TREATMENT OUTCOMES OF DISTAL TIBIA FRACTURES AMONG ADULT PATIENTS AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA

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ABSTRACT

Background: The treatment of distal tibia fractures remains challenging since they are prone to higher rates of complications. Treatment options are expanding and although their indications, advantages and disadvantages have been discussed in literature, controversy still exists over the clinical efficacy and cost-effectiveness of each option. This has led to different orthopaedic surgeons employing different operative treatment options based on their experience, preference and patient characteristics.
Objective: This study sought to describe the patients' characteristics and treatment of distal tibia fractures at MTRH and compare the outcome results of the various treatment options.
Design: A prospective observational study design was used. Adult patients with distal tibia fractures admitted during the study period were included through consecutive sampling.
Methods: A total of 76 patients were followed up. Data including injury aetiology, fracture types and classification, treatment and complications were collected. Functional outcome was assessed using Olerud and Molander Ankle Score (OMAS) at 6 months after treatment. Data was collected between October 2015 and March 2017 using a structured questionnaire and analyzed using STATA version 13 at 95% confidence level. Chi square test was used to determine the significance of associations between categorical variables.
Results: The median age was 40.0 (30.0, 52.0) years, with a male-to-female ratio of 1.7:1. Most common causes of injury were RTA in 37 patients and falls in 29 patients. There were 48 closed and 28 open injuries. According to Arbeitsgemeinschaftfür Osteosynthesefragen (AO)/ Orthopaedic Trauma Association (OTA) classification, there were 40 (52.6%) type A, 28 (36.8%) type B and 8 (10.6%) type C fractures. Twenty-five (32.9%) patients were treated non-operatively, 28 (36.8%) patients underwent internal fixation with plating and 23 (30.3%) patients were treated using external fixation method. Non-operative treatment was mostly used for closed injuries (80%) whereas majority of open fractures (82%) were treated operatively (P=0.033). Complications occurred in 48 (57.8%) patients, including 30 (62.5%) wound infections, 21 (43.7%) malunions and 3 (6%) chronic osteomyelitis. Infections were significantly higher among external fixation treated patients (P=0.002). At final follow up the functional outcome using OMAS was excellent in 11(14.5%) patients, good in 28 (36.8%), fair in 17 (22.4%) and poor in 20 (26.3%) patients. OMAS scores were significantly high in patients treated with plating and low in patients with comminuted fractures, complications and open injuries (P<0.001).
Conclusion: Distal tibia fractures mostly occurred in young males. Road traffic accidents and falls were the commonest causes. Treatment by plate fixation resulted in significantly higher functional outcome scores and lower rate of complications compared to non-operative treatment.
Recommendation: Distal tibia fractures should be treated operatively by plate fixation to improve treatment outcomes.

Key words: Distal tibia fracture, OMAS, Treatment outcome

INTRODUCTION

Distal tibia fractures account for 18-25% of all tibia fractures. They commonly occur as a result of high energy injuries including Road Traffic Accidents (RTA) and falls from heights (1). Distal tibia fractures have been reported as having a high complication rate pre-operatively as well as post-operatively. Because they are high-energy injuries, majority tend to be either open fractures or have associated extensive soft tissue damage (2). The distal tibia has thin skin and subcutaneous tissue cover with poor blood supply therefore predisposing distal tibia fractures to non-union, delayed union and infections. In addition distal tibia fractures cause significant morbidity and result in prolonged periods away from work and social activities (3).

Limb loss can occur as a result of severe soft-tissue trauma, neurovascular compromise, compartment syndrome, or infection such as gangrene (4).

Several methods of treatment have been described including; non-operative treatment by use of plaster casts and braces, operative treatment by use of intramedullary nail, open plate fixation, minimally invasive plating, and various constructs of external fixation. Each of these options has its merits and demerits (5).

Non-operative techniques such as immobilization in long leg plaster cast with partial weight bearing, and immobilization in a wheelchair with thrombosis prophylaxis and functional bracing have been used for non-displaced or in situations when surgery is not possible. However, the long period of immobilization has been associated with increased risks of thrombosis, reflex dystrophy and contractures with poor limb function. In addition there is increased risk of secondary reduction loss leading to fracture malunion and nonunion (5, 6).

Operative treatment options are expanding and include locked intramedullary nails, plate and screw fixation, as well as external fixation systems including the Ilizarov frame and hybrid fixators (7). Although the indications, advantages and disadvantages of each of these operative treatment options have been discussed in the literature, controversy still exists over the clinical efficacy and cost-effectiveness of each option. This has led to different orthopaedic surgeons employing different operative treatment options based on their experience, preference and patient factors (8).

Various studies have reported varying outcome results with different modalities of treatment. Treatment with Open Reduction and Internal Fixation (ORIF) has shown superior results in the setting of good soft tissue quality or low energy trauma (9). However, bad outcome has been reported with ORIF when performed on patients with associated nerve or vascular injury, wound complications and infections (10). Factors such as timing of treatment, method of stabilization, techniques of operative care, and postoperative rehabilitation, affect clinical and functional outcomes and have been subjects of debate among traumatologists (11).

MTRH serves as the main trauma care centre in the western region of Kenya. At MTRH, fractures are managed by a team of clinicians with varied experience and qualifications but definitive management and further follow up after treatment is performed by orthopaedic registrars and orthopaedic surgeons in consultation with other specialists (12). The local epidemiological patterns and outcomes of the treatment modalities for distal tibia fractures at MTRH have not been documented before. This study therefore sought to describe the patients' characteristics and the treatment of distal tibia fractures at MTRH and compare the outcome results of the various treatment options.

Ethics: Permission was sought from Institutional Research and Ethics Committee (IREC) of Moi University College of Health Sciences/MTRH and the hospital Director. Written informed consent was sought from each patient. Confidentiality was maintained and patient information de-identified. No coercion or payment was used to have patients join the study.

MATERIALS AND METHODS

This study took place between October 2015 and March 2017 at the Orthopaedic Surgery wards and clinics of MTRH. A prospective observational study design was used. Skeletally mature patients (aged 18 years and above) with acute distal tibia fractures were included through consecutive sampling. Exclusion criteria were: (a) multiple injury patients, (b) pathological fractures and (c) patients who were already on follow up before the study begun. A total of 76 patients were included. Patients who met the inclusion criteria were approached for their consent and data such as age, sex, premorbid conditions, mechanism of injury and clinical characteristics were obtained from both the patient and the files and were recorded. Radiographs and case summaries were presented for discussion in the Trauma meeting (attended by consultant orthopaedic surgeons and registrars) where fracture and injury classification were done together with discussion on initial management. Fractures with associated soft tissue injuries were classified using Gustillo-Anderson classification for open injuries and Tscherne classification for closed injuries while distal tibia fractures were classified using the Arbeitsgemeinschaftfür Osteosynthesefragen (AO) classification system. Definitive treatment was determined by the consultants of the admitting firm. Patients were then reviewed at 72 hours, 2 weeks, 6 weeks, 3 months and 6 months to assess clinical outcomes and complications. Functional outcome was assessed using Olerud and Molander Ankle Score (OMAS) at 6 months after treatment using a self-administered questionnaire during clinic visits. In this system, a score of more than 91 points was considered excellent; 61–90 points, good; 31–60 points, fair; and less than 30, poor. Excellent and good OMAS grades were rated as satisfactory while fair and poor OMAS grades were rated as unsatisfactory.

Statistics: Data was collected using a structured questionnaire and analyzed using STATA version 13. Descriptive statistics such as median and interquartile range were used for continuous data while frequency listing was used for categorical data. Graphical summaries included bar charts. Chi square test was used to determine the significance of association between categorical variables. In cases where the cell count was below 5, Fisher's exact test was used. Kruskal Wallis and Mann-Whitney U tests were used to compare median for continuous variables since the data was skewed. Functional outcome was assessed using Olerud and Molander Score (OMAS). An OMAS score of more than 91 points was considered excellent; 61–90 points, good; 31–60 points, fair; and less than 30, poor. Bivariate analysis with Fisher's exact test was used to test associations between the possible predictive variables and OMAS. The variables included sex, injury type, and method of treatment, fracture comminution, malunion, and infections. All analyses were performed at 95% level of confidence.

RESULTS

Age and gender characteristics: Seventy six patients were studied. The median age was 40.0 (IQR: 30.0, 50.0) years with a range of 19 to 91 years. Most patients (63.2%) were male with a male to female ratio of 1.7:1. As shown in Table 1, majority of patients, (52.6%) were aged 40 years and below. Among those patients aged 40 years and below, there was a male preponderance (Male: Female=3:1). There was a fairly equal distribution of fractures between the two sexes after the age of 41 years; however the number of affected male reduced with advancing age.

Table 1

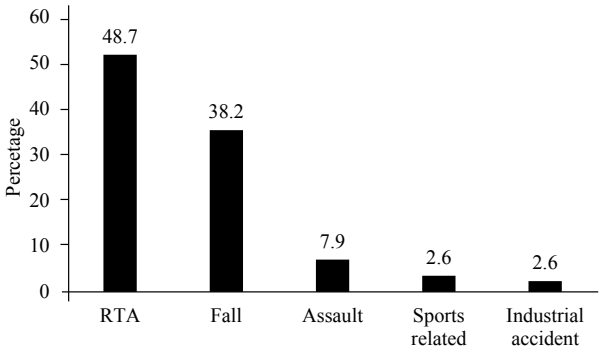
Age and gender distribution

Sex	<40 years	41-60 years	>61 years	Total
Male	30(39.5%)	15(19.7%)	3(3.9%)	48(63.2%
Female	10(13.2%)	13(17.1%)	5(6.6%)	28(36.8)%
Total	40(52.6%)	28(36.8%)	8(10.5%)	

Injury aetiology: As shown in Figure 1, most of the injuries were as a result of Road Traffic Accidents (RTA) in 37 patients and falls in 29 patients. The patients who had sustained fractures caused by falls had a higher mean age (61.2 years) compared with the patients who had sustained fractures from RTA, assaults, sports and industrial accidents combined (34.7 years) (P<0.001).

Figure 1

Injury aetiology



Injury classification: As shown in Table 2, majority of the injuries were closed and were classified according to the Tscherne classification. Most of the closed injuries were Tscherne grade 2 and there were no Tscherne grades 1 and 3 injuries. Open fractures were classified according to the Gustilo-Anderson classification and majority were type II injuries and there were no type IIIC injuries.

Table 2

Injury classifications

Variable	Category	n (%)
Nature of injury	Open	48 (63.2%)
	Closed	28 (36.8%)
Ipsilateral fibular fracture deformity		37 (48.6%)
	None	6 (8%)
	Varus	56 (74%)
	Vulgus	14 (18%)
Tscherne classification for closed injuries	Grade 1	20 (41.7%)
	Grade 2	28 (58.3%)
Gustillo-Anderson classification for open injuries	Type I	3 (18%)
	Type II	13 (46%)
	Type IIIA	7 (25%)
	Type IIIC	3 (11%)

Classification of distal tibia fractures: Distal tibia fractures were classified according to the AO/OTA classification system as shown in Table 3. The extra-articular AO/OTA type A fractures were the most common and constituted 52.6% of all the distal tibia fractures. AO/OTA type B constituted 36.8% of the distal tibia fractures while type C was rare (10% of the fractures). Among the fracture subgroups, the most common fracture patterns were: Type 43B1 (21%), type 43 A1, (19.7%), type 43 A2, (17%) and type 43 A (15.8%).

Table 3

AO classification of distal tibia fractures

Subgroup	43 A (n=40)	43 B (n=28)	43 C (n=8)
Subgroup 1	15	16	4
Subgroup 2	13	10	3
Subgroup 3	12	2	1
Total	42	28	8

Treatment of distal tibia fractures: Patients were treated using either non-operative treatment with casting (23%) or operative treatment (67%) with plating and external fixation. Table 4 shows the distribution of the treatment options according to demographic and clinical characteristics.

Operative treatment options included fixation with external fixators (23 patients) and fixation with plating (28 patients). The two operative treatment methods were similar with respect to gender, AO/OTA fracture classification and fracture comminution. However, plating was mostly used on closed injuries and external fixation was mostly used to treat open injuries (p<0.001).

Union was assessed at the end of six months using radiographs. All fractures achieved radiological union (100% union rate) by the end of six months.

Table 4

Treatment of distal tibia fractures

Variable	Category	Non-operative (n=25)	Operative (n=51)	Total	P-value
Sex	Female	8	20	28	0.540*
	Male	17	31	48	
Injury type	Closed	20	28	48	0.033*
	Open	5	23	28	
AO classification	Extra-articular	13	27	40	0.531**
	Partial-articular	8	20	28	
	Intra-articular	4	4	8	
Fracture comminution	Comminuted	13	18	31	0.164*
	Non-comminuted	12	33	45	

**Fishers Exact test; * Chi square

Complications occurred in 41 (54%) patients. The overall rates of complications for non-operative treatment, plating and external fixation were 72%, 25% and 52% respectively. There were 27 infections including 15 pin-site infections, 3 chronic osteomyelitis and 9 wound infections. Table 5 shows the distribution of complications in each treatment option. Infections occurred more commonly in the operatively treated patients, although this is not statistically significant (p=0.142). There were 21 malunions and the rate of malunion was 44% among the non-operatively treated patients and 19.6% for those operatively treated.

Table 5

Complications

Complication	Mode of treatment		Total	P-value
	Non-operative	Operative		
Infection	3	17	20	0.034
Malunion	8	6	14	
Combination	3	4	7	
Total	14	27	41	

Infections occurred mostly in patients treated operatively (P=0.034)

Functional outcome after treatment of distal tibia fractures: The average OMAS was 64 (IQR: 30, 85) points with a minimum and a maximum of 21 and 95 respectively. OMAS was poor in 20 patients, fair in 17, good in 28 and excellent in 11. Majority of patients had good-to-excellent (satisfactory) OMAS scores at 6 months. Tables 6 shows the results of univariate analysis of the factors associated with functional outcome.

Table 6

Univariate analysis of factors affecting functional outcome

		Outcome (0=Poor/Fair; 1=Good/Excellent)		
Variable	Category	Poor/Fair	Good/ Excellent	P-value
Sex	Female	10	18	
	Male	27	21	0.084
Injury type	Closed	19	29	
	Open	18	10	0.038
Fracture	Comminuted	12	19	
comminution	Non-comminuted	25	20	0.149
Treatment	Conservative	17	8	
option	Operative	20	31	0.018
Treatment option	Plating	7	21	
	Exo-fix	13	10	0.122
Infections	No	16	33	
	Yes	21	6	<0.001
Malunion	No	20	35	
	Yes	17	4	0.001
		Chi Square		

Patients' age, sex and fracture comminution were not associated with either satisfactory or unsatisfactory outcome. Having a closed injury and undergoing operative treatment were associated with good-to-excellent (satisfactory) functional outcome whereas open injuries and presence of complications (infections and malunions) was associated with poor-to-fair (unsatisfactory) functional outcome (All *P*s<0.05).

There was no statistically significant difference in functional outcome between the two operative treatment options; ORIF and external fixation, although more patients who received ORIF had satisfactory outcome compared to the ones who underwent external fixation (*P*=0.122).

DISCUSSION

This study found the average age of patients with distal tibia fractures to be 40 years and a male preponderance of 63.2%. This is in agreement with the findings from other studies on similar fractures. Bhairi *et al*. (13) studied patients whose average age was 39.5 years and a male preponderance of 65%.

The rate of ipsilateral fibular fracture was low (48%). This rate was similar to that reported by Joveniaux *et al*. (3) who found the rate of ipsilateral fibular fracture to be 46%. However a study by Bonnevialle *et al.* (14) found a higher rate of 93% of ipsilateral fibular fracture. This difference may be explained by the difference in the mechanism of injury between the two studies. The fibula articulates distally with the lateral surface of the distal tibial metaphysis via the lateral syndesmotic ligaments and the distal interosseous membrane and is the reason why the fibula is often injured in higher-energy fracture characteristics. Indeed there were fewer higher-energy injuries in this study (68%) compared to Bonnevialle *et al.* (14) study (96%).

Treatment outcomes of distal tibia fractures: Operative treatment options in this study were limited to only open reduction and internal fixation with plating and external fixation. Other operative techniques such as fixation with locked intramedullary (IM) nails and closed reduction and fixation by Minimally Invasive Plate Osteosynthesis (MIPO) have been reported in literature and in most instances as having superior outcomes compared to open plating and external fixation (15). Although SIGN® IM nails were used for treatment of other long bone fractures in the orthopaedic department, there is a growing concern over their technical difficulties with distal nail fixation and the risk of nail propagation into the ankle joint. MIPO was not used in the orthopaedic department during the time of this study. Demographic characteristics and fracture classification were similar in the two types of treatments, operative and non-operative. Among patients with closed fractures, majority (58%) underwent operative treatment. Equally 82% of the patients with open fractures were treated operatively. Operative treatment was the most common treatment option used for both open and closed injuries (*p*= 0.033).

The rate of malunion was higher among patients who underwent non-operative treatment than in those who were operatively treated. Similar high malunion rate was reported by Böstman *et al.* (16) who reviewed

103 patients managed initially with a long leg cast and subsequent intramedullary (IM) nailing if there was loss of reduction. A malunion rate of 26.4% was observed in the non-operatively managed group. We think malunion results from failure to achieve adequate reduction during closed manipulation and the relative stability of the cast stabilization that results in reduction loss.

Functional outcome: This study found that the characteristics that influenced functional outcomes as determined by OMAS system were non-operative treatment, presence of infections and malunion, which were found to be associated with poorer functional scores (all p values < 0.005). Sex, type of injury and fracture comminution were not found to be associated with poorer function on OMAS. This findings are in agreement with that of Collinge *et al*. (17) who found that open fracture pattern, fracture comminution, sex and age were not associated with either poorer or higher OMAS scores and the only patient or injury characteristic that influenced functional outcomes was the occurrence of a secondary surgery for treatment of complications. In contrast to this study in which both operative and non-operative treatments were studied, Collinge *et al.* (17) only studied operative treatments.

With respect to functional outcome (OMAS), our results showed no statistical difference between operative treatment by external fixation and ORIF with plating. Similar observation was made by Wyrsch *et al.* (18) who compared definitive treatment by means of open reduction and internal fixation with external fixation. The authors found that postoperative infections were significantly more frequent with the open plate fixation with no statistically significant differences in functional results and complications (although the average clinical scores in the group treated with external fixation were higher than for patients treated with a plate).

CONCLUSION

Operative treatment with plating seems to be the obvious choice for distal tibia fractures. Plate reconstruction is also known to provide reliable results in other peri-articular fractures of the lower limb. Presence of complications and severe injuries resulted in poorer functional outcome.

Conflict of interest: None.

Source of funds: None.

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