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Case Study

PRESENTATION AND MANAGEMENT OF BILATERAL TIBIAL SHAFT FRACTURE: A PROSPECTIVE CASE SERIES OF RARE ENTITY AND REVIEW OF LITERATURE.

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Abstract

Introduction: Unlike unilateral tibia fracture bilateral tibia fractures are rare and often associated with multiple systemic injuries results from high energy trauma in motor vehicle accidents, sports or falls from height. Management and complications of such injuries are little existing in the literature.

Materials and methods: Demographics, the severity of the injury, fracture pattern, the extent of the open fracture, associated injuries and treatments were documented in a prospective, single center study of nine cases. Complications and outcome were recorded in follow-up.

Results: Eight were an adult male and one was a female child. Mean age was 24.55 year (range, 3 to 33). 11.11% had bilateral closed, 22.22% sustained bilateral open, and 66.66% had unilateral open fracture. The most common associated injury was fracture distal radius in 44.44% followed by shoulder dislocation (22.22%) and fracture proximal humerus (11.11%). The New Injury Severity Score was range from 18 to 27. 27.77% (5, tibia) cases (Total 18 tibia) managed with definitive casting and remaining 72.22% cases were treated with immediate (11, tibia) and delayed intramedullary nailing (2, tibia). Complications were included superficial wound infection, wound necrosis and delayed union, required additional surgeries. Average hospital stay was 19.88 days (range, 7-45 days). 66.66% of cases went on heal without complication. The average follow-up was 8 months (range, 3-12 months).

Conclusion: Bilateral tibial shaft fractures can associate with musculoskeletal injuries in other region and show a high rate of open fractures which may require additional procedures.

Keywords: Bilateral tibial shaft fractures; intramedullary nail; Open tibia fracture.

Introduction

Tibia shaft fractures are the most common long bone fractures. They usually occur in young and active patients. A common mechanism of injuries is motor vehicle accidents, sports or falls from a height [1]. Fractures of the tibia occur as a result of strong valgus or varus forces

combined with axial loading [2]. Fracture shaft tibia is well known for the high rate of open injuries due to delicate soft tissue coverage on medial aspect. Bilateral tibia fractures are rare, accounting for approximately 1.8% in children [3] and 4% in the adult [4] of all tibial fracture. Bilateral involvement is often associated with multiple other systemic injuries in the polytraumatized patients result from high energy trauma [5]. There is a strong association of bilateral tibial shaft fractures with high-energy mechanisms, multiple trauma, and mortality. Such injury results in 20% mortality as compared with unilateral where it is 16.3% [4-5]. There is a high rate of open fractures which required the need for additional procedures and create a challenging environment for fracture healing which is only compounded by the presence of bilateral injury [4]. Recommendations for management of tibia fracture is well described in new trauma literature however, these little exist for bilateral tibia fracture [4-7]. These bilateral injuries are complicated by symptomatic hardware, malunion, delayed union, adult respiratory distress syndrome, cast sore, contracture, refracture, compartment syndrome, and infection [2]. We report a prospective study of bilateral tibia fracture in the patients who sustained injury following fall from slope while rock or mountain climbing in hilly terrain.

Materials and Methods

Total 124, tibia fractures from mountain region were admitted in the department of orthopedics; located at foothills from Aug 2014 to Dec 2016. Nine among them were with bilateral fracture tibia. All patients were presented within one week of injury to reception. Patient's particulars; name, age, sex, date and time of the incident, the exact mode of injury, position while the incident was noted. Clinical and initial radiological examination was done on arrival. All patient managed as per advanced trauma life support guidelines [8]. The height of fall, the severity of the injury as per New injury severity score (NISS) [9]' fracture pattern as per Arbeitsgemeinschaft fu¨r Osteosynthesefragen /Orthopaedic Trauma Association (AO/ OTA) classification [10] extent of open fracture and classification [11] and associated injuries were documented (Table I). All patients prospectively enrolled in the study and informed consent was obtained. All open cases were taken for emergent irrigation, debridement and provisional immobilization or definitive fixation within 24 hrs depending on contamination level, soft tissue status, and patient stability. The surgical procedure was performed under regional anesthesia. In supine position on a radiolucent fracture table with the knee on the affected side was flexed to at least 90. The entry side was made using, an incision extending from the inferior pole of the patella to tibial tubercle. A transpatellar split was utilized and the entry site was selected. Entry into the medullary canal was made with an awl. The guide wire inserted and advanced gently past the fracture. Flexible reamer was used in those cases which required reamed nailing. Once the nail inserted proximal and distal locking was performed. The initial intervention followed by events in the management of concomitant injuries, antibiotics, and repeated/secondary procedures; specific investigations required for further evaluation was noted. Complication and outcome were recorded in follow-up at the outpatient department.

Postoperative protocol

All patients were placed in an above-knee plaster cast in 10-degree flexion for 6 weeks followed by patellar tendon bearing plaster cast for another 4 weeks, who were managed by definitive casting. Patients who were managed definitively by surgery, gentle knee and ankle range of motion exercises were started on day 2,

postoperatively. Partial weight bearing ambulation by using assistive devices was allowed after 10 weeks followed by full weight bearing by 12 weeks. Full weight bearing without assistive device was started after 3 months. Rehabilitation for associated fractures was done as per protocol. At the final follow-up, all patients were evaluated for knee and ankle range of motion, delayed non-union and hardware complication.

Results

There were nine patients of bilateral tibia fracture among 124, the incident was 6.45%. Eight were an adult male and one was a female child. Mean age was 24.55 year with a range of 3 to 33 years. Mechanism of injury was fall from slope while rock or mountain climbing in hilly terrain in all patients. Height was less than 7 meter in all cases. One patient (11.11%) had bilateral closed tibial fractures, 2 patients (22.22%) sustained bilateral open fractures, and 6 patients (66.66%) had a unilateral open fracture. As per AO/ OTA classification, there were 5 type 42A2 fractures, 10 type 42A3fractures, 2 type 42B2 fractures and one was type 42C2 fracture among 18 tibia fractures. The most common associated injury was fracture distal radius in 44.44% patients followed by shoulder dislocation (22.22%) and fracture proximal humerus (11.11%), .The NISS was range from 18 to 27 with average 23.11. All accidents were no- life threatening and two bilateral open cases required resuscitation for hypovolumia. Fractures were managed by definitive casting or internal fixation using unreamed intra medullary nailing (IMN) in open fractures and reamed IMN in closed fractures (Table I). Associated fractures were managed as per pattern in four patients and shoulder dislocation was managed by a close reduction in two patients. Fracture proximal humerus in one patient was managed conservatively by the splint. The most frequent secondary procedures were irrigation, debridement and dyanamization in those cases who had open fractures. In one case, split skin grafting done for wound necrosis. Dyanamization was done in one case for the delayed union. Complications were included superficial wound infection in open cases and delayed union, required additional surgeries. Reduced range of motions at ankle joint was present in four cases. Average hospital stay was 19.88 days (range, 7-45 days). Six cases went on heal without complication. The average follow-up was 8 months (range, 3-12 months).

Discussion

Bilateral fracture shaft of the tibia is rare entity both in adult as well as in children, results from high energy trauma as in motor vehicle accidents and associated with multiple severe consequences. Incident was 6.45% as compared to injury results from motor vehicle accidents where it is 4% in other studies [4-6].

Presentation of this injury was quite different. In our experience main reason was when person fall from slope of rock or mountain during climbing, the amount of energy imparted to the leg after primary feet impact over ground ; subsequently to hand and then whole upper limbs secondarily leads to such injuries. Most of cases in our study were sustained associated fracture distal radius, fracture proximal humerus and shoulder dislocation which was not encountered in other published studies. None of our cases were reported with chest, facial, intracranial and abdominal injury as these are common associated injuries in motor vehicle accidents, reported in 10 cases in series of 14 in other study [4]. These multiple systemic concomitant involvement is responsible for 20% mortality in bilateral cases compared to unilateral where it is 16.3% [6] which was not experienced in our cases.55.55% fractures pattern were of transverse type, 27.77% fractures pattern were of oblique type and rest 16.66% fractures pattern of bending wedge in 2

cases and segmental type was found in one case. In another study, there were 37 type 42A fractures, 52 type 42B fractures, and 47 type 42C fractures in 72 patients [12]. We believe that fall from height while rock or mountain climbing tend to create more compressive forces results in relative simple fracture configuration as in our cases. In a multicentre analysis of bilateral tibia fracture, there were 18% cases of closed fracture, 37% cases were of bilateral open fracture, and 44% cases had unilateral open fractures [12]. In total 18 tibia in our study, 55.55% sustained open fracture of which there were 22.22% Gustillo type IIB, 22.22% Gustillo type IIIA and 11.11% Gustillo type IIIB fractures. We believe motor vehicle accidents are responsible for more open tibial fractures due to high energy director side impact rather than fall from slope of rock or mountain. We have calculated trauma severity from NISS in our study instead of ISS as it may find differences in bilaterality which is not encountered in earlier studies. It is defined as the sum of the squares of the Abbreviated Injury Scale scores of each of the patient three most severe injuries regardless of the body region in which they occur [9]. The ISS has been shown to under-represent injury severity by not accounting for multiple injuries in the same anatomic region and acknowledging, at most, three-systems of injury. The lower ISS scores in other bilateral injury studies could also be skewed by the ISS itself because it is limited in evaluating bilateral injuries because only one (the worst) is utilized in grading [13-15]. We were treated 27.77% (5 tibia) our cases (Total 18 tibia) with definitive casting and remaining 72.22% cases were treated with immediate IMN (11 tibia) and delayed IMN (2 tibia) after temporary external fixation removal. We used undreamed IMN in open fractures. In a study of 14 patients, initial treatments were included 12 immediate plate fixations, five immediate IMN, five delayed IMN, and four casts [4]. In another study of 12 patients (Total 24 tibia), were treated by primarily IMN [5]. In most of studies, authors did not comment on a greater need for soft-tissue reconstruction procedures, effect of reamed and undreamed nailing on outcome [4-5, 12]. We done staged wound closure in two cases and split skin grafting in one case for wound necrosis. We did not experience any adverse outcome of reamed and unreamed nailing in our cases. One of our case (children) was unusual, bilateral tibial fracture with fracture proximal humerus managed with definitive casting. No similar case was found on literature search except bilateral fracture of proximal tibia in healthy adolescent girl [16]. Hospital stay was consistent with other study where it was 21 days [12]. However, two cases were stayed longer due to requirement of soft tissue procedures.

One patient in our study (one tibia) was developed delayed union for which dynamization was done. We have not experienced delayed bone grafting, amputations, symptomatic hardware, and malunion, cast sore, contracture, refracture, compartment syndrome, which were noted in other old studies [4-5]. We have not observed any respiratory complication or mechanical ventilation in our cases treated with bilateral IMN. The reason is that the approaches and techniques in care of multiply injured patients continue to evolve. These adaptations have resulted in less infection, fewer secondary procedures and faster union [17-19]In our study all patients were independent ambulatory and three patients (33.33%) used assistive devices for ambulation at final follow up whereas in another study of 72 patients, it was 24% [12].

In our study, we were able to identify the most frequently encountered associated injuries, their evaluation and complication rates in patients who were presented with bilateral tibia fracture in hilly terrain. Our

study has its limitations, as the height of fall was considered as told by the patient or attendant. No site visits were conducted to determine the exact height of the fall. We believe further studies will require with longer follow up and large sample size to perform comparative or correlating statistics. No prospective data exist regarding the efficacy of new injury severity score in evaluating trauma severity, associated musculoskeletal injuries; effects of reamed and undreamed nailing on the outcome, bilateral involvement in children who are presented with bilateral tibia fractures. Our study was not large enough to conclude such data.

Conclusion

The results of our study show that bilateral tibial shaft fractures can occur after falling from slope while rock or mountain climbing in hilly terrain. These injuries can associate with other musculoskeletal injuries and a high rate of open fracture which may require additional procedures. Evaluation of severity and management as per trauma recommendation leads to a successful outcome in such type of injuries.

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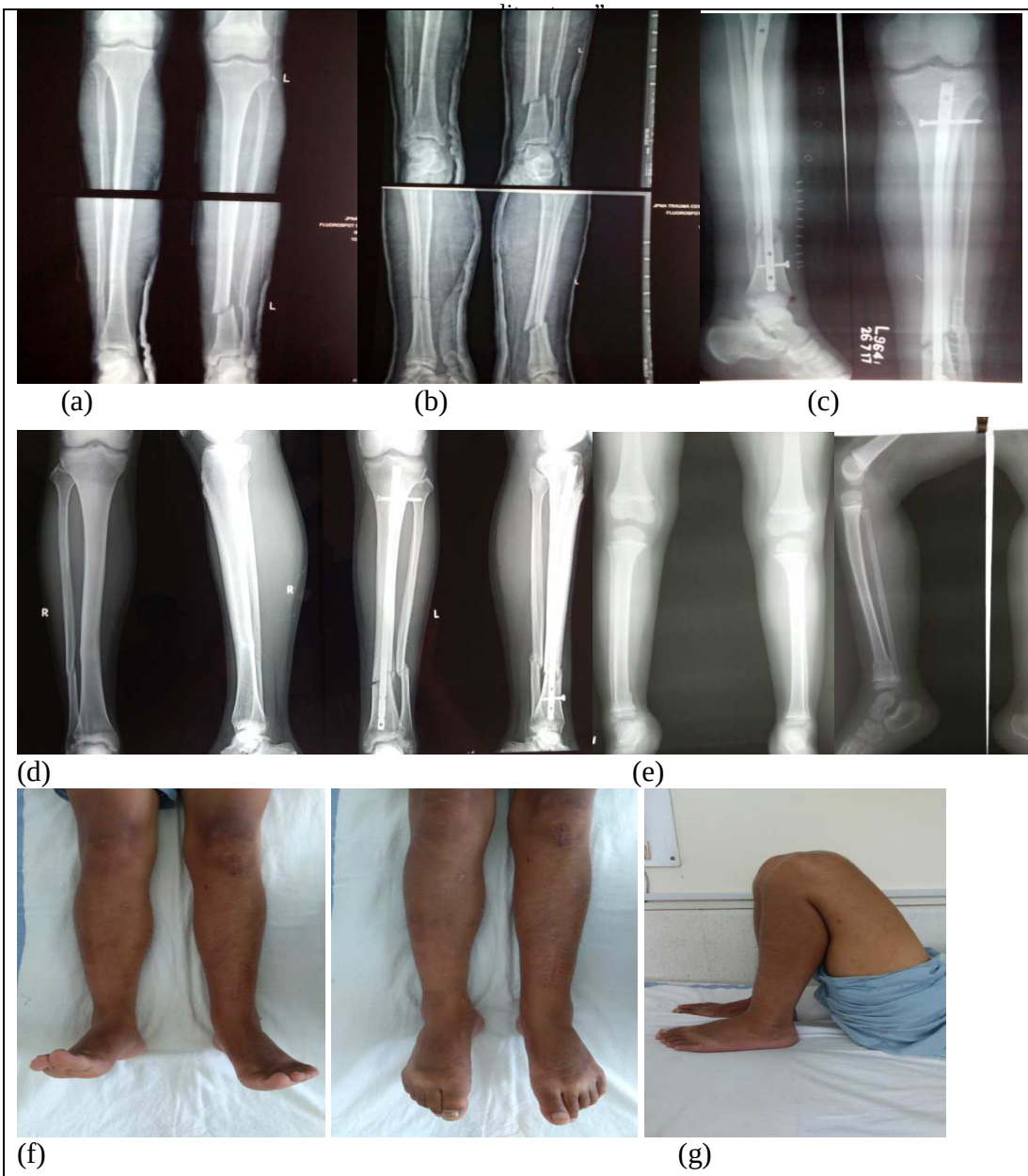

Fig. 1 (a), (b) Preoperative digital radiograph, (c) Digital radiograph left after operation, (d) Digital radiograph at 9 month showing delayed union left in patient no 1. (e) Standard radiograph showing tibia fracture in patient no 8. (f), (g) Clinical photograph showing range of motions.

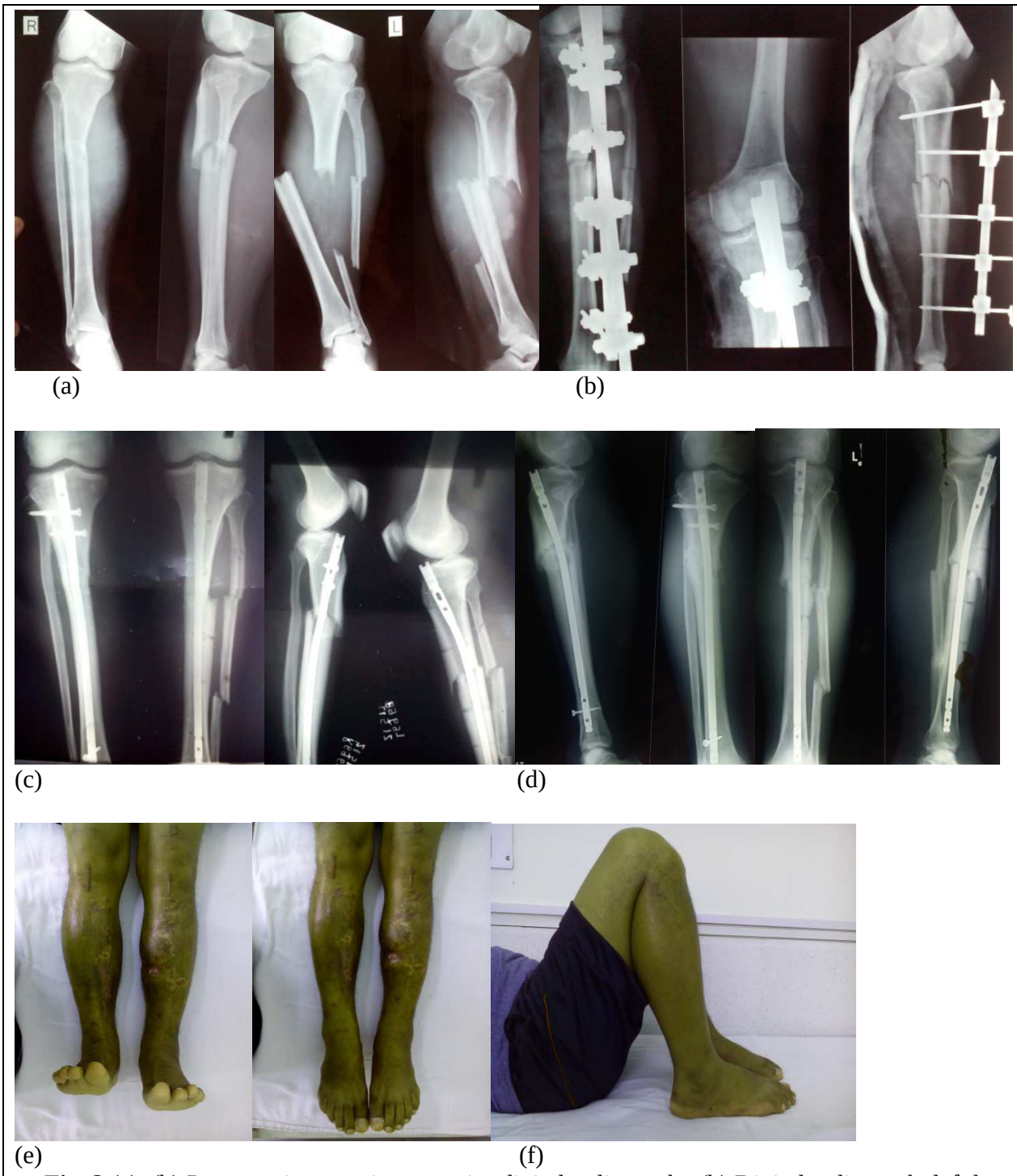

Fig. 2 (a), (b) Preoperative anterior posterior digital radiograph, (b) Digital radiograph left leg showing External fixator in situ, (c) Standard radiograph after definitive fixation, (d) Digital radiograph at 6 month, (e), (f) Clinical photograph showing range of motions in patient no 6.

Table I: Demographics and associated data.

Patient No	Age/ Sex	Associated injury	OTA	Close/ Open Grade (R/L)	NISS	Treatment (R/L)	Complication	additional surgery	Follow up (In months)
1.	20/M	R-Fracture distal radius	42A3[#]	Close IIB	27	Definitive casting[*] ORIF with IMN[$]	Delayed union* Reduced ROM	Dynamization[*]	9
2.	27/M	-	42A2[#]	Close IIIA	18	CRIF with IMN[&] CRIF with IMN[$]	-	-	6
3.	26/M	R- Fracture distal radius	R-42A3 L-42A2	Close IIB	27	Definitive casting[*] CRIF with IMN[$]	-	-	12
4.	33/M	L-Shoulder dislocation	R-42A3 L-42C2	IIIA IIIB	22	CRIF with IMN[$] Provisional external fixation Definitive CRIF with IMN[$]	Superficial wound infection[*] Wound necrosis	Staged wound closure Split skin grafting*	12
5.	23/M	R- Fracture distal radius	R-42A3 L-42A2	Close IIIA	27	CRIF with IMN[&] ORIF with IMN[$]	-	-	12
6.	32/M	L- Shoulder dislocation	42A3[#]	IIB IIIB	22	CRIF with IMN[$] Provisional external fixation Definitive CRIF with IMN[$]	Superficial wound infection[#] Reduced ROM	Wound debridement Staged wound closure*	6
7.	23/M	-	R-42A2 L-42B2	IIB Close	19	CRIF with IMN[$] Definitive casting[*]	Reduced ROM	-	6
8	3/F	R-Fracture proximal humerus	42A3[#]	Close	27	Definitive casting[#]	-	-	6
9.	34/M	-	R-42A3 L-42B2	Close IIIA	19	CRIF with IMN[&] CRIF with IMN[$]	Superficial wound infection*	-	3

Abbreviations:-M-male; R-Right; L- Left; OTA- Orthopaedic Trauma Association; NISS-New Injury Severity Score; ORIF-Open Reduction Internal Fixation; CRIF-Close Reduction Internal Fixation; IMN- Intra Medullary Nailing; #:- Bilateral limb; [*]:- Unilateral limb; $:-Unreamed Nail; &:- Reamed Nail; ROM:- Range of motion.