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Unreamed Tibia Intra Medullary Interlocking Nails to Prevent Complications & Fat Embolisms as A Damage Control Orthopaedics in Human Even in COVID 19 Era- Legacy of Method for These Common Musculoskeletal Injuries

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Abstract

Introduction: Tibial fracture is one of the commonest bony injuries associated with increasing number of road traffic accidents in developing countries. The long bone contains long medullary canal & have a subcutaneous position. Reaming of medullary canal may increase the chances of fat embolisms syndrome & increase the inflammatory response. Controversy prevails between reaming & unreaming of the medullary canal as considered the fracture union, ease & short surgical time & systemic complications. ***Objective:*** The objective of the study is to evaluate the results of short surgical time & unreamed vancomycin dipped tibia interlocking nail surgery in hanging leg position for tibia fractures. ***Material & Methods:*** In this study total (n= 49) cases of tibia fracture who underwent unreamed tibia nailing were evaluated retrospectively. Among (n=49) cases (n= 35) 71% were males & (n=14) 29% were females. According to Ellis classification (n=20) patients had mild, (n=25) patients had moderate & (n=4) patients had severe variant. ***Results:*** In the study total number of cases with tibia fracture included where commonest mode of injury was vehicular accident (n=40) (82%) and fall from height (n=9) (18%). Patients who were operated late had associated injuries that prevent early operation. Rust score was used for radiological union score. Mean value of rust score for this study was 8.8 with Inter observer agreement among all three reviewers was substantial, with ICC=0.78(95% CIs 0.65-0.90). Follow-up duration varied from 1 to 6 months with one patient had infection at surgical side and went for debridement and intravenous antibiotics for recovery. ***Conclusion:*** Unreamed interlocking tibial nailing can be safely used for type-I and type-II open injuries even with delayed presentation. Compared to reamed nail there is ease of technique application and the decreased operative time in unreamed interlocking nailing.

Key words: Reamed, unreamed, interlocking nailing, fracture shaft of tibia.

INTRODUCTION

Leg bone fractures are one of the commonest road traffic & heavy accident injuries. These injuries lead to long bone of leg fractures & heavy immobility to the patients. Treatment options include cast immobilization, open reduction and internal fixation with plates, external fixator, and intramedullary nailing [1]. These fractures pose a serious problem because of their subcutaneous location and precarious blood supply and resultant problems in union. Fractures of the tibia cannot be treated successfully in all cases with only one approach or a single simple set of rules [2-4].

The successful results of the treatment include good bony union, early rehabilitation, infection free treatment outcome, Prevent discrepancy & prevention of complications [5]. External fixation leads to less

early complications but also leads to high chances of nonunion& revision surgery, pin tract infections & other complications. Enders' nails & other elastic nails also lead to high hances of nonunion& malunion [6].

For tibial diaphyseal shaft fractures tibial interlocking nail has been the gold standard. The different techniques of interlocking nail include reamed vs undreamed nailing, traction table vs hanging leg method vs simple table method [7-9].

As per the other studies reaming of the long bones liberates IL-6 & other related inflammatory mediators. Some studies suggested that undreamed interlocking nail yield less complications & better results while other suggests no significant difference [7, 9, 10]. Some studies suggest that reaming will fetch early union & better outcome [11]. Many studies in the recent time focused on Second hit phenomenon of the trauma inflammatory & stress response & its implications [12].

MATERIAL & METHODS

A retrospective study was conducted on (n=49) patients with displaced tibia or tibia fibula shaft fractures. All (n= 49) patients with tibia fractures were treated with closed reduction and internal fixation using unreamed tibia interlocking nail. Out of (n= 49) patients (n=34) were male & (n=15) were female patients. In no case any bone grafting was performed. All the fractures were treated under image intensifier television by trained orthopaedic surgeons.

Fractures were classified according to Ellis classification. (N=20) patients had mild; (n=25) patients had moderate & (n= 4) patients had severe variant [13] (Table 1).

Table-1: Ellis Classification

Characteristics	Mild	Moderate	Severe
Deviation	0-50% diameter	51-100% diameter	100%
Comminution	0 or minimal	0-1 fragment	>/= 2 fragments/segments
Soft Tissue	Closed grade 0, open grade 1	Closed grade 1, open grade 2	Closed grade 2-3, open grade 3-4
Energy	Low	Moderate	High
Mechanism	Helical	Obliquely oriented/ cross sectional	Cross sectional/ fragmented.

INCLUSION CRITERIA

a. Skeletally mature patient was chosen (above age 18 years).
b. Open fracture grade I and grade II (Gustilo and Anderson classification)[6]
c. Patient with isolated tibia shaft fracture.

EXCLUSION CRITERIA

a. Skeletally immature patient (below age 16 years).
b. Open Grade IIIa (Gustilo and Anderson classification).
c. Fractures extending to an articular surface.
d. Fractures with neurovascular injuries.
e. Pathological fractures were excluded from the study.

For Grade I and II, antibiotic prophylaxis and tetanus prophylaxis were administered, and wound dressing was performed; internal fixation was undertaken at an appropriate time. All fractures were classified according to AO classification for diaphyseal fractures of tibia. All the patients underwent fracture fixation under spinal/epidural anesthesia. All cases were done in hanging leg method. An anterior midline patellar ligament splitting approach was used. Nail length was measured preoperatively and then confirmed on table with the help of image intensifier. After the entry made with owl the straight canal opener passed up to upper one third of the tibia length. The flexible guide wire passed from proximal entry (which was made by owl) & made cross the fracture site & secured in the distal fragment cancellous metaphyseal bone centrally both in anteroposterior & lateral views checked under image intensifier (IITV) television. Then the undreamed tibia interlocking nail passed over the guidewire according to checked nail length under IITV. The interlocking nail secured proximally & distally by the interlocking screws.

Fig-1: Shows entry point of the nail

Fig-2: Shows nail with its proximal and distal locking bolts & Herzog curve [7].

For accessing the outcome RUST score was used (Table: 2). It is a novel fracture assessment tool that was developed to help standardize the radiographic assessment of tibial fractures [14]. This score assesses cortical bridging, which has been shown to correlate with the biomechanical strength of the fracture site in *in vivo* models [15].

The RUST scoring system evaluates radiographic fracture healing based on the bridging of each cortex in two radiographic planes (i.e. anterior-posterior and lateral planes). Each of the four cortices is assigned a score of 1 (fracture line, no callus), 2 (bridging callus with visible fracture line), or 3 (bridging callus with no evidence of fracture line) to produce a cumulative score from 4 to 12, with higher scores indicating greater radiographic healing [16].

The three examiners were used to take scores at 1 month, 3 month and then 6-month intervals. Intraclass correlation coefficients (ICC) with 95% confidence intervals (CI) were used to measure agreement in the observer's RUST scores. The ICC, used to quantify agreement for a continuous variable, is equivalent to the quadratically weighted kappa [17] for categorical data. The weighted kappa, as described by Fleiss [18], adjusts the observed proportion of agreement by correction for the proportion of agreement that could have occurred by chance alone. Landis and Koch [19] suggest kappa of 0 to 0.2

represents "slight agreement," 0.21 to 0.40 "fair agreement," 0.41 to 0.60 "moderate agreement," and 0.61 to 0.80 "substantial agreement." A value above 0.80 is considered almost "perfect agreement." The value of the ICC ranges from +1, in which case there is "perfect agreement," to -1, which corresponds to "absolute disagreement.

Table-2: Assessment Tool for the Radiographic Union Score for Tibial Fractures (RUST)

Cortex	Fracture Line, No callus (Score =1)	Fracture Line, Visible callus (Score=2)	No fracture line, Bridging callus (Score=3)	Total score: Minimum = 4, Maximum =12
Anterior				
Posterior				
Lateral				
Medial				

RESULTS

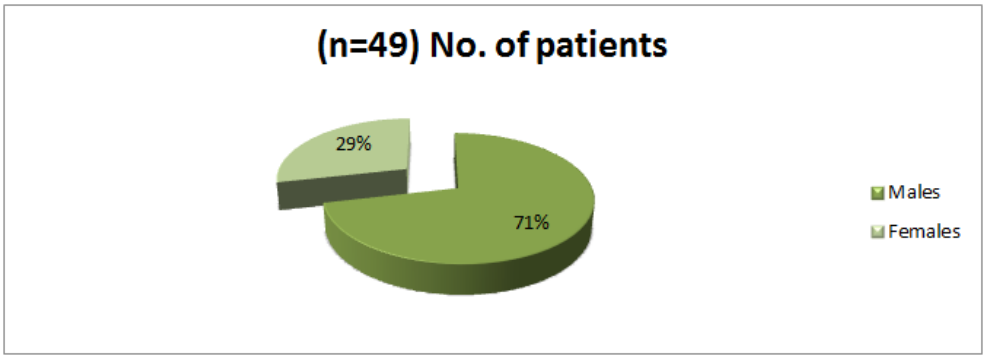

Chart-1: Sex distribution of the study patients

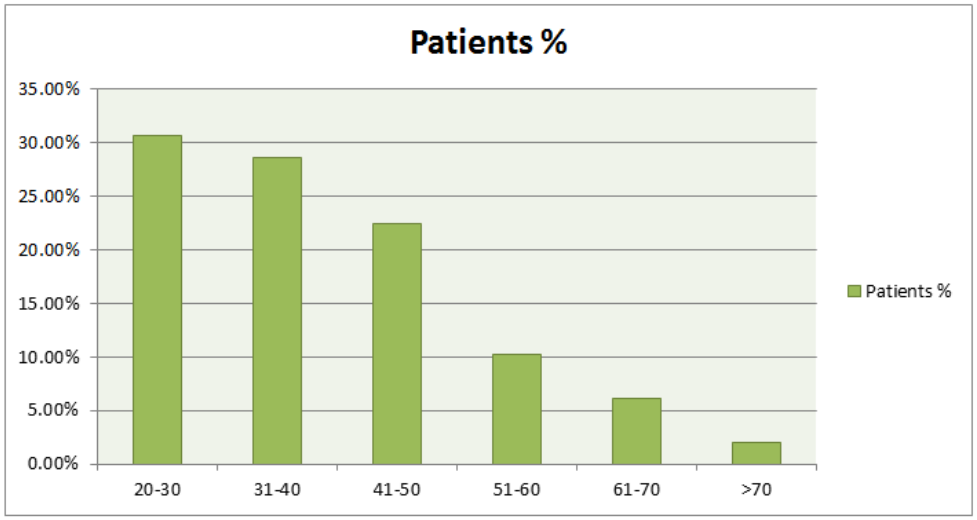

Chart-2: Age distribution of the patients

In our study 15 patients were between 20-30 years,14 of 31-40,11 of 41-50,5 of 51-60,3 of 61-70,1 of >70 years of age out of (n=49) patients.

Table-3: Injury to surgery interval

Interval (weeks)	No. of Fractures
7 days	45 (91.9%)
7-10 days	3(6.1%)
>10 days	1 (2 %)
Total	49

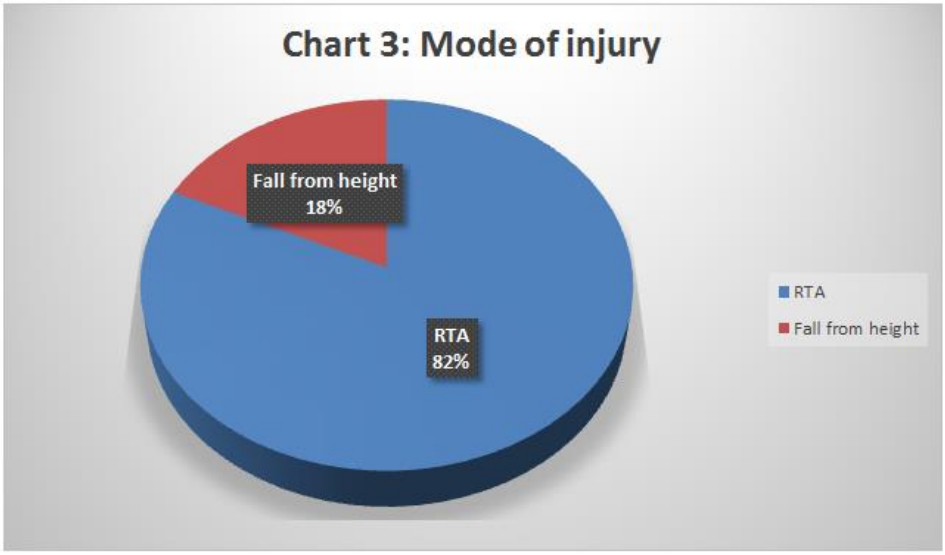

Chart-3: Commonest mode of injury was vehicular accident (n=40) (82%) and fall from height (n=9) (18%). Patients who were operated late had associated injuries that prevent early operation.

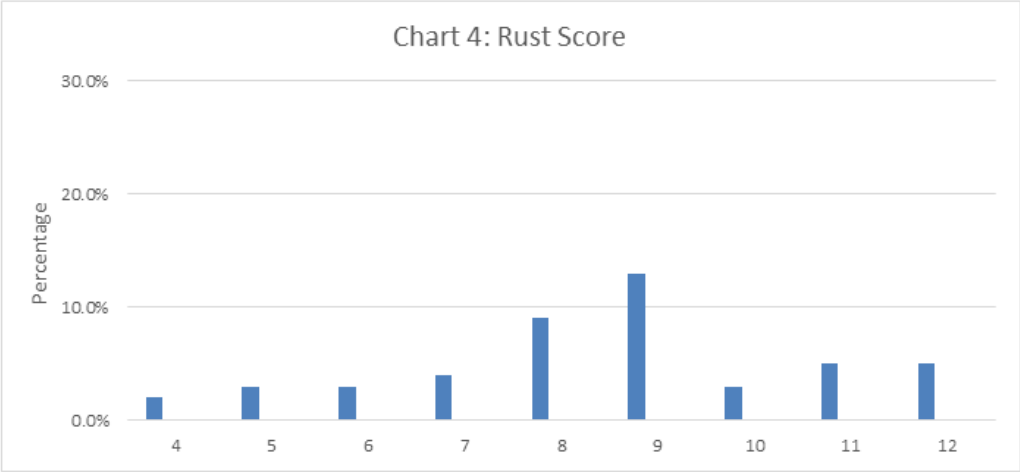

Chart-4: RUST Score

Among 49 radiographs, the RUST score ranged from 4 to 12 with mean score of 8.8 with standard deviation of 2.8 (Chart 4). Interobserver agreement among all three reviewers was substantial, with ICC=0.78(95% CIs 0.65-0.90).

On discharge we had mobilized 96% (n= 47) of our patients, with non-weight bearing crutch walking. 4% (N=2) patients were discharged with mobilization in bed with high sitting as all of them have associated injury. Commonest nail size used 36 cm and commonest nail diameter used was 9 mm.

Follow-up duration varied from 1 to 6 months; all (n=49) patients were available for the regular follow-up and final assessment. 48 Patients fracture was united clinic radiologically with good outcome. One patient had surgical site infection with the implant insitu (n=49) (3%). He was taken for debridement of the wound. The wound shows Klebsiella growth on pus culture sensitivity. He was advised for repetitive dressings &injectable antibiotics for 3 weeks followed by oral antibiotics. He has been showing poor signs of union & yielded poor outcome.

Fig-2: Pre-operative and Post-operative X-ray

DISCUSSION

Intramedullary nailing is a well-established method for stabilization of long-bone shaft fractures. But the choice between reamed and unreamed intramedullary nailing for the treatment of tibial fractures is a hot topic. In the past, experimental and clinical studies have found that the changes in cardiac and pulmonary hemodynamics, the biomechanical testing of stiffness and strength, the circulation of the surrounding muscles and intramedullary pressure are different between reamed and unreamed intramedullary nailing [20-22]. The first report solely dedicated to the use of unreamed nailing in distal tibial fractures was attributed to Richter *et al*. in 1997 [23].

Reaming resulted in the destruction of all vessels of the medullary canal, rigid nailing with reaming leads to a higher incidence of infection as dead bone produced due to reaming (debris/endosteal necrosis) acts as a good culture medium for bacteria [24-25], while medullary nail without reaming caused minor damage to the blood supply. Court Brown CM *et al.* [26-28] made a prospective study in (n=50) cases and concluded that reamed is better than unreamed nailing in tibial closed fractures. Mohit Bhandari *et al*. [29] conducted a multicenter, blinded randomized trial of 1319 adults in whom a tibial shaft fracture was treated with either reamed or undreamed intramedullary nailing and demonstrated a possible benefit for reamed intramedullary nailing in patients with closed fractures. They found necrosis of the inner 50- 70% of the cortex after reaming.

In this study the average union rate was around 20.3 weeks, the union time was 36.7 weeks in the study by Court Brown *et al*. [28]. In this study mean rust score was 8.8 with ICC=0.78(95% CIs 0.65-0.90) compared to Mohit Bhandari *et al*. [29] who had mean rust score of 8.3 with ICC = 0.86 (95% CI, 0.79–0.91). R. Maharjan *et al*. [30] in their study mean RUST score was 9.9 at 24 weeks compared to 8.8 in this study.

Table-4: Comparison of Keating *et al*. [36] Blanchet *et al.* [37], Puri S. *et al*. [35].

Coloum	Keating *et al*.	Blanchet *et al.*	Puri S	Our study
No. of Pt	41	56	20	49
Union rate	88%	89%	95%	97%
Nonunion rate	12%	11%	5%	3%
Infection	2.4%	4.3%	5%	3%

Intramedullary nailing process and reaming techniques are known to produce increased intra-canal pressure followed by fat emboli intravasation [31]. Several studies have assessed the effects of nail insertion with and without reaming the canal [32]. Reaming procedure is considered responsible for increasing medullary canal pressure. So, in this study with usage of unreamed we have overcome such complication especially in this covid 19 era where bad chest accentuates complications. There are studies which shows use of unreamed tibia nail gives excellent results in grade I and Grade II fractures [33] and even as part of damage control orthopedics in multiple injured patient putting temporary external fixator, unremed nail plays important role as such patient polytrauma will be undergoing simultaneous surgery for other injuries and this technique offers the advantages of rapid stabilization performed under controlled circumstances in the operating room, without some of the disadvantages of using external fixation in this situation [34].

CONCLUSION

Unreamed interlocking tibial nailing can be safely used for type-I and type-II open injuries even with delayed presentation. Compared to reamed nail there is ease of technique application and the decreased operative time in unreamed interlocking nailing with

good bone union. This can potentially reduce the systemic complications & healthcare morbidity.

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