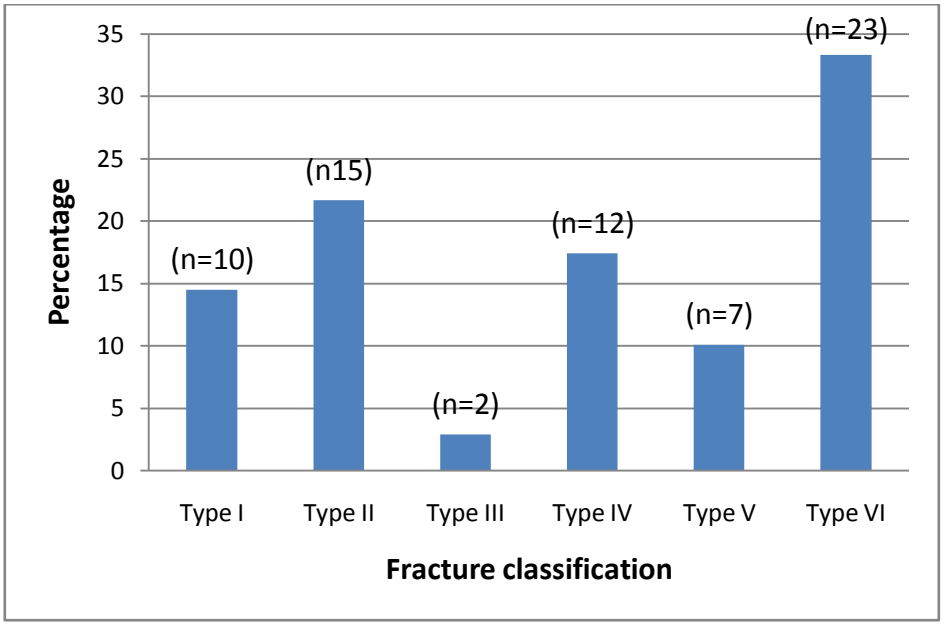


In this study, the most common cause of injury was RTC which accounted (79.7%) followed by fall from height (15.9), sports (2.9%) and fall from level surface (1.4%). **(Figure 2**).

In this study 47.8% of patients sustained injury on the right side and 52.2% sustained injury on the left side. Most of the fractures were closed (89.9%) the open fractures were (10.1%)

Among the associated injuries, fracture of the fibula was the commonest and it accounted (36.2%)

Figure 3: Distribution of sample by fracture classification (n=69)



All the fractures in this study were classified according to Schatzker Classification. The low velocity injuries, type I to III accounted (39.1%) while high velocity injuries, type IV to VI accounted (60.9%) with maximum being type VI (33.3%) of all patients and least being type III (2.9%) of all patients**.(Figure 3).**

Low velocity injuries type I to III were encountered in 16 patients (23%) aged 18 to 29 years and in 11 patients (15.8%) aged 40 years and above. High velocity injuries type IV to VI was encountered in 23 patients (33.1%) aged between 18 to 29 years and in 19 patients (27.3%) aged 40 years and above.

Table 2: Distribution of Classification of fracture and definitive treatment (n=69)

Variable	Definitive treatment	
	Conservative	**Surgical**
Type I	10 (34.5%)	0 (0.0%)
Type II	8 (27.6%)	7 (17.5%)
Type III	0 (0.0%)	2 (5.0%)
Type IV	3 (10.3%)	9 (22.5%)
Type V	2 (6.9%)	5 (12.5%)
Type VI	6 (20.7%)	17 (42.5%)
Total	**29 (100.0%)**	**40 (100.0%)**

P value = 0.001

During the study period 29 patients (42%) were treated conservatively while 40 patients (58%) were treated surgically. The low velocity injury, type I to III who were treated conservatively were 18 (26.1%) while in surgically treated patients they were 9 (13%). Patients with high velocity injury, type IV to VI who were treated conservatively were 11 (15.9%) while those who were treated surgically were 31 (44.9%). **(Table 2).**

The duration of initial treatment before surgery was more than 14 days in 19 patients (47.5%), less than 7days in 13 patients (32.5%) and between 7 and 14 days in 8 patients. Post surgical hospital stay was 2 to 5 days in 30 patients (75%) less than 2 days and more than 5 days in 8 patients (20%) and 2 patients (5%) respectively.

Table 3: Knee flexion, definitive treatment and type of fracture (n=69).

Variable	Knee flexion at 16th week		
	<90	**91-110**	**111-135**
Definitive treatment given			
Conservative	11 (15.9%)	1 (1.4%)	17 (24.6%)
Surgical	10 (14.5%)	4 (5.8%)	26 (37.7%)
Classification of fracture			
Type I	0 (0%)	0 (0%)	10 (14.5%)
Type II	1 (1.4%)	1 (1.4%)	13 (18.8%)
Type III	0 (0%)	1 (1.4%)	1 (1.4%)
Type IV	3 (4.3%)	2 (2.9%)	7 (10.1%)
Type V	4 (5.8%)	0 (0%)	3 (4.3%)
Type VI	13 (18.8%)	1 (1.4%)	9 (13.0%)

Knee flexion between 111 to 135 degrees were encountered in 17 patients (58.6%) who were treated conservatively and in 26 patients (65%) in surgically treated patients. Flexion of 91 to 110 degrees was encountered in only 1 patient (3.5%) in conservatively treated patients and in 4 patients (10%) in surgically treated patients. Less than 90 degrees flexion was encountered in 11 patients (37.9%) in conservatively treated patients and in 10 patients (25%) in surgically treated patients. Based on type of fracture, 24 patients (34.8%) had a knee flexion of 111 to 135 degrees in low velocity injury and 19 patients (27.5%) in high velocity injury. Knee flexion of 91 to 110 degrees was found in 2 patients (2.9%) with low velocity injury and in 3 patients (4.3%) with high velocity injury. Knee flexion of less than 90 degrees were found in I patient (1.4%) with low velocity injury and in 20 patients (29%) with high velocity injury. **(Table 3).**

Table 4: Post treatment patients follow up (n=69)

Variable	Type of fracture		
	Open	**Closed**	**P value**
Status of the wound (n=40)			
No infection	5 (83.3%)	30 (88.2%)	0.738
Infection	1 (16.7%)	4 (11.8%)	-
Pain assessments on weight bearing			
No limitation	26 (89.7%)	37 (92.5%)	
Mild limitation	1 (3.4%)	1 (2.5%)	
Severe limitation	2 (6.9%)	2 (5.0%)	0.918
Fracture healing			
Yes	27 (93.1%)	38 (95%)	
No	2 (6.9%)	2 (5.0%)	0.739
Knee stability			
Stable	28 (96.6%)	38 (95.0%)	
Unstable	1 (3.4%)	2 (5.0%)	0.755

Infection

During the study period, 5 patients (12.5%) among 40 patients who were treated surgically developed deep infection. One patient (16.7%) out of 6 patients with open fractures developed infection while 4 patients (11.8%) out of 34 patients with closed fractures developed infection. The infection between open fractures and closed fracture was not statistically significant (P value = 0.738). Implants removal, surgical debridement and intravenously antibiotics were given to 3 patients and 2 patients were still waiting for such type of treatment. One patient had non union.

Pain on weight bearing

At 16^{th} week of follow up 26 patients (89.7%) among 29 patients who were treated conservatively had no limitation on weight bearing while 37 patients (92.5%) among 40 patients who were treated surgically had no limitation on weight bearing. 1 patient (3.4%) had mild limitation on weight bearing among conservatively and 1(2.5%) among surgically treated patients. In severe limitation on weight bearing, 2 patients (6.9%) were in conservatively treated group and 2 patients (2.5%) encountered in surgically treated patients.

Fracture healing

At 16^{th} week of follow up 27 patients (93.1%) among 29 patients who were treated conservatively had their fracture united while 38 patients (95%) among 40 patients who were treated surgically had their fractures united. 2 patients (6.9%) in conservatively treated patients had their fractures not united and 2 patients (5%) in surgically treated patients had their fractures not united they were considered as delayed union.

Knee stability

At 16th week of follow up 28 patients (96.6%) among 29 patients who were treated conservatively had no knee instability while 38 patients (95%) among 40 patients who were treated surgically had no knee instability. In conservatively treated patients 1 patient (3.4%) had knee instability and in surgically treated patients 2 (5%) patients had knee instability.

Time from treatment to full weight bearing

During the study period, 16 patients (55.2%) among 29 conservatively treated patients started full weight bearing between 6th and 12th week while 13 patients (32.5%) among 40 surgically treated patients started full weight bearing during the same period. Those who started full weight bearing after 12th week in conservatively treated patients were 13 patients (44.8%) and 27 patients (67.5%) among surgically treated patients.

CHAPTER FOUR

4.0 DISCUSSION

Tibial plateau fractures continue to be challenging in orthopedics surgery despite many advances in the management of those fractures. Over the past decades, various surgical techniques have been developed and better understanding of soft tissue injuries but still management of these fractures are associated with complications and poor functional outcome. When reviewing previous studies it is apparent that results are reported collectively without regard to severity of the fracture type. This study reported the short term outcome of patients with tibial plateau fractures treated both surgically and conservatively.

In this study the mean age was 39.9 years with age range from 19 to 69 years. Most of the patients were aged between 29 to 39 years and 40 to 50 years which accounted 43.5% and 30% respectively. In a study done by Porter in 1970 he reported average age of 47 years in 68 cases[55]. Similar results were reported by Bowes and Conolly in 1988 where by the average age group was 48 years[56, 57].

This study has a male preponderance which encountered 85.5% male and 14.5% female. Studies done by Bowes and Hohl, Marwah et al and Duvelius and Conolly also showed male preponderance[56,57,58]. The male preponderance might be due to highly involvement of occupational and recreational activities.

Road traffic crash was the commonest cause of injury (79.5%) followed by fall from height (15.9%) and sports (2.9%). Fall from level surface accounted for 1.4%. Hohl reported that RTC was the commonest cause (52%) followed by fall from height (17%) and sports recreational (5%)[9]. Blokker et al in 1984 reported the most common cause of injury were road traffic accident[26]. Similar results were reported by Chaix et al in 1982 whereby 71.6% were due to road traffic crash, 16% were due to fall from height, 12% were due to fall from level surface and 1% were due to sports[59].

In this study, 36 patients sustained injury on the left side and 33 on the right. In a study done by Rasmussen D. S in 1973, 131 patients sustained injury on the right side and 129 on the left side[60].

In this study 10.1% of patients had open fractures. Moore et al in 1987 he reported 6% of patients with open fractures in his study1[11]. The ipsilateral fibula fracture in this study was encountered in 36.2% of all patients. Similar results were reported by Hohl in 1997 where the fibula fractures were between 23% to 76% of patients[9].

All the fractures in this study were classified according to Schatzker Classification. The low velocity injuries, type I to III accounted (39.1%) while high velocity injuries, type IV to VI accounted (60.9%) with maximum being type VI (33.3%) of all patients and least being type III (2.9%) of all patients. These results are contrary to other studies done by Hohl, Lansinger O. and Rasmusen whereby the type II fractures were the commonest[9, 22, 60]. This difference might be due to increase in motorcycle crashes in our setting whereby the lower extremities are injured most[61].

In this study deep infection was encountered in 5 patients (12.5%) among 40 surgically treated patients. Similar results were reported by David P. and Muller KL in USA whereby the infection rate was 8.4% and 11% respectively[35, 40]. Waddel JP he reported infection rate of (2%) [28]. The high infection rate in this study might be due to extensive ORIF as we don't do less invasive stabilization surgery. Also the high rate of infection can be due cross infection because of overcrowding of patients in our wards and mixing septic cases and clean cases.

The overall knee flexion of less than 90 degrees was encountered in 21 patients (30.4%), 11 (37.9%) among conservatively treated patients and 10 (25%) among surgically treated patients. This problem was common in high velocity injury (type IV to VI) whereby 20 patients (29%) had knee flexion of less than 90 degrees. This results were contrary to those reported by P. Gaston where by the overall knee flexion of less than 100 degrees were (12

%)[47]. The difference might be due to lack of regular physiotherapy in this setting and severity of injury which cause delay in starting the knee joint motion.

At 16th week of follow up 27 patients (93.1%) among 29 patients who were treated conservatively had their fracture united while 38 patients (95%) among 40 patients who were treated surgically had their fractures united. 2 patients (6.9%) in conservatively treated patients had their fractures not united and 2 patients (5%) in surgically treated patients had their fractures not united they were considered as delayed union. Bal GK et al reported mean time for fracture union at 20 weeks[62]. George C Babis reported average time of 3.4 months for fracture healing[2]. The variation might be due to fracture type, pattern and associated soft tissue injury.

In severe limitation on weight bearing, 2 patients (6.9%) were in conservatively treated group and 2 patients (2.5%) encountered in surgically treated patients.

The stable knee joint at 16th week was found in 28 patients (96.6%) in conservatively treated patients and 38 patients (95%) in surgically treated patients. 1 patient (3.4%) had unstable knee joint among conservatively treated patient and 2 patients (5%) in surgically treated patients. George C. Babis reported 78.8% stable knee[2].

During the study period, 16 patients (55.2%) among 29 conservatively treated patients started full weight bearing between 6th and 12th week while 13 patients (32.5%) among 40 surgically treated patients started full weight bearing during the same period. Those who started full weight bearing after 12th week in conservatively treated patients were 13 patients (44.8%) and 27 patients (67.5%) among surgically treated patients. The contrary results were reported by Zahid M et al where by the time from surgery to full weight bearing was 16 weeks[63]. The difference might be due to severity of fracture and mode of treatment

4.1 Study Limitations

1. The follow up time was limited to 16 weeks, which was not adequate to fully assess the treatment outcome.
2. Some of the patients were lost to follow up.
3. It was difficult to compare the results of this study with other studies because many studies use the functional assessments score and reported the results as either excellent, good or poor.

CHAPTER FIVE

5.0 CONCLUSION

The correct method of treatment of tibial plateau fractures depends on good clinical judgment. If rational treatment is to be instituted, it must be individualized with respect to each patient's age, level of activity, extent of fracture comminution, joint impaction, and associated soft tissue injury. The surgeon must have sound knowledge of the personality of the injury and a clear understanding of the knee joint examination, imaging studies and must be familiar with variety of techniques available at present for treating tibial plateau fractures. The conclusions of this study are;

1. Most of the affected patients aged between 29 and 50 years.
2. Males were affected more than female with male to female ratio 5.9:1.
3. The commonest common cause of injury was road traffic crash.
4. Most of the patients were residents of Dar es Salaam.
5. High velocity injury was common than low velocity injury with type VI being the commonest.
6. Infection was the common complication in surgically treated patients.
7. Good results in terms of knee joint flexion, stability, fracture union and ability to bear weight without pain were seen in both conservatively and surgically treated patients.
8. Knee stiffness (flexion less than 90 degrees) was common among patients with high velocity injury. (Type IV to VI).

5.1 RECOMMENDATIONS

Both surgical and conservative modes of treatment are effective in the treatment of tibial plateau fractures. In this study, good results in terms of knee flexion, stability, fracture union and ability to bear weight without pain were seen in both modes of treatment.

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APPENCIES

Appendix I: Consent Form (English)

Title: Short term outcome of patients with tibial plateau fractures treated at MOI 2012.

Dear Sir/Madam

Greetings;

My name is Dr Frank John, a resident in the department of Orthopaedics and Traumatology at Muhimbili University of Health and Allied Sciences. I would like to conduct the study above as a necessary requirement for fulfillment of my postgraduate studies.

Purpose

The purpose of the study is to determine the short term outcome of patients with tibial plateau fractures treated at MOI 2012**.**

This study requires you to participate so that important information can be obtained from you regarding these injuries.

Confidentiality:

All information collected on questionnaires will be entered into computer with identification number. The questionnaires will be handled with greater secrecy in order to maintain confidentiality.

Risk:

There will be no risk associated with this study.

Participation

Your participation in this study is voluntary and therefore any decision you make will be respected. If you agree to participate in the study, you will be interviewed. If you choose not to participate in the study, you will continue to receive all services that are normally provided in our institute.

If you have any question about the study, you can contact Dr Frank John 0754668426 and Dr Anthony Assey 0754377767, Department of Orthopaedics and Traumatology, MUHAS. If you have questions about your rights as a participant, you may contact Professor E. F. Lyamuya, Director of MUHAS Research and Publications Committee. P.O.BOX **65001 Dar es Salaam.**

Do you agree?

Participant agrees…….. Participant does NOT agree……

I, _____have read/been told of the contents of this form and understood its meaning; hence, I do agree to participate in this study.

Signature_____ (Participant), Date_____

Signature_____ (Researcher), Date_____

Appendix II: Consent Form (Swahili)

FOMU YA RIDHAA (TOLEO LA KISWAHILI)

Utafiti kuhusu vitu vinavyosababisha na jinsi sehemu ya juu ya mfupa wa ugoko katika goti unavvyovunjika, matibabu na matokeo ya muda mfupi baada ya tiba kwa wagonjwa wanaotibiwa katika taasisi ya mifupa ya Muhimbili.

Salaaam!

Mimi naitwa Dr Frank John ni mwanafunzi wa udhamili Chuo Kikuu cha Sayansi za Afya Muhimbili, idara ya magonjwa ya mifupa na majeraha. Ninafanya utafiti huu kama hitaji la lazima ili niweze kumaliza masomo yangu. Pia matokeo ya utafiti huu yatasaidia kufahamu kwa undani zaidi kuhusu tatizo hili ha hivyo kuboresha zaidi tiba yake.

Jinsi ya kushiriki

Kama utakubali kushiriki katika utafiti huu, nitakuhoji maswali machache kuhusu ulivyopata tatizo na maswali mengine yanayohusu jamii kama vile umri, jinsia, kazi na kadhalika. Pia baada ya tiba na kuruhusiwa nyumbani nitakufuatilia katika idara ya wagonjwa wa n je kwa kipindi cha wiki 16 toka ulipopata tiba ili kujua maendeleo yako.

Madhara/usiri

Hakuna madhara yoyote yanayotegemewa kutokana na utafiti huu.Taarifa za ugonjwa wako zitatunzwa kwa kutumia herufi maalum ili kuwa na usiri.

Uhuru wa kushiriki ;

Kushiriki kwenye utafiti ni hiari yako.

Unaweza kujitoa wakati wowote. Kama utachagua kutoshiriki, utaendelea kupata huduma kama kawaida hapa hospitalini.

Faida ya utafiti

Ukishiriki kwenye utafiti huu , utapata fursa ya kufahamu kwa undani ukubwa wa tatizo, aina mbalimbali za tiba, pamoja na matokeo baada ya tiba. Pia utapata ushauri wa kitaalamu kwa kipindi chote cha utafiti muda wowote unapohitaji.

Taarifa

Kuna kamati ya kusimamia udhibiti wa utafiti huu.

Endapo unahitaji kupata maelezo kuhusu haki zako au taarifa ,wasiliana na Dr Frank John, 0754668426 au Dr Anthony Assey wa chuo kikuu cha Afya na tiba Muhimbili na taasisi ya mifupa muhimbili. Kama unaswli lolote kuhusu haki yako kama mshiriki wasiliana na Professor E. F. Lyamuya, ambaye ni mkurugenzi wa bodi ya utafiti chuo kikuu cha Afya na Tiba Muhimbili, kwa S.L.P **65001 Dar es Salaam**

Baada ya maelezo hayo , Je unakubali kushiriki kwenye utafiti? (weka alama) ya vema, Ndiyo.....Hapana.....

Mimi ....., nimeelezwa na nimesoma maelezo

haya. Maswali yangu yamejibiwa.

Nimekubali kushiriki katika utafiti huu.

Sahihi ya mtafiti..... Tarehe…….

Sahihi ya Mtafiti ..... . Tarehe……

Appendix III: Questionnaire

Pre operative evaluation

1. Name of the patient.....
2. Hospital Registration Number.....
3. Age.....
4. Sex: M.....F……
5. Residence ……
6. Date of injury...../...../…..
7. Date of consultation/admission at MOI …. /……/……..
8. Cause of injury :(1) RTA (2) Fall from level surface (3) Fall from height (4) Sports (5) Others……. (Specify)

Clinical characteristics

9. Side involved (1)Right (2)Left (3)Both
10. Fracture type (1)Closed (Open)
11. Associated injuries (1)None (2)Fibula (3)Patella (4)Neurovascular (5)Pelvis (6)Spine (7)Metatarsal/foot (8)Others……..(Specify)

Radiological findings

12. Classification of the fracture according to Schatzker's Classification (1) Type I (2) Type II (3)) Type III (4)) Type IV (5) Type V (6) Type VI
13. Depression (1)Yes (2)No
14. Displacement (1)Yes (2)No

Treatment

15. Definitive treatment given (1)Conservative (2)Surgical (If surgical go to question number 19)

16. If conservative (1)Closed reduction with POP (2)Traction (3)Hinged brace (4)Others…..(Specify)
17. Duration of conservative treatment (1)4 weeks (2)4 to 6 weeks (3)More than 4 weeks
18. If surgical treatment (1)ORIF with screws (2)ORIF with plate (3)Screws and EF (4)EF (5)Others……..(Specify)
19. Initial treatment given before surgery (1)Backslab pop (2)Calcaneal traction (3)Skin traction (4)EF (ligamentotaxis) (5)Others…….(Specify)
20. Duration of initial treatment (1)Less than 7 days (2)7 to 14 days (3)More than 14 days

Post treatment Evaluation

21. Immediate control X- ray after treatment (1) Good reduction (2) Accepted reduction (3) Poor reduction
22. Days of hospital stay……
23. Post surgical hospital stay……

Post treatment patient follow up

24. Status of the wound:
    a. At 2nd week
    (1)No infection (2) Infection
    b. At 6th week
    (1)No infection (2) Infection
    c. At 12th week
    (1)No infection (2) Infection
    d. At 16th week
    (1)No infection (2) Infection

25. ROM of the knee(flexion)

(1)At 6th week……

(2)At 12th week……..

(3)At 16th week……..

26. Pain assessments on weight bearing

a. At 6th week

(1)No limitation (2) Mild limitation (3) Severe limitation

b. At 12th week

(1)No limitation (2) Mild limitation (3) Severe limitation

c. At 16th week

(1)No limitation (2) Mild limitation (3) Severe limitation

27. Reduction:

a. At 6th week

(1) Maintained (2) Lost

b. At 12th week

(1) Maintained (2) Lost

c. At 16th week

(1) Maintained (2) Lost

28. Fracture healing

a. At 6th week

(1)Yes (2) No

b. At 12th week

(1)Yes (2) No

c. At 16th week

(1)Yes (2) No

29. Knee stability at 16th week (1) Stable (2) Unstable

30. Time from surgery to full weight bearing (1) less than 6 weeks (2)6 weeks to 12 weeks (3) More than 12 weeks