EARLY TREATMENT OUTCOMES OF PATIENTS WITH IPSILATERAL FRACTURE OF FEMUR AND TIBIA AS MANAGED AT MUHIMBILI ORTHOPEADIC INSTITUTE

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EARLY TREATMENT OUTCOMES OF PATIENTS WITH IPSILATERAL FRACTURE OF FEMUR AND TIBIA AS MANAGED AT MUHIMBILI ORTHOPEADIC INSTITUTE

By

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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 titled; **"Early treatment outcome of patients with ipsilateral femur and tibia fractures as managed at Muhimbili Orthopaedic Institute "** in partial fulfillment of the requirements for the award of the degree of Master of Medicine in Orthopaedics and Trauma of the Muhimbili University of Health and Allied Sciences.

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Dr. Robert I. Mhina

Supervisor

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Date

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Dr. Billy T. Haonga

Co-supervisor

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Date

DECLARATION AND COPYRIGHT

I, **Magdalena T. Mbeyale**, declare that, this **dissertation** is my own original work and that it has not been submitted and will not be submitted to any other University for similar or any other degree award.

Signature……..... Date…….....

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DEDICATION

This dissertation is dedicated to my beloved daughter Karen and my late father Timothy Lupyana Mbeyale.

ABSTRACT

Introduction: Floating knees are rare fractures occurring in long bones involving ipsilateral fracture of the femur and tibia; Floating knee injuries may include a combination of diaphyseal, metaphyseal, and intra-articular fractures. They are complex fractures caused by high energy trauma mostly associated with other significant injuries.

Objectives: The objective of this study was to evaluate the causes of injury, fracture pattern, treatment modality and functional outcomes of floating knee injury patients at Muhimbili Orthopaedic Institute (MOI) – Dar es Salaam from March 2014 to Feb 2015.

Methodology: This was a hospital based descriptive prospective study done to patients aged 15 years and above who presented with floating knee injuries at MOI between March 2014 and February 2015. A structured questionnaire to collect data from the participants was used, clinical and radiological evaluations were done to classify the fracture patterns. The patients were followed-up post-operatively at the 2nd, 6th, 12th and 18th week. Each patient was followed up for a minimum of 18 weeks and their functional outcomes scored using the Karlstrom and Olerud criteria. The data was analyzed by SPSS version 2.0.

Results: A total of 44 patients with floating knee injuries were enrolled. Males were 41 (93.2%) and females 3(6.8%) giving an M:F ratio of 13.7:1 and mean age of (33.05±11.23) years.

Motor traffic crash was the most common cause of injury 42(95.4%) in which Motorcyclists were mostly affected 20(47.6%). Fraser type I was the most common type accounting for 29(65.9%).Type IIA accounted for 3(6.8%), type IIB 7 (15.7%) and IIC 5(11.4%).75% had open floating knee injuries. Associated injuries were seen in 29(66%) of all floating knee patients with head injury being the most common 14(32%).

Both operative and non-operative management were used either as temporary measure or definitive. Skeletal traction was commonly used in the femur 15(34.1%) as a temporary measure and external fixator in tibia by 23(52.3%). In femur fracture intramedullary nailing were most used as definitive method of treatment in 32 (72.7%), followed by Plaster of Paris

in 6(13.6%), EF in 3(6.8%), plate /screw fixation in 2(4.6%) and one underwent above knee amputation (2.3%).

For the tibia definitive management using Plaster of Paris was most frequently used 22(51.1%), followed by external fixation in 9(20.9%), intramedullary nailing in 7(16.3%) and plate fixation in 3(7%). Two patients underwent below knee amputation and one were loss to follow up. The functional outcomes of the patients with floating knee injuries using Karlström and Olerud criteria found excellent in 5(12.5%), good in 15(37.5 %), acceptable in 8(20%) and poor in 12 (30%).

Conclusion

Floating knee injuries are complex fractures and are commonly due to high energy trauma. Young active males were the most affected. Motor traffic crash was the most common cause of injury. Motorcyclists were the most common victims seen. Extra articular fractures were commonly seen and had better functional outcomes compared to intraarticular floating knee injury. Most floating knee injuries were associated with other injuries .Both modes of treatment were used operative and non-operative. Excellent results were seen more in operative treatment than in non-operative treatment.

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ABBREVIATIONS

EF	External fixation
EMD	Emergency Medicine Department
IMN	Intramedullary Nailing
DCS	dynamic condylar screw
IF	Internal fixation
POP	Plaster of Paris
ACL	Anterior cruciate ligament
PCL	Posterior cruciate ligament
MCL	Medial collateral ligament
LCL	Lateral collateral ligament
TT	Tetanus Toxoid
AP	Anteroposterior view of x- ray
ATLS	Advance trauma life support
MMed	Master of Medicine
MOI	Muhimbili Orthopedic Institute
MUHAS	Muhimbili University of Health and Allied Sciences
SPSS	Statistical Package for the Social Science

CHAPTER ONE

1.0 INTRODUCTION

The phrase “floating knee” was first used by Blake and McBryde in 1970’s to define ipsilateral fracture of femur and tibia. It may include metaphyseal, diaphyseal or intra articular knee fractures[1]. This complex injury has increased in proportion to population growth, number of motor vehicle on the road and high speed traffic. It’s a serious injury caused by high energy trauma, producing severe musculoskeletal and other associated injuries. Most of these injuries result in high morbidity and permanent disability.[2, 3]

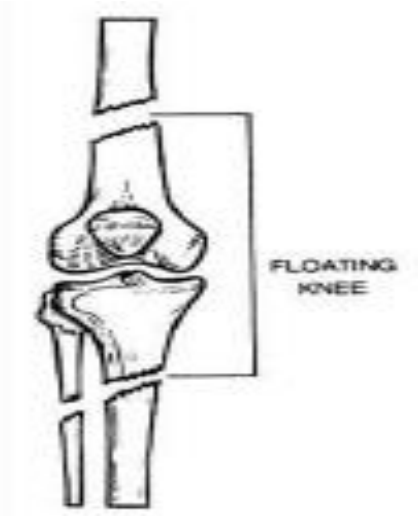


Figure 1.1: Drawing depicting a typical pattern of floating knee

Commonly used classifications of floating knee injuries include:

1. Fraser’s Classification
2. Blake and McBryde’s Classification
3. Letts classification
4. AO classification

With regard to soft tissue injury, floating knees can also be classified as open or closed fractures. For open injuries Gustilo-Anderson classification was used.

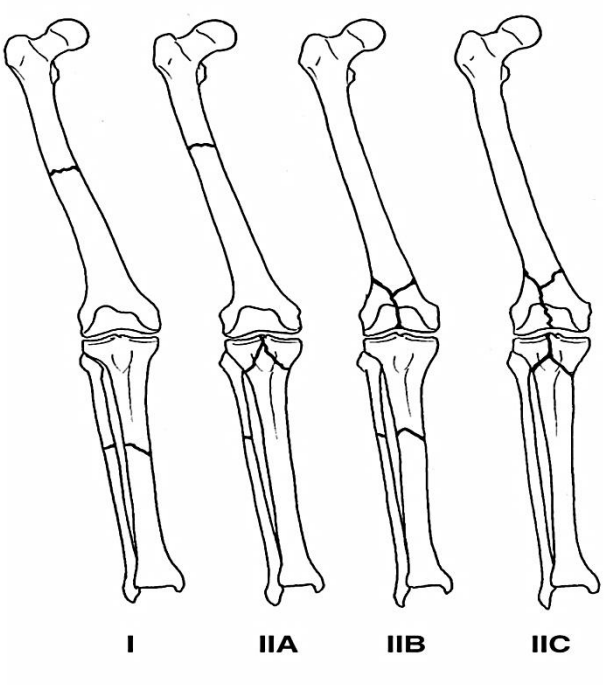


Figure 1.2: Description of Fraser classification

Adapted from Fraser RD, Hunter GA, Waddell JP.

J Bones joint surg Br 1978, 60:510-515

Fraser classification was used in this study. Type I fractures are extra-articular. Type II fractures are classified according to the knee injury: type IIA injuries are characterized by a tibial plateau fracture and an ipsilateral femoral shaft fracture; type IIB, by an intra-articular distal femoral Fracture and a tibial shaft fracture; type IIC, by ipsilateral intra-articular fractures of both the tibial plateau and the distal femur.

A Pilot study done at MOI- 2013 found that, floating knee injuries comprised of 0.9% of all lower limb injuries with all patients requiring admission.

Floating knee injuries are usually associated with life threatening injuries such as head injury, chest injury and abdominal injuries. Other skeletal injuries are also common.[4]

Soft tissue injuries can also range from minor abrasions to grade III open fractures. Neurovascular injuries may also occur. These associated injuries have greater influence on choose of implant even in the most experienced surgeon during management.

Patients presenting with floating knee injuries should be managed as polytrauma patients. Therefore ATLS protocols should be followed, and injuries to other organ systems should be identified and treated promptly. X- Ray of the chest, pelvis and cervical spine should be part of the routine evaluation. The affected extremity should be carefully examined and findings documented.

The definitive treatment can be either non-operative or operative. Non-operative management can be achieved through casting and skin or skeletal traction. The non-operative modality may be acceptable in patients with non-displaced tibial fractures. Current recommended treatment is surgical fixation of both femur and tibia. Methods of surgical stabilization are individualized for the specific type of floating knee injuries. Each fracture depends on the pattern, soft tissue status, associated injuries, and preferences of the surgeon. The definitive treatment includes early and thorough debridement of the wound in case of open fractures, accurate reduction of intraarticular fractures and reduction of dislocations, stabilization of fractures with appropriate implants, concurrent management of neurovascular injury, primary or delayed primary closure of wounds and appropriate soft tissue cover, early mobilization of the knee joint and introduction of the functional activities of the lower limb as a whole.

The implant of choice in case of operative management can be plate and screw fixation, intramedullary nail and external fixation. Each treatment modality and choice of implant has different functional outcome which must be put into consideration when choosing the treatment modality[5].

The main objective of this study is to determine early treatment outcome of floating knee injury patients managed at Muhimbili Orthopedic Institute from March 2014 to February 2015

1.1 Literature Review

Epidemiology

There is little recorded in the literature on the subject of ipsilateral fracture of the femur and tibia, a severe injury which appears to be increasing in frequency. Earlier papers have pointed out the high risk of complications and of permanent disability.[1]

Floating knees occur commonly in active young people who are responsible economically and socially to the society. A study done by Kumar et al recruited 40 cases in a period of about 10 years. Among those cases, 63% were young people below 30 years of age and males were 9 times more involved than females.[6]

The largest study to be reported in the literature is that of 222 patients over 11 years in 13 hospitals of Ontario and Quebec (Canada) by Waddell et al. The largest population injured was below 25 years of age and the male to female ratio was 4:1[7].

A study done by Elmrini et al in Morocco over 8 years, reported 18 cases with a mean age of 35 years and male predominance at a ratio of 5:1[8]

Mechanism of Injury

Floating knee injuries are commonly due to high energy trauma and mostly present as complex injuries or polytrauma patients. The force required to fracture two of the strongest bones in the body is immense and road traffic crashes accounts for most of the cases of floating knee injuries followed by falls from heights .[2]

Anastopoulos et al conducted a study on ipsilateral femur and tibia fractures and all cases were due to road traffic accidents[9]. Hagazy et al found that 94% of floating knee injuries involved was due to motor traffic accidents and 6% sustained injuries by falling from heights[10].

A study done in Iran showed that in 17.3% of floating knee injuries were car to pedestrian accident, 48.2% were car to motorcycles accident, 26.8% were car to car accident, 4.5% were motorcycles to pedestrian accident, and 3.2% were due to other causes[11].

Associated Injuries

Most cases of floating knee injuries presented as polytrauma cases. Others associated with other significant injuries were head injury, chest injury, abdominal injury and other extremity injuries which are mostly life threatening.[18,19] Studies show that floating knee injuries when associated with other injuries have mortality rate ranging from 5% to 15%[4].

These patients present hemodynamically unstable and therefore need close monitoring and resuscitation during initial assessment.

Rethnam et al in their study had 29 floating knee cases and a total of 38 associated injuries. The investigators strongly found a strong relationship between the presences of these associated injuries in delaying surgical management, rehabilitation and dictating the outcome[19].

A Study done by Adamson and others revealed that associated injuries, such as head injuries, chest injuries, abdominal injuries and injuries to the other extremities are mostly life threatening. In their study 71% had major associated injuries, open fractures occurred in 62 % of all cases, with 21% associated vascular injuries and 3(9%) had amputation [20.]

Hegazy et al insisted that a deliberate and careful examination of the patient must be carried out to determine major intracranial, abdominal or thoracic injury if is present. Such injuries should take precedence over extremity injuries in the priority of treatment.[10]

Rethnam et al did a study in floating knee injuries covering epidemiology, prognostic indications and outcome following surgical management. This study included 29 patients with floating knee injuries. The study concluded that the associated injuries and the type of fracture (open, intra-articular, comminution) are the prognostic indicators in the outcome. Therefore thorough initial assessment, prompt management and early rehabilitation are crucial determinants for better outcome. The associated injuries played a major role in the initial outcome of patients with regard to a delay in initial surgery, prolonged duration of surgery, anesthetic exposure and a delay in rehabilitation. [2, 11, 19]

Szalay et al reported knee ligament laxity in 53% of patients with floating knee injuries, whereas 18% complained of instability and most patients with instability had a rupture of the anterior cruciate ligament with or without damage to the other ligaments (PCL, MCL and

LCL). They concluded that a knee ligament injury was more common with floating knee injuries than with isolated femoral fractures, and advocated careful assessment of the knee in all cases of fractures of the femur and floating knee injuries.[21]

Classification

Fraser classification was used in this study. It has Fraser type I for extra articular and II for intraarticular floating knee fractures. This makes easier for researcher to describe fracture pattern but in clinical management soft tissue injury has to be considered .Hence Gustilo-Anderson were used for open fractures.[12]

Dwyer et al reported femoral fractures mostly were closed accounted for 70% while tibia majority were open fractures by 63.33% and the right extremity to be more commonly involved 58.33%.[13]

Study done by Vidyadhara et al reported the incidence of open fractures was high, approaching 50-70%, at one or both fractures sites in floating knee injuries. The most common combination being closed femoral fracture with an open tibial fracture.[14, 15]

In a study done by Hegazy et al, the Fraser classification was used, 5 type I, 3 type IIa, 4 type IIb and 3 IIc, 2 had open floating knee in tibia others were closed fractures, and the best results were seen in type I fractures[10].

In the Pietu et al study found that, the fracture pattern were as follows, 71.5% had Fraser type I, Fraser type IIa 8.2%, IIa 11.6% and IIa 8.7% and at least one of the fractures had open in 69.2% of floating knee injuries.[16]

In a study by Abalo et al on 43 patients with floating knee injuries, the results showed according to Fraser classification ,21 type I,10 type IIa,7 type IIb and 5 type IIc respectively.[17]

Treatment and Outcome

Patients with floating knee injuries should be managed as polytrauma and the involvement of other systems should be strongly suspected. Assessment and treatment of these patients should follow the ATLS protocol. Therefore a thorough primary survey, resuscitation and splinting of the affected limb, followed by secondary survey should be performed. When the patient is

stable, the definitive treatment should be according to fracture patterns, soft tissue injuries and their associated injuries.[12, 19]

Early joint mobilization is a key to success. Early weight bearing may be helpful in patients with diaphyseal fracture and delay in weight bearing is preferred for those with intraarticular or metaphyseal fracture .[14]

The patients should be observed closely for the development of fat embolism as clinically indicated by presence of tachypnea, confusion, and tachycardia. If fat embolism is diagnosed, the patients should be managed in the surgical intensive care and surgical fixation of the fractures should be postponed. A patient with associated chest injuries, head injuries or abdominal injuries has to be managed appropriately before surgical stabilization of the fractures. Once the vital functions are stable, definitive management can be conducted.[10]

In the 1960's and 1970's, treatment of floating knee injuries was non-operative mostly by skeletal traction and plaster of Paris. Comminuted fractures involving the joints became a real challenge and invariably ended up painful, stiff with significant joint function loss. The challenge to keep fracture aligned and the complications inherent from the long period of bed rest contributed to catastrophic clinical outcomes.[1,3]

In a study done by Blake and McBryde in 47 patients, non-operative treatment was the main means of treatment. 26 femora in 37 patients of floating knee injuries were treated non-operatively together with all tibia. They ended up with poor results. Half of all cases had to undergo surgery and the majority had permanent functional impairment[1].

Studying floating knee injuries, Fraser et al had 56% of femoral fractures and 75% of tibia fractures treated non-operatively. Assessment of the results using the Karlstrom and Olerud criteria, revealed 28% had excellent or good outcome, 48% acceptable and 24% poor. The worst were seen more in non-operative treatment of both fractures.[7]

Karlstrom and Olerud reported 32 patients with floating knee injuries, 14 patients were treated by IF or EF for both fractures. 3 patients had IF or EF of one fracture and non-operative treatment of other fracture. 15 patients underwent non-operative management for both fractures. The patients treated operatively for both fractures had a lower incidence of complications, shorter duration of hospitalization and shorter time to healing. Those who

underwent surgery produced considerably better functional results.59% had excellent to good, 26% acceptable, and 15 % poor functional outcomes. 12 of 14 patients treated surgically, resumed their former occupations compared with 4 of 13 patients treated non-operatively[22].

In a study done by Dwyer et al patients treated with different modalities were followed up. They observed that using combined modalities of treatment is an affordable, practicable and effective approach, especially for a low resource-poor environment. EF of the fractured femur resulted in a decreased range of movement at the knee due to quadriceps muscle fixation. Fractured tibia, treated by any of the method, did not interfere with patient's joint mobilization whereas associated injuries did[13].

Study done in Egypt by Hegazy et al femur were treated with IMN in 8 cases (type I:5 and IIa 3), plate/screw in 2 cases (type IIb:1 and type IIc:1), dynamic condylar screw in 5 cases(type IIb:3 and IIc:2). Tibia fractures were treated with an EF in 2 cases, plate/screw in 5 cases (typeIIa:2 and type IIc:3) and IMN in 8 cases(type I :4 and type IIb: 4).The best results were obtained to the fractures treated by intramedullary nailing. These patients returned to their normal level of activities earlier than when the fractures were treated with other modalities. Tibia fractures treated with external fixation had a longer union time, which is related to the soft tissue injury and comminution at the initial injury[10].

Veith et al reported on 57 patients. 56 of those with femoral fractures and half of the tibial fractures were treated with IF. These included open fractures. An overall good or excellent functional result was achieved in about 80 % of the patients. The best results were achieved when both fractures were stabilized surgically[4].

Van Raay reported a 31% incidence of ligament injuries in 47 floating knee injury patients.[18] Disruption of knee ligaments had not been recognized initially and injury to the knee ligaments had been diagnosed in 3 patients. Upon stabilization of both fractures followed by ACL reconstruction, knee stability was attained. It was concluded that there is a high incidence of missed ligamentous injuries. The possibility of disruption of the knee ligaments should be considered in all patients with fractures of both femur and tibia. Early surgical repair of peripheral tears of the meniscus should be done.[18]

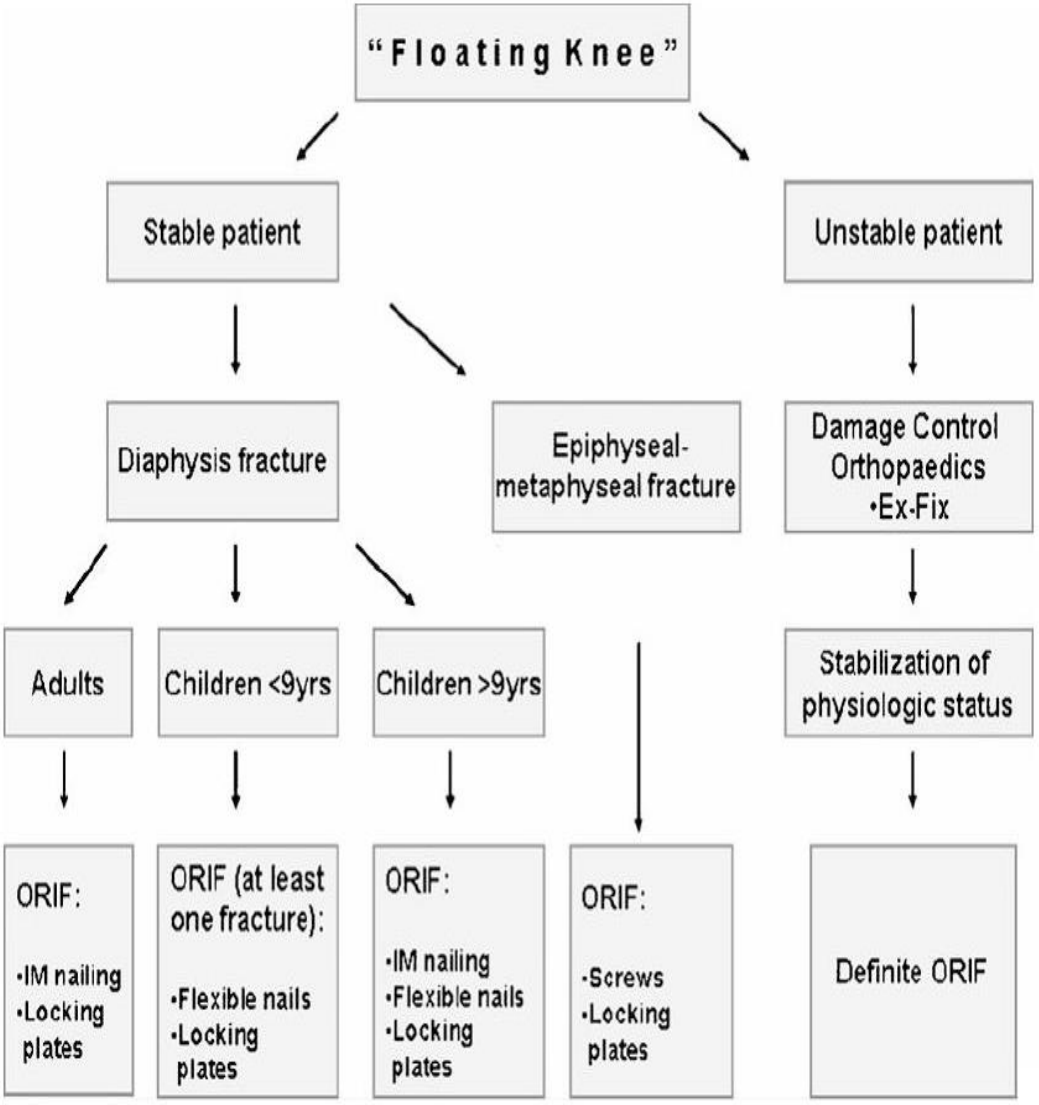
In a retrospective descriptive study done by Nouraei et al, in Iran 70% of the treatment modality used was surgical with 35.9% being managed by plate and screw for distal femur and proximal tibia, IMN was used in 34.1%, EF in 11.8% and hybrid fixation in 5% of the cases. Skeletal traction and casting were applied in 12.3% and 0.9% needed amputation.[11]

Arslan et al used different methods of treatment, Femur fractures were treated by locked IM nailing, AO plates, plate-screws, EF, or DCS, and tibia fractures by EF, plate-screws, locked IM nailing, or with conservative methods. Amputation at the fracture level was required in a patient with type 3C open tibia fracture; Results were excellent in 3 patients, good in 9 patients, acceptable in 5 patients, and poor in 6 patients.[23]

Most surgeons currently recommend aggressive treatment with early anatomical reconstruction of both fractures, integrated with a multisystem approach that emphasizes early mobilization of the patient to facilitate better care and quicker recovery.[2, 3, 8,13,24,25]

Some authors however have reported that the complications and mortality rates of patients of floating knee remains high regardless of the treatment regimen used[15]

Figure 1.3: ATLS management protocol for floating knee injuries [14].



1.2 Problem Statement

Floating knee injuries occurred in a significantly large number of patients seen at MOI. The number of patients is expected to increase following the use of motorcycles as a means of transport. These injuries mostly affect the productive age group. The injuries are severe and therefore pose challenges while managing them. Little is known regarding the magnitude of this problem in our set up, the common fracture patterns, modality of treatment commonly used and functional outcomes of the treatment of floating knees.

There was no published data documenting on floating knee injury and their burden. No retrievable data available that assess efficiency and management of these injuries and outcomes to MOI and Tanzania in large.

1.3 Rationale

Globally the incidence of floating knee is low. There is paucity of data on floating knee in Tanzania but the records of 2013 from MOI suggest that floating knee is not as uncommon (0.9%) as thought.

This study will help setup baseline information to fill the gap of knowledge about main causes floating knee injuries, patterns and morphology, their modality of treatment and results. This will in turn lay a foundation for research, intervention and to standardization of the management of floating knee injuries.

Finally, this study will help to improve floating knee management and hence reduce complications. It will also help to identify modifiable factors affecting functional results and eventually enable MOI to draft a floating knee treatment protocol.

1.4 Research Questions

1. What's the burden of floating knee at MOI?
2. What are the common mechanisms of injuries of floating knee in patients treated at MOI?
3. What are the modes of treatment and functional outcomes of floating knee patients treated at MOI?

1.5 Objectives of the Study

1.5.1 Broad Objective

To determine early treatment outcome of floating knee injuries as managed at Muhimbili Orthopedic Institute from March 2014 to February 2015.

1.5.2 Specific Objectives

i. To determine the mechanism of injury of patients with floating knee injury
ii. To determine the common fracture patterns of patients with floating knee injury
iii. To determine associated injuries to patients with floating knee injury
iv. To determine modes of treatment of patients with floating knee injury
v. To determine functional outcomes of patients with floating knee injury as treated at MOI from March from 2014 to February 2015.

CHAPTER TWO

2.0 METHODOLOGY

2.1 Study Design

This was hospital based descriptive prospective study.

2.2 Study Area

Muhimbili Orthopedics Institute in Dar-es-salaam, Tanzania, which is a specialized institute of Orthopedic, Trauma and Neurosurgical care with a bed capacity of 165 beds, and it is the main referral hospital for patients with skeletal trauma serving Dar es Salaam city and the country at large. The institute is also involved in carrying out research in these fields with a view of improving management of patients.

2.3 Study Population

Included patients aged 15 years and above with ipsilateral fracture of femur and tibia admitted at MOI from March 2014 to Feb 2015.

2.4 Study Period

The study was conducted from March 2014 to February 2015 at Muhimbili Orthopedic Institute, a referral and teaching institution in Dar es Salaam, Tanzania.

2.5 Inclusion Criteria

Included all Patients aged 15 years and above with a diagnosis of ipsilateral fracture of femur and tibia admitted at MOI and have consented to participate in the study, for those below 18 years if parent consent to participate.

2.6 Exclusion Criteria

i. Patient with deformity of at least one limb.eg polio, major joint contracture or amputation prior to these injuries.

2.7 Sample Size Estimation and Sampling Technique

Convenient sampling was used, where patients who met inclusion criteria admitted due to ipsilateral fracture of femur and tibia were requested to participate.

Sample size was estimated by using the following formula

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

Where n= sample size, Z= standard deviation, d= standard error, p= proportion/prevalence

Z= 95% confidence interval =1.96

d= Standard Error = 5%

p = 2.2% (calculated prevalence of floating knee from 2013 data)

Hence:

$$n = (1.96/0.05)^2 x\ 2.2(100-2.2) = 33$$

Hence minimum sample =33 + loss to follow up 15%=37 sample size

All patients who meet criteria presented at MOI during the data collection were included to the study.

Enrollment, Procedures and Follow-up

2.8 Data collection method

Recruitment of patients with ipsilateral fracture of femur and tibia was done after patients arrived at EMD or either traced them in the wards. Participants were asked for their consent to participate in the study and were assured that there were no risks associated with participating in the study.

2.9 Data Collection Tool

Data was obtained by interviewing and examining patients, using a structured Questionnaire prepared by the researcher, questionnaires were used to collect information on socio-demographic characteristic of the patients, mechanism of injuries, modalities of treatment used and functional outcome of the patient.

Preoperative

Initial management involved resuscitation and hemodynamic stabilization of the patient, splinting of the affected limb and a thorough primary and secondary survey which was done at EMD by researcher or the 1st doctor who saw the patient.

Here the social-demographic factor was taken, mechanism of injury and classification of the fracture by Fraser classification for floating knee injuries and Gustilo and Anderson Classification for open fractures was done.

Plain radiographs both Anteroposterior and lateral views and the joint above and joint below were taken pre-operatively in the Radiology Department to determine the fracture configuration.

In those patients with open fractures tetanus immune status was determined. Those who had been immunized within the last 5 years before the injury were not given a TT booster dose. Those who were immunized more than 5 years before the injury were given TT booster dose. Patients who have never been immunized or those who don't remember the time of their last immunization were given TT immunization booster dose and tetanus immunoglobulin.

Operative Procedure

There are no specific guidelines for the management of floating knee cases at MOI. The choice of implant is determined by both the type of fracture and extent of soft tissue injuries. Those with open floating knee fracture were treated by thorough surgical debridement and fixation by either internal fixation (IF) or external fixation (EF). Those with closed floating knee injuries were either fixed one fracture on the same day and then put on traction for surgeries or mobilized with POP as temporary measures or definitive management. These operations were done by MOI staffs on an emergency duty basis or elective.

3rd generation cephalosporin was given during induction of anesthesia, and then continued with the dose according to the level of contamination of the wound.

Post-Operative Care and Follow-up

Immediate post-operative control x-rays were obtained and assessed for alignment and fracture reduction, limb length and rotational deformity.

After being discharged these patients were requested to continue with wound dressing and complete antibiotic as prescribed, and attend follow-up clinic on the 2nd week post-operatively.

2nd week follow-up

During the 2nd visit the wound was assessed and sutures removed, patients with superficial infection were put on oral antibiotics and continued with daily wound dressing, those patients with pin tract infection were advised to clean their pins with either spirit or povidone.

No x-rays were taken during the 2nd week.

6th, 12th and 18th week follow-ups

The patients were then followed-up at 6th 12th and 18th week post treatment, clinical and radiological evaluation was done on limb length and limb rotation or deformity. Function of the limb was assessed at 18 weeks according to Karlstrom criteria for functional outcomes of floating knee injuries.

Patients were scheduled to attend physiotherapy soon after operation, those with deep wound infection were scheduled for surgical debridement, delayed union re-operated as per required and implant failure were removed and new implant were fixed. Those who underwent amputation were advised to attend the orthotic unit for artificial limb.

Measurement of limb length discrepancy

True Limb length discrepancy was determined by comparing the limb length of affected and normal limb.

Measurement of rotation deformity

Lower limb rotational deformities i.e. internal/external rotation was determined clinically and radiological by observing the position of the patella and second toe in regards to the anterior superior iliac spine on the same side.

Measurement of range of knee motion

Assessment of the range of movement was done using a goniometer; assessment of stability of the knee was done by using Lachman's tests, anterior and posterior drawers and stress in varus and valgus after fracture healing.

The functional outcome was assessed using the Karlstrom and Olerud criteria.

Table 1.3 Karlstrom criteria for functional assessment after management of floating knee injuries

Criterion	Excellent	Good	Acceptable	Poor
Symptoms from thigh or leg	None	Intermittent slight symptoms	More severe symptom impairing function	Considerable functional impairment: pain at rest
Symptoms from knee or ankle joint	None	Same as above	Same as above	Same as above
Walking ability	Unimpaired	Same as above	Walking distance restricted	Uses cane, crutch or other support
Work and sports	Same as before	Given up sports; work same as before	Change to less strenuous work	Permanent disability
Angulation, deformity or both	0	< 10 degrees	10 – 20 degrees	> 20 degrees
Shortening	0	< 1 centimeter	1 – 3 centimeters'	> 3 centimeter's
joint mobility	0	< 10 degrees degrees at hip, knee or both	10 – 20 degrees at ankle; 20 – 40 degrees at hip, knee or both	> 20 degrees at ankle; > 40 degrees at hip, knee or both

Rethnam *et al.,* 2009

The standard criteria to assess function outcomes of floating knee patient. For instance, patients had to fulfill all of the excellent criteria to be rated as excellent. Patients were rated as good outcome if they fulfilled all the good or excellent criteria. A fair or acceptable outcome was rated if the patient had at least 1 fair criterion fulfilled, and, no poor criterion. A patient who had 1 poor criterion was considered as a poor outcome.

2.10 Data management and analysis

Data was entered into SPSS version 2.0 and cleaned; Sample characteristics were explored using descriptive statistics. Mean and standard deviation was used for continuous variables Categorical variables were summarized by frequency tables, difference in proportion handled by Chi square. Statistical significance for independent variables was tested. The level of significance was set at 5 %(0.05).

2.11 Ethical Consideration

Ethical clearance was obtained from the ethical clearance committee of MUHAS. Both verbal and written consent were obtained from the respondents. Explanation was given to the respondents on the aim of the study and that all the data obtained to be used for research purpose only. To ensure confidentiality, Respondent's names were not used in the questionnaire. The patients' freedom to participate, refusal to participate and withdrawal from the study without prior information was clearly explained to all participants, and that these acts won't affect their treatment quality.

CHAPTER THREE

3.0 RESULTS

From March 2014 to Feb 2015 a total of 44 patients with floating knee fractures were enrolled into the study after fulfilling the inclusion criteria. They were followed-up for a minimum of 18 weeks.

Table 3.1: Socio-demographic characteristics of the studied population (N=44).

Character	Frequency (n)	Percentage (%)
Age category (years)		
15 to 25	13	29.5
26 to 35	17	38.6
36 to 45	8	18.2
46 to 55	4	9.1
56 and above	2	4.5
Sex		
Male	41	93.2
Female	3	6.8
Residence		
Dar es Salaam	34	77.3
Upcountry	10	22.7
Elapsed time from injury to admission		
Less than 8hrs.	22	50
9 to 24hrs.	16	36.4
>24hrs. to 1 week	5	11.4
More than 1 week	1	2.2
Time of injury to a second operation		
No. 2nd operation done	33	75
>1 week to 2 weeks	1	2.3
>2 weeks to 3 weeks	3	6.8
>3 weeks to 4 weeks	3	6.8
>4 weeks.	4	9.1

A total of 44 patients met the study inclusion criteria. Males were 41(93.2%) and females 3(6.8%) with male to female ratio of 13.7:1.

The age ranged from 17 to 70 years with a mean age of (33.05±11.23) years. The patients who were below 35 years were 68.1%. Most of the patients were from Dar es salaam, 34 (77.3%).

The mean duration of hospital stay were 22.6 ± 23.5 days with minimum days being 1 and maximum being 97 days.

Table 3.2 Causes/mechanism of floating knee injuries treated at MOI

Character	Specific variable	Frequency (n)	Percentage (%)
Causes of injury			
	Motor traffic crush	42	95.4
	Fall from height	1	2.3
	Others	1	2.3
Type of motor traffic crush			
	Motor vehicle	8	19.1
	Motorcycle	34	80.9
Victims			
	Driver	4	9.5
	Passenger	13	31
	Pedestrian	5	11.9
	Motorcyclist	20	47.6

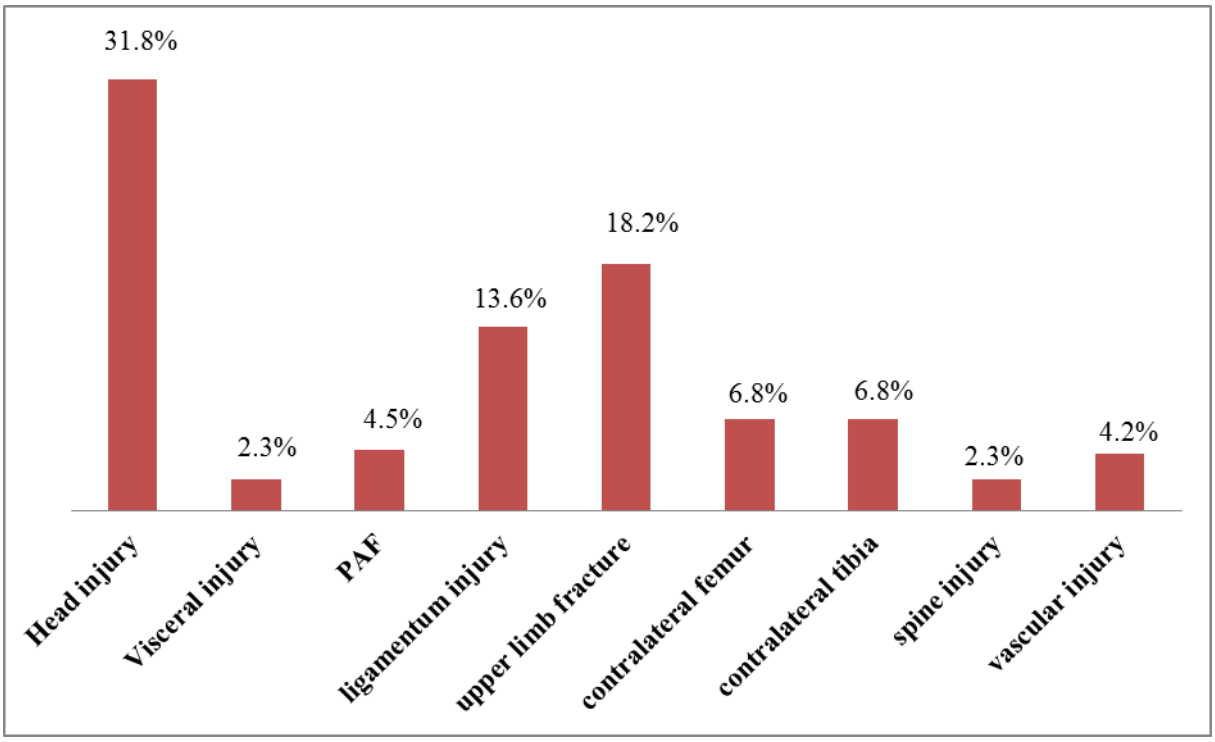
Major causes of injury were motor traffic crush accounted for 95.4% of all patients enrolled in the study, most were due to motorcycles 34(81%) and motorcyclist are the ones that were commonly affected 20(47.6%).

Table 3.3: Fracture pattern in patients with floating knee injury seen.

Character	Specific variable	Frequency (n)	Percentage (%)
Side of floating knee			
	Right	34	77.3
	Left	10	22.7
Fracture pattern (Both)			
	Open	33	75
	Closed	11	25
Fracture of Femur			
	Closed	27	61.4
	Open	17	38.6
Fracture of Tibia			
	Closed	17	38.6
	Open	27	61.4
Gustilo-Anderson classification			
	I	2	6.1
	II	5	15.2
	IIIA	21	63.6
	IIIB	4	12.1
	IIIC	1	3
Floating knee type by Fraser			
	Type I	29	65.9
	Type IIA	3	6.8
	Type IIB	7	15.9
	Type IIC	5	11.4

Right lower limb was dominantly affected accounting for 77.3% , three quarter of floating knee injuries were open fractures , 38.6 % were open femur and 61.4% were open tibia. For those who had open floating knee fracture 63.6% had type IIIA Gustilo-Anderson classification and 3% had type IIIC Gustilo- Anderson classification.

Type 1 Fraser classification was the most common accounting for 65.9%.



**PAF – Pelvic and Acetabular fractures.*

Figure: 4.4. Floating Knee Injuries Associated Other Injuries.

During the study 29 out of 44 patients had associated injuries which is (65.9 %). Head injury was the most observed associated injury which accounted for 32% followed by upper limb fractures 18.2%. Visceral injury and spine injuries were the least observed associated injuries with 2.3% each.

Table: 3.4 Treatment modality used in floating knee injuries at MOI.

Bone involved	Modalities	Temporary (n, %)	Definitive (n, %)
FEMUR	**IMN**	0 (0)	32 (72.7)
	Plate	0 (0)	2 (4.6)
	EF	10 (22.7)	3 (6.8)
	POP	1 (2.3)	6 (13.6)
	Traction	15 (34.1)	0 (0)
	No fixation	18 (40.9)	0 (0)
	AKA	0 (0)	1 (2.3)
TOTAL		44 (100)	44 (100)
TIBIA	**IMN**	0 (0)	7 (16.3)
	Plate	0 (0)	3 (7)
	EF	23 (52.3)	9 (20.9)
	POP	8 (18.2)	22 (51.1)
	Traction	1 (2.3)	0 (0)
	No fixation	12 (27.3)	0 (0)
	BKA	0 (0)	2 (4.7)
TOTAL		44 (100)	*43 (100)

AKA= above knee amputation

BKA= below knee amputation

**=one had amputation above knee remain 43*

Different modes of treatment were used, temporary and definitive treatment. In temporary treatment, skeletal traction (34.1%) was commonly used in femur fractures and 40.9% had no temporary measure used.

IMN was commonly used as definitive treatment of femur (72.7%) and one had AKA on femur, other modalities are as shown on the table above.

EF was commonly used in tibia fractures as temporary measure of treatment in 52.3%, followed by POP by 18.2%, at the same time POP was commonly used as a definitive treatment in tibia in 51.1%, followed by EF in 20.9%. Two had below knee amputation while others are as shown on the table above.

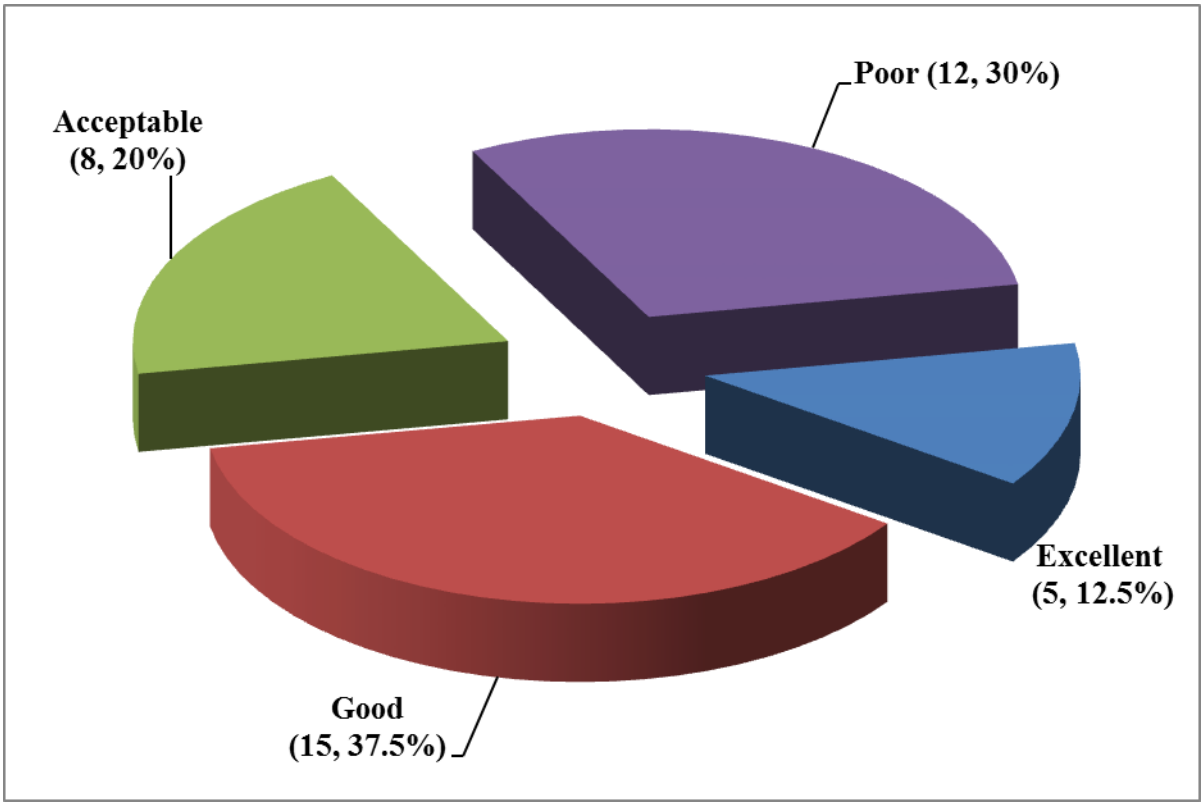


Figure 5.5: Pie chart showing Karlstrom criteria for functional assessment for floating knee management.

Functional outcome was assessed, KARLSTROM AND OLERUD criteria was used. A total of 40 patients were assessed, three were amputated and one lost to follow up. The results show five (12.5%) with EXELLENT, fifteen (37.5%) GOOD, eight (20%) with ACCEPTABLE and twelve (30%) with POOR outcome.

Table 3.5: Functional outcome of floating knee patients as treated at MOI

Variable	KARLSTROM CRITERIA				Total	p-value
	Excellent (n,%)	Good (n,%)	Acceptable (n,%)	Poor (n,%)		
Fraser classification						
Type I	5 (18.5)	13 (48.2)	5 (18.5)	4 (14.8)	27	
Type IIA	0 (0)	0 (0)	2 (66.7)	1 (33.3)	3	
Type IIB	0 (0)	2 (33.3)	0 (0)	4 (66.7)	6	**0.036**
Type IIC	0 (0)	0 (0)	1 (25)	3 (75)	4	
Open vs closed fractures						
Closed	2(11.8)	8(47.2)	3(17.7)	4(23.3)	17	**0.746**
Open	3(13.0)	7(30.4)	5(21.72)	8(34.8)	23	
Injury association						
Present	3 (12)	10 (40)	3 (12)	9 (36)	25*	
Absent	2 (13.3)	5 (33.3)	5 (33.3)	3 (20.1)	15	**0.383**
Definitive management of femur						
IMN	5 (16.1)	14 (45.2)	7 (22.6)	5 (16.1)	31	
Plate	0 (0)	1 (100)	0 (0)	0 (0)	1	
EF	0 (0)	0 (0)	0 (0)	2 (100)	2	**0.036**
POP	0 (0)	0 (0)	1 (16.67)	5 (83.33)	6	
Definitive management of tibia						
IMN	3 (42.9)	4 (57.1)	0 (0)	0 (0)	7	
Plate	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)	3	
EF	0 (0)	3 (37.5)	1 (12.5)	4 (50)	8	**0.065**
POP	1 (4.5)	7 (31.81)	6 (27.27)	8(36.36)	22	

*Four could not be assessed for functional outcomes because 3 underwent amputation and 1 loss to follow up.

Fraser type I as compared to type II displayed more excellent to good functional outcomes by 66.7%. The difference was statistically significant with P value-0.036

Patients who had closed floating knee injury were 17, 10 of them had excellent to good functional outcome while 10 out of 23 patients who had open fractures had excellent to good functional outcome. The difference was not statistically significant (P-0.746).

There were no significant association between functional outcome and associated injuries in this study, 52%of those patients with associated injuries had excellent to good functional outcome while 46.6% of the patients without associated injury scored excellent to good (P value-0.383).

In the definitive management of femoral fractures in floating knee injuries; IMN displayed excellent to good functional outcome by 16.1% and 45.2% respectively while all patients who were managed by EF had poor functional outcome and POP all had acceptable to poor functional outcomes. The difference was statistically significant (P-0.036).

All patients who had IMN as a definitive management for tibia had excellent to good functional outcome while POP had only 4.5% excellent and none had excellent in EF.

CHAPTER FOUR

4.0 DISCUSSION

Floating knee injuries are caused by high energy trauma which can have effects on other parts of the body. These patients sustain significant and occasionally life threatening associated injuries. An expanding population, increasing number of motor vehicles on limited road infrastructure of most cities in developing countries, various modes of treatment and their effectiveness made floating knee injuries a target of concern from both surgical and socio-economic standpoints.

4.1 Socio demographic characteristics

Young men are most commonly involved in MTC, as they are high risk takers in their driving habits[13]. In Tanzania, there is a significant increase in motorcycles. These motorcycles are mostly run by the young economically active population.

In this study, male to female ratio is 14:1. The mean age is 33 years. Most of the patients (68.1%) were aged between 15 and 35 years. Almost similar findings were reported by Kumar et al where 63% of the patients were young below 30 years and males were 9 times more than females.[6]

In this study 77% of the affected individuals were from the urban areas. This can be due to the fact that urban areas have more developed infrastructures and higher number of population as well as motor vehicles.[2, 3, 10,]. The young economically active age group was the most affected, which was also seen in other studies[2, 3,6,7,8, 10,]

4.2 Mechanism of injury

Floating knee injuries are commonly high energy injuries and mostly present as complex injuries or polytrauma cases. The force required to fracture two of the strongest bones in the body is supposed to be so high. In this study motor traffic crush accounted for most of the cases of floating knee injuries and others were due to falls. This being similar to the study done by Rethnam et al and Hegazy et al where 93.1% and 94%of all cases involved were due

to motor traffic crush, 6.9%and 6% sustained injuries due to fall from height respectively [2,10,], while Anastopoulos et al reported all patients were due to motor traffic accident[9].

In this study, it was also found that, motorcycles were the most common cause of injury which accounted to 81% and the motorcyclists are the ones who seem commonly to be affected. Dwyer et al reported similar results where 43 out of 60 patients who were enrolled in the study were motorcyclists[13]. Kao et al reported similar results where most of the injuries were caused by motorcycle crashes accounted to 63.5%, the reason being that motorcycles were the major means of transport in Taiwan.[15]

4.3 Classification of floating knee injury

Fraser classification is among the commonest classification of floating knee injuries. This classification focuses mainly on fracture pattern of femur and tibia according to anatomical locations, hence providing both diagnosis of fracture pattern and treatment option. The severity of injury increases as the classification progress from Fraser type I to IIC. For open soft tissue management Gustilo and Anderson classification was used accordingly.

Open floating knee injuries accounted for 75%, open femoral fractures 38.6% and open tibial fractures 61.4%. Gustilo and Anderson type IIIA was the commonest. This can be due to high energy trauma and hence significant soft tissue injury. Due to the subcutaneous nature of the tibia and better soft tissue coverage of the femur, most of the open fractures were observed on the tibial fractures as compared to femoral fractures. Study done by Vidyadhara et al shows incidence of open fracture is high, approaching 50-70%, at one or both fracture sites. The most common combination being closed femoral fractures with open tibia fractures[14,15]. Dwyer et al reported a similar finding whereas the majority of the femoral fractures were closed (70%) and tibia were open (63.3%) and the right lower limb were the most common involved by (58.33%)[13]. Other studies also reported the incidence of open fractures in floating knee injuries to be predominant .[2,12,13,15,16,20]

Extra articular fractures (type I Fraser) accounted for most of the floating knee injuries, 29(65.9%) has Fraser type I, three (6.8%) type IIA, 7(15.9%) type IIB and 5(11.4%) Fraser type IIC. Pietu et al study reported similar result where 71.5% had Fraser type I, and Fraser

type IIa 8.2%, IIb 11.6% and IIc 8.7% and at least one of the fractures were open in 69.2% of the patients[28]. Abalo et al reported the same distribution, the Fraser type I being the most pattern seen[31].

4.4 Associated other injuries

Every floating knee needs to be categorized according to its associated injuries. This is due to the fact that, the associated injuries have impact on the management as well as final functional outcome of the patient. In this study associated injuries accounted to 66%, mild head injury being the commonest followed by upper limb fractures. Rethnam et al had similar results by having 38 associated injuries out of 29 patients enrolled in the study.[19] Adamson et al also reported similar results where 71% of floating knee injuries had associated injuries, open floating knee injuries in 62% but with high number of vascular injuries, 21%. The study showed that floating knee injuries when associated with other injuries mortality rate is as high as 5% to 15%[20].

Ligamentous injury is commonly seen and has been documented in many floating knee injury literatures [13,18]. In this study 13.6% had ligamentous injuries. Szalay et al reported ligament laxity to be common in floating knee injuries than in isolated fractures. In the study, the ligamental laxity was as high as 53% of all floating knee injuries. Thorough knee examination are needed in every floating knee injuries patients.[21]

In this study 7% patients underwent amputations. Almost similar results were reported by Adamson G et al when they had 9% of the floating knee patients who underwent amputation[20]. While Dwyer et al had maximum of 25% floating knee patients who ended up having amputation[13].

4.5 Modality of treatment

In the management of floating knee injuries, surgical fixation of both femur and tibia is currently the recommended treatment option. Each surgery should be individualized according to quality of fracture patterns and anatomy, location of fracture, soft tissue injury, availability of resources, surgical capability and preference.[2,3,9,15,22,24,25,26]

As most of floating knee patients present with other associated injuries the management can either be definitive or start with damage control by temporary fixation.

Skeletal traction (34.1%) and External fixation (52.3%) were commonly used as temporary stabilization of the femur and tibia fractures respectively. Different modes of treatment were reported by Nouraei et al whereby 70% were operated[11]. This is similar to the findings of this study where 86.4% of all the femora and 49% of the tibia were operated. In the study by Nouraei 35.9% of the operative group, were treated using plate and screw for both the femur and tibia while 34.1% underwent intramedullary nailing (IMN). This differs from this study where IMN was commonly used in the treatment of femoral fractures (72.7%) and EF in the treatment of tibial fractures (20.9%). This difference can be explained by the fracture pattern encountered in the study where diaphyseal femoral fractures were commonly seen and open tibial fractures were more common. In this study POP were used as definitive treatment in the femur (13.6%) and in tibia (51.1%), the percentage is higher as compared to Nouraei findings where skeletal traction and POP comprised 12.3%. The rate of amputation (7%) is also higher in this study as compared to Nouraei study (0.9%).[11]

Dwyer et al also used different modes of treatment in floating knee injury. Out of 56 floating knee patients 11 used combined methods of operative femur and casting tibia.[13]

4.6 Functional outcomes

In comparing modes of treatment used in the study for femur management, those who were treated with IMN had excellent to good functional outcome in about 61.3% and in tibial all scored excellent to good. No patient had excellent or good functional outcome in EF or POP in femur. Karlstrom et al report lower incidence of complications, shorter duration of hospitalization and short time to healing in those treated operatively whereby 59% had

excellent to good functional outcome. Hegazy et al also reported the best results in those patients treated by IMN and ⅔ of those treated by plating. For those treated by external fixation and Plaster of Paris (POP) the functional outcome was acceptable or poor in 62.5% for EF and 64% for POP.

Veith et al reported 80% excellent and good functional outcome for those who were operated. Blake and McBryde reported almost half of the patients had poor functional outcome after being treated non-operative, all femur treated non-operatively had acceptable and poor results and 63.6% of tibia had acceptable and poor function outcomes[1,4,10,22]

Intramedullary nail were the best modes of treatment used with maximum number of patients and excellent results were seen despite of other associated injury and soft tissue injuries. In tibia fractures all that had IMN had excellent and good function outcomes, suggesting that when both femur and tibia fixed operatively will give excellent and good function outcomes to these injuries. For acceptable and poor function outcomes of femur which accounted to 38.7% could have reduced if much of numbers of tibia could use the IMN or plate in definitive management. But also result showed that proper use of POP in Tibia still could bring excellent and good function outcomes which accounted to 36%, below knee POP does not affect the knee range of movement causing knee stiffness. External fixator were commonly used in fixing open fractures and temporary fixation of intraarticular fractures, however due to financial constrain or sometimes unavailability of proper implant for the particular fractures EF was used as definitive modes of treatment or changed to POP after the wound was healed.

This were supported by the study done by Dwyer et al who also used different modalities of treatment in floating knee injury, out of 56 floating knee patients 11 used combined methods of operative femur and casting tibia, results were excellent and good in 8 patients, 1 acceptable and 2 poor, they suggested that for the resource poor country combined method when used properly is affordable, practical and effective[13].

In this study 56.5% of patients who had open floating knee injuries in one of the fracture or both and they had acceptable and poor functional outcome compared to (41%) of closed floating injury, intraarticular fracture as well played a greater part in displaying a poor functional outcome, the reason being most of the patients ended up getting knee stiffness and

others still using crutches even after definitive management. Only 14.8% extra articular floating knee patients reported to have poor functional outcome compared to 33.3% , 66.7% and 75% of Fraser type IIA, IIB and IIC respectively which are intraarticular floating knee injuries. There is association between floating knee fracture patterns and functional outcomes of the patient. Similar studies reported almost the same result with Hegazy et al reported the best result were seen in patients having extra articular and knee stiffness and pain in most of the intraarticular fracture.[10.] Rethnam et al 2007 reported that the associated injuries and the pattern of fracture open, intra-articular are the prognostic indicators in the outcome of floating knee injury, proper initial assessment and management of open fracture in floating knee injury is one of the key indicators of good functional outcome which was also seen in this study[1,2,11]

For those patients with associated injuries, 52% and 46.6% with no associated injuries had excellent and good functional outcome. This difference was not statistically significant (p-0.383). Rethnam et al in their study of impact of associated injury in floating knee, had 38 associated injuries in 29 patients, only 3 had isolated floating knee injuries. The associated injuries ranged from head injuries to metatarsals injuries. Most of associated injuries had excellent and good outcomes. They also reported that associated injuries play major role in initial outcome of the patient either by delaying surgery (like head injury or chest injury), prolong surgery and delay rehabilitation but not final functional outcomes.[2]

There was statistically significant difference between modality of treatment used in femur and the functional outcomes but not in tibia. Generally, from the study, Karlstrom and Olerud criteria for functional outcome of floating knee patients 5(12.5%) had excellent results, 15(37.5 %) good, 8(20%) acceptable and twelve (30%).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

- Floating knee injuries are complex fractures and are due to high energy trauma. Young active males were mostly affected.
- Motor traffic crash particularly motorcycles are the commonest causes of injuries.
- Fracture patterns play major role in final function outcomes
- Most of floating knee injuries seen had other associated injuries.
- Both operative and non-operative modalities of treatment were used, but good functional outcome of the patients were seen on those treated operatively.

5.2 Recommendations

- Larger series and longer follow-up studies are needed to explore more findings and produce treatment protocol of floating knee injury.
- In order to achieve good function outcomes of the floating knee patients ,carefull assessment of factors like fracture patterns, open or closed and modality of treament should be highly considered.
- Operative treatment should be the first option in managing floating knee injuries.

5.3 Study Limitations

This was a hospital based study therefore the results cannot be generalized to the whole country.

Follow up limitations of 18 months.

For functional outcomes of the floating knee patients Karlstrom criteria were used which is clinical assessment.

Limited funds

REFERENCES

1. Blake R, McBryde Jr A. The floating knee: ipsilateral fractures of the tibia and femur.South Med J. 1975; 68:13-16.
2. Rethnam U, Yesupalan RS, Nair R. The floating knee: epidemiology, prognostic
3. Indicators & outcome following surgical management. J Trauma Manag Outcomes. 2007;1:2.
4. Marco FA De, Rozim AZ, Piedade SR. “Knee Joint stability in ”Floating Knee" condtion. Acta ortop. Bras. 2008;16:32–6.
5. Veith RG, Winquist RA, Hansen ST. Ipsilateral fractures of the femur and tibia. A report of fifty-seven consecutive cases. J. Bone Joint Surg. Am. 1984;66:991–1002.
6. Lundy DW, Johnson KD. “Floating knee” injuries: ipsilateral fractures of the femur and tibia. J. Am. Acad. Orthop. Surg 2001;9:238–45.
7. Kumar A, Mam MK, Paul R. Ipsilateral Fracture of Femur and Tibia , Treatment and Functional Outcome. J.K .Science. 2006;8:42–4.
8. Waddell JP. Ipsilateral fracture of the femur and tibia. J. Bone Jt. Surg. 1978;60:510–5.
9. Elmrini A, Elibrahimi A, Agoumi O, Boutayeb F, Mahfoud M, Elbardouni A. Ipsilateral fractures of tibia and femur or floating knee. Int Orthop. 2006;30:325–8.
10. Anastopoulos G, Assimakopoulos A, Exarchou E, Pantazopoulos T. Ipsilateral fractures of the femur and tibia. Injury.1992;23:439–441.
11. Hegazy AM. Surgical Management of Ipsilateral Fracture of the Femur and Tibia in Adults (the Floating Knee): Postoperative Clinical , Radiological , and Functional Outcomes. J. Clin. Orthop. Surg. 2011;3:133–9.

12. Nouraei MH, Hosseini A, Zarezadeh A, Zahiri M. Floating knee injuries : Results of treatment and outcomes. J. Res. Med. Sci. 2013;18:4–7.

13. Radu S. Does fracture classification work all the time? Dilema persists! J. Orthop Muscul Syst. 2013;2(1).

14. Dwyer AJ; Paul R; Mam MK; Kumar A; Gosselin RA Floating knee injuries: long-

15. Term results of four treatment methods. Int Orthop. 2005; 29:314-8.

16. Vidyadhara S. Shetty MS, Rao SK,.Gnanadoss JJ Floating Knee Treatment & Management 2014. 1. Available from http://emedicine.medscape.com/article/1249181

17. Kao FC, Tu YK, Hsu KY, Su JY, Yen CY, Chou MC. Floating knee injuries: a high complication rate. Orthopedics. 2010;33:14.

18. Piétu, G., Jacquot, F., & Féron, J.-M. The floating knee: a retrospective analysis of 172 cases. Rev Chir Orthop Reparatrice Appar Mot.2007;*93*: 627–634.

19. Abola A,Randoph S,Ayouba G,Walla A, Dossim A. floating knee: Epidemiology and results of treatment. Niger J Orthop trauma 2011;10:23-7.

20. Van-Raay J, Raaymakers E, Dupree H. Knee ligament injuries combined with ipsilateral tibial and femoral diaphyseal fractures: the “floating knee”. Arch Orthop Trauma Surg. 1991;110:75–7.

21. Rethnam U, Yesupalan RS, Nair R. Impact of associated injuries in the Floating knee: A retrospective study. BMC Musculoskelet. Disord. 2009;10:1–8.

22. Adamson G, Wiss D, Lowery G, Peters C. Type II floating knee: ipsilateral femoral and tibial fractures with intraarticular extension into the knee joint. J Orthop Trauma. 1992;6:333–9.

23. Szalay M, Hosking O, Annear P. Injury of knee ligament associated with ipsilateral femoral and tibial shaft fractures.Injury 1990;21:398–400.

24. Karlstrom G, Olerud S. Ipsilateral fracture of the femur and tibia. J Bone Jt. Surg Am. 1977;59:240–3.

25. Arslan H,kapukaya A, Kesemenli CC,Necmioglu S,Subasi m, Coban V. the floating knee in adults: twenty-four cases of ipsilateral fractures of the femur and tibia.Acta orthop traumatol Turc. 2003;37:107-12

26. Chalidis B, Metha S, Tsiridis E, Giannoudis P. Mini-symposium: management of fractures around the knee joint. (ii) The "floating knee" in adults and children. Curr Orthop. 2006;20:405–10.

27. Ríos JA, Ho-Fung V, Ramírez N, Hernández RA. Floating knee injuries treated with single-incision technique versus traditional antegrade femur fixation: a comparative study. Am J Orthop. 2004; 33:468-72

APPENDICES

Appendix I: Informed Consent Form- English version

Consent to participate in the study titled "early Treatment outcome of patients with ipsilateral fracture of femur and tibia as managed at MOI- march 2014 to Feb 2015

Greetings: I am Dr Magdalena Mbeyale, a resident in Orthopaedics and Traumatology expecting to do a study on *"*early Treatment outcome of patients with ipsilateral fracture of femur and tibia as managed at MOI- march 2014 to Feb 2015.

Purpose of the Study: To determine the early Treatment outcome of patients with ipsilateral fracture of femur and tibia as managed at MOI- march 2014 to Feb 2015 treatment.

What participation involves: If you agree to participate in this study, you will be asked questions and examined. Then you will be followed up for the entire period of four months.

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.

Risk: We ensure that there is no harm in engaging 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 guidelines of the Institute for all patients with ipsilateral fracture of femur and tibia.

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

Who to contact: If you have any other questions regarding this study, feel free to contact me, the investigator, Dr Magdalena Mbeyale, Muhimbili Orthopaedic Institute, P.O. Box 65474, Dar es Salaam, Tel No 0754952360.

If you have any questions concerning your rights as a participant, you may contact **Prof.** Mainen Moshi, Chairman of the Research and Publication committee, P.O. Box 65001, Dar es Salaam. Telephone: 2150302/6.

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…….

Appendix II: Informed Consent Form- Swahili version

Ruhusa ya Kushiriki Utafiti Kuhusu kuangalia matokeo ya matibabu ya wagonjwa wenye mivunjiko ya mifupa kwa wakati mmoja ilio juu na chini ya goti katika taasisi ya mifupa MOI- Marchi to Februari 2014.

Mimi naitwa Dr. Magdalena Mbeyale ni mwanafunzi wa udhamili chuo kikuu cha tiba Muhimbili, nachunguza matokeo ya matibabu ya wagonjwa wenye mivunjiko ya mfupa iliyo juu na chini ya goti kwa wakati mmoja katika taasisi ya mifupa MOI.

Dhumuni la utafiti huu: Kupata taarifa muhimu ya matokeo ya matibabu ya mifupa iliyovunjika kwa wakati mmoja juu na chini ya goti 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 utafiti huu

Haki ya kujitoa kwenye utafiti: Kushiriki katika utafiti huu ni hiari, na kutokubali kushiriki au kujitoa hautaadhibiwa au kupoteza haki yako ya matibabu. Utatibiwa na kuendelea kufuatiliwa kama taratibu za hospitali zinavyoelekeza.

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 MOI- Tanzania.

Faida ya kushiriki kwenye utafiti: Kama utakubali kushiriki kwenye utafiti huu, Faida utakazopata ni pamoja na kuonwa na kufuatiliwa kwa ukaribu na daktari anayefanya utafiti. Tunatumaini kwamba taarifa zitakazopatikana zitawanufaisha wengine pia

Kwa mawasiliano zaidi: Kama unamaswali au maelezo kuhusu utafiti huu, uwe tayari kuwasiliana na mtafiti, Dr Magdalena Mbeyale, Taasisi ya mifupa muhimbili P.O. Box 65474,DSM. simu: 0754952360. Kama una maswali kuhusu haki yako kama mshiriki **wasiliana na Prof. Mainen Moshi,** Mwenyekiti wa kamati ya utafiti, P.O. Box 65001, DSM. Simu 2150302/6.

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 …….

Appendix III: Research Questionnaire

TITLE: early treatment outcomes of patients with floating knee as managed at MOI march 2014 to Feb 2015

PART A: PRE-OPERATIVE EVALUATION:

1. Form number: ……
2. Registration NO ……
3. Age: …….
4. Sex……..
5. Place of residency: …….. Phone no: …….
6. Date of injury: ……
7. Date of admission: ……..Time of injury to admission…….
8. Date of operation……Time of injury to operation(s) ….. i)……... ii)…….

CAUSES OF INJURY

9 a) Motor traffic crush

b) Fall from height

c) Missile injury

d) Others……..

10. Type of MTC

a) Motor vehicle

b) Motorcycle

c) Bicycle

d) Others (specify)……

11. Who is the patient in MTC?

a). Driver

b). Passenger

c). Pedestrian

d). Motorcyclist

CLINICAL EXAMINATION

12. Side of floating knee fracture:

a) Right…….. b) Left …….

13. Femur (a) closed (b) open ……..go to (15)

14. Tibia (a) closed (b) open……..go to (15)

15. Gustilo-anderson classification

Femur a) I b) II c) IIIA d) IIIB e) IIIC

Tibia a) I b) II c) IIIA d) IIIB e) IIIC

16. Floating knee type by Fraser (a) Type I

(b) Type IIA

(c) Type IIB

(d) Type IIC

17. Associated injuries: i) present, go to iii) ii) absent

iii. a) Head injury ……

b)Chest injury ……..

c) Visceral injury ……

d) Pelvic injury……

(e) Ligamental injury ……

f) Upper limb ……

g) Contralateral femur …….

h) Contralateral Tibia……

i) Bilateral floating knee……

j) Vascular injury

k) Spine injury……..

m) Others……..

PART B: OPERATIVE MANAGEMENT

18. Type of fixation

i. **Temporary**

a) Femur) 0) no temp fixation 1) backslab /POP 2) EF (spanning) 3) Traction

b) Tibia 0) no temp fixation 1) POP 2) EF 3) traction

ii .**Definitive management**

a) Femur (1) IMN (2) plate (3) EF 4) POP 5) other
6) Amputation

b) Tibia (1) IMN 2) plate 3) EF 4) POP 5) others 6)amputation

c) Contralateral limb a) femur……..
b)Tibia……..

PART C: POST-OPERATIVE

Immediately post-operative

19).Post op control x-rays- alignment:

i) Femur a) Good alignment b) Mal alignment

ii) Tibia a) Good alignment b) Mal alignment go to (iii)

iii) a) Varus b) Valgus c) Anterior angulations d) Posterior angulation

20. Degree of angulation of mal-alignment

a) Less than 10^0 b)10^0- 20^0 degrees c) More than 20^0 degrees

21. Affected Limb length:

a) Normal b) Less than 1 cm c) 1 cm- 2cm d) More than 2 cm

22. Limb rotation deformity:

a) Yes…… b) No …….. if no go QN 25

23. If there is rotational deformity:

a) External rotation b) Internal rotation

24. Degree of rotational deformity

a) Less than 10^0 b) 10^0- 20^0 c) More than 20^0

PART D: 2nd WEEK POST OPERATIVE EVALUATION AND MANAGEMENT

25. Date of hospital discharge……. Number of days in hospital Post-operative……

26. Is there wound problem? a) Yes……. b) no……

27. i)Thigh ii)leg iii) both

28. Type of wound problem……..

c) Superficial infection (oral antibiotics)d) Deep infection (requiring surgical debridement)

29. Is there pin tract infection? EF a) Yes…… b) no……

6th 12th and 18th FOLLOW UP

30. Limb length discrepancy

a) At 6 weeks i) Yes…… If yes specify cm…….

ii) No

b) At 12 weeks i) Yes…… If yes specify cm…….

ii) No

c) At 18 weeks i) yes …… If yes specify cm…….

ii) No

31. Limb rotation deformity

a) At 6 weeks i) Present ……. Specify (type/ degree)…….

ii) Absent

b) At 12 weeks i) present …….specify ……ii) absent……..

c) At 18 weeks i) present …… specify ……

ii) Absent

32. Callus formation on control X-ray:

a) At 6 weeks i) Yes…… ii) No……

b) At 12 weeks i) Yes …. ii) No ….

c) At 18weeks i) Yes …. ii) No ….

33. Pain from the thigh /leg

a) None b) slightly c) severe impairs function d) at rest which impair functioning

34. Pain from knee and ankle

a) None b) slightly c) severe impairs function d) pain at rest which impair function

35. Walking ability

a) Unimpaired b) slightly c) walking distance restricted d) use support (crutch)

36 .Work and sport

a) as before b)slightly impaired c) less strenuous work d)permanent disability

37. Restricted joint mobility

a) none b)< 10°ankle and <20° hip n knee c)ankle 10°-20° ,hip n knee 20°-40° d) ankle>20° ,hip n knee>40°

Karlstrom criteria for functional assessment after management of floating knee injuries

Criterion	Excellent	Good	Acceptable	Poor
Symptoms from thigh or leg	None	Intermittent slight symptoms	More severe symptom impairing function	Considerable functional impairment: pain at rest
Symptoms from knee or ankle joint	None	Same as above	Same as above	Same as above
Walking ability	Unimpaired	Same as above	Walking distance restricted	Uses cane, crutch or other support
Work and sports	Same as before	Given up sport; work same as	Change to less strenuous work	Permanent disability

		before		
Angulation, rotational deformity or both	0	< 10 degrees	10 – 20 degrees	> 20 degrees
Shortening	0	< 1 centimeter	1 – 3 centimeter's	> 3 centimeters'
Restricted joint mobility	0	< 10 degrees at ankle; < 20 degrees at hip, knee or both	10 – 20 degrees at ankle; 20 – 40 degrees at hip, knee or both	> 20 degrees at ankle; > 40 degrees at hip, knee or both