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Various modalities of management of segmental fractures of long bones: A prospective study in a tertiary care teaching hospital in Telangana India

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Abstract--Introduction: Segmental long bone fractures in high energy injuries are a challenging combination of bone and soft-tissue damage and loss. The state of the surrounding soft tissues and the local blood supply to the bone are the most important factors determining the tendency of the fracture to heal. Objectives: To study the efficacy and safety of various method of treatment in segmental fractures long bones and various complications associated with it. Materials and Methods: 20 patients with segmental fractures of long bones, satisfying the inclusion criteria, who were treated with various modalities of management were included in the study. The fractures were evaluated clinically as well as radiologically and the modality of management was based on the type of fracture and associated injuries. Out of 10 tibial fractures, 6 were treated with static intramedullary nail, and 2 with external fixator 2 conservatively. Out of 5 femoral fractures, 4 were treated with intramedullary nail. Out of 2 humerus fractures 2 were treated with dynamic compression plate technique. Out of 3 both bone forearm

fractures 3 were treated with dynamic compression plate technique. Results: Out of the 20 patients 10 patients were in the age group of 18 to 30 and 6 patients were in the age group of 31-40 and 4 patients were in the age group of 41-60. Young active adults in the age group of 18 -30 years are most commonly affected in this study. Sex ratio is 4:1. Males are most commonly affected than females in this study. In this study right side is most commonly affected than left side, Road traffic accident is the most common mode of injury. Most of the fractures are closed and G1 compound fractures. In this study most of the cases 60 % people treated by ILN nailing, 20% plating, 10 % ilizarov, 10% conservative. Most of the patients 36% are had no complication ,27% patients devolpoed pain, 9% patients infection, 9%stiffness,9% shortening,5% delayed union, 5% non union.Based on the dash score (upper limb) and neer-granthamand Shelton score(lower limb) 13 patients fractures corrected with excellent healing.05 patients fractures corrected with good improvement and 02 patients fractures corrected with poor healing. Conclusion: From the results it can be concluded that still conservative management plays a significant role particularly in those with undisplaced closed segmental fractures who are either those who have not sustained any other system or bone injury as well as unfit for major surgery. External fixators (ILIZAROV) are significant tools in the correction of Grade III compound fractures.

Keywords--segmental fracture, long bones, surgical management, plate technique, conservative management.

Introduction

Fractures of segmental long bones in high energy injuries are a challenging combination of bone and soft-tissue damage and loss¹. The local blood supply to the bone and state of the surrounding soft tissues are the two most significant factors that determines the tendency of the fracture to heal.This is usually compromised in segmental fractures due to reduced blood supply to the middle segment in addition to the injury to the surrounding soft tissues.This often leads to nonunion or delayed union². These fractures are generally caused by a high-energy trauma, motor vehicle and motorcycle crashes³, falls from a height, industrial and train accidents.Very few research studies were carried out in the eighties and nineties to study and to found out the significant understanding of these fractures and its special challenges in management and the treatment protocols were recommended based on the their results.Hence there is real need for more studies to understand the behavior of these fractures and to establish the proper management protocols. Hence the present study was carried out to evaluate the various modalities of management of segmental fractures and to identify the complications encountered during the course of the treatment.

Materials and Methods

This study titled “Various Modalities of Management of Segmental Fractures of Long Bones: A Prospective Study in a Tertiary Care Teaching Hospital in Telangana India” was carried out during the period of September 2018 to March 2020. This study was carried out on 20 adult patients with segmental fractures of long bones, satisfying the inclusion criteria, who were treated with various modalities of management. The study is carried out in Osmania Medical College and General Hospital, Afzalgunj, Hyderabad with an aim to study the Various Modalities of Management of Segmental Fractures of Long Bones. The patients who were available for regular follow up for a minimum period of 18 months were included in the study

Inclusion criteria

- Age >18 yrs
- All segmental fractures
- Radiological evidence of fused physis

Exclusion criteria

- Associated vascular injury
- Neurological injury
- Pathological fracture
- No indication surgical management
- Associated comorbid conditions which increases high risk of surgery

Ethics

This study was approved by the Institutional Ethics Committee Osmania Medical College and General Hospital, Afzalgunj, Hyderabad. An informed written consent was taken from all the patients involved in the study after explaining regarding the study.

Study Procedure

All the stable patients and polytrauma patients undergoing emergency procedures and DCO were analysed with standard parameters and taken up for definitive fixation once they satisfy all the inclusion criteria. After the patient with segmental fracture was admitted to hospital, all the necessary clinical details were recorded in proforma prepared for this study. The fractures were evaluated clinically as well as radiologically and the modality of management was based on the type of fracture and associated injuries. Out of 10 tibial fractures, 6 were treated with static intramedullary nail, and 2 with external fixator 2 conservatively. Out of 5 femoral fractures, 4 were treated with intramedullary nail. Out of 2 humerus fractures 2 were treated with dynamic compression plate technique. Out of 3 both bone forearm fractures 3 were treated with dynamic compression plate technique. After the completion of the hospital treatment, patients were discharged and called for follow up at outpatient level at regular intervals for serial clinical and radiological evaluation.

Statistical Analysis

Data obtained was analyzed using the SPSS Version 17 software and, arranged according to characteristics and represented as a number and percentage of respondents.

Results

Twenty patients with segmental fractures of long bones, satisfying the inclusion criteria, who were treated with various modalities of management were included in this study.

Table 1
Age distribution

Age group(in years)	Number of cases	Percentage
18-30	10	50
31-40	6	30
41-60	4	20

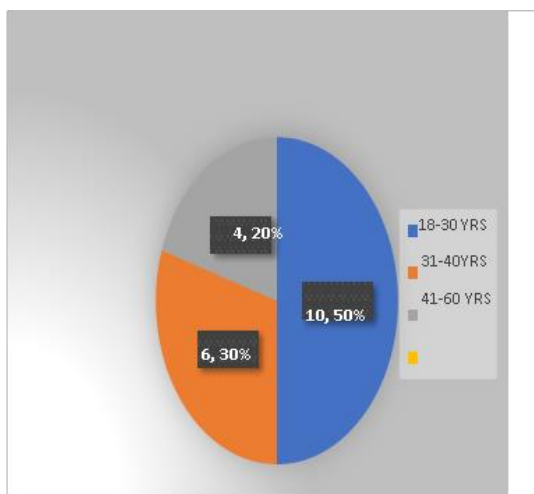


Figure 1. Age distribution

Out of the 20 patients 10 patients were in the age group of 18 to 30 and 6 patients were in the age group of 31-40 and 4 patients were in the age group of 41-60. Young active adults in the age group of 18 -30 years are most commonly affected in this study

Table 2
Gender distribution

Gender of the patient	Number of cases	Percentage
Female	4	20
Male	16	80
Total	20	100

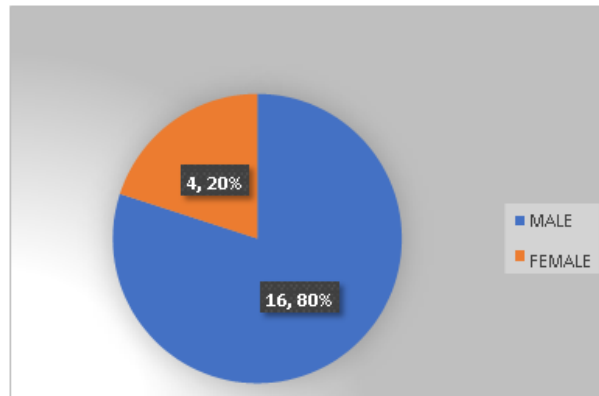


Figure 2. Gender distribution

Sex ratio is 4:1. Males are most commonly affected than females in this study

Table 3
Side Effected

Side effected	Number of cases	Percentage
Right Side	17	80
Left Side	03	20
Total	20	100

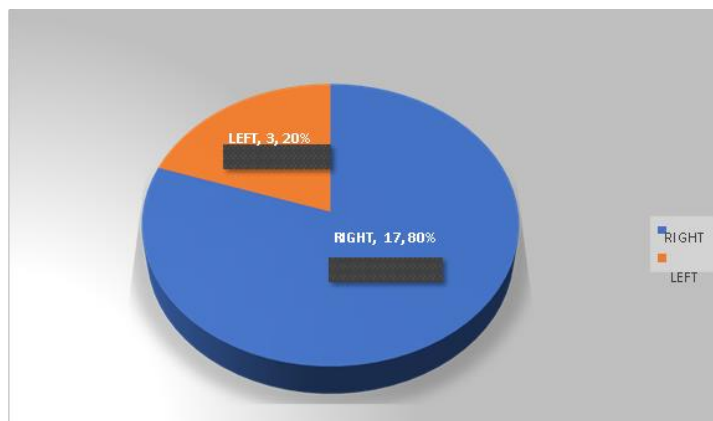


Figure 3. Side effected

In this study right side is most commonly affected than left side

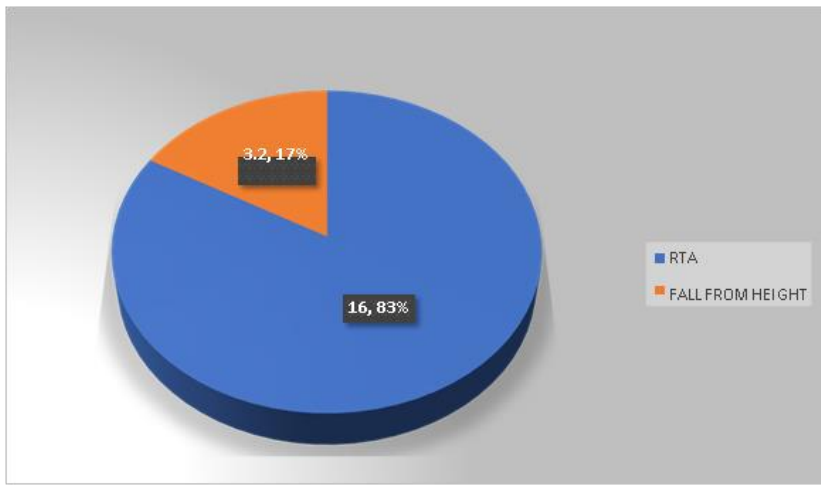


Figure 4. Mode of Injury

RTA is the most common mode of injury

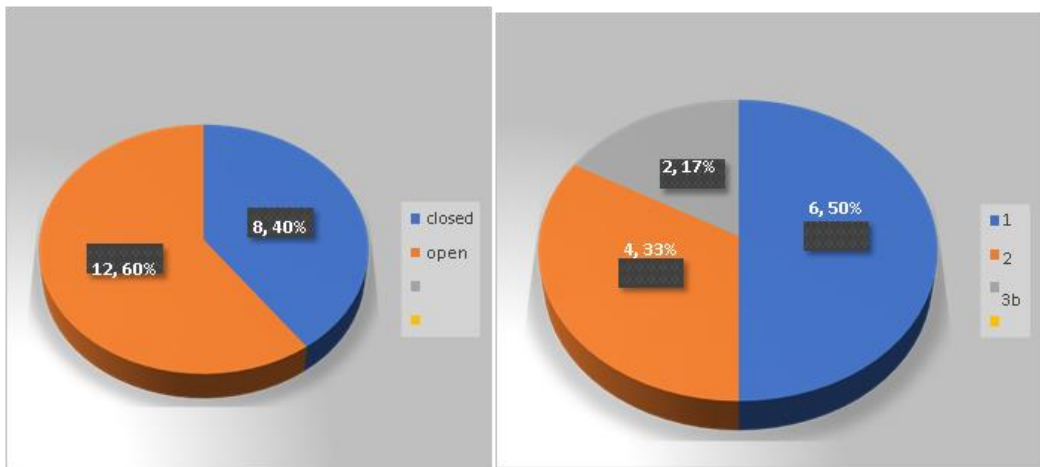


Figure 5. Type of (closed/ open) fractures

Most of the fractures are closed and G1 compound fractures in this study

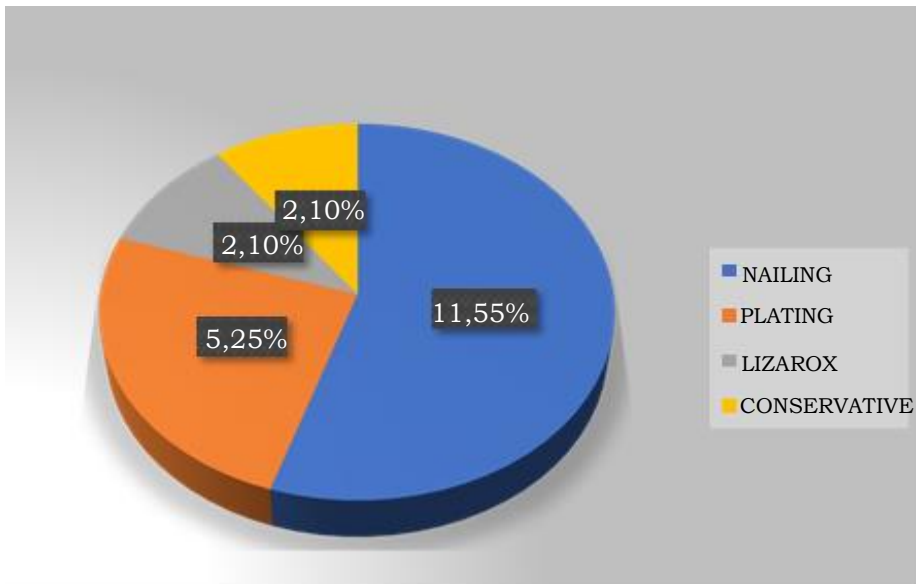


Figure 6. Type of fixation (treatment)

Most of the cases 60 % people treated by ILN nailing, 20% plating, 10 % ilizarov, 10% conservative

Table 4
Associated Injuries

Associated injury	No of patients
Acetabulum fracture on right side	1
closed both bone fracture left leg	1
Closed shaft of femur fracture	1
Grade II compound fracture both bone right leg with closed clavicle fracture left side	1
Superior pubic ramus fracture	1
Left clavicle fracture	1
Nil	14
Total	20

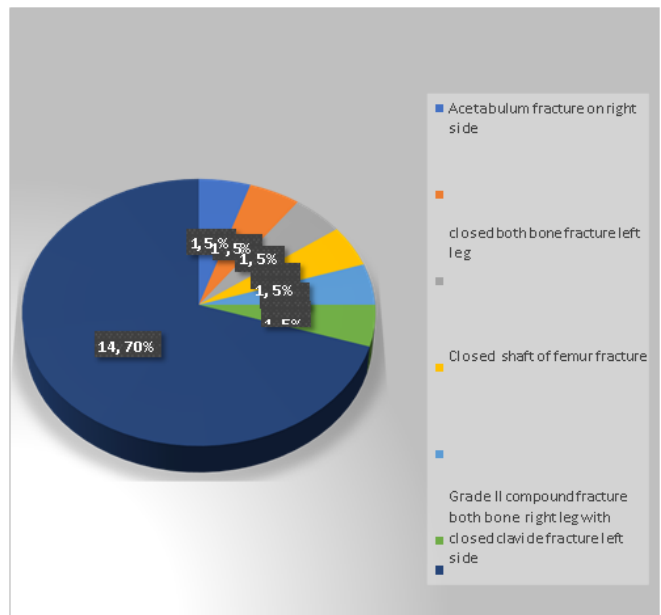


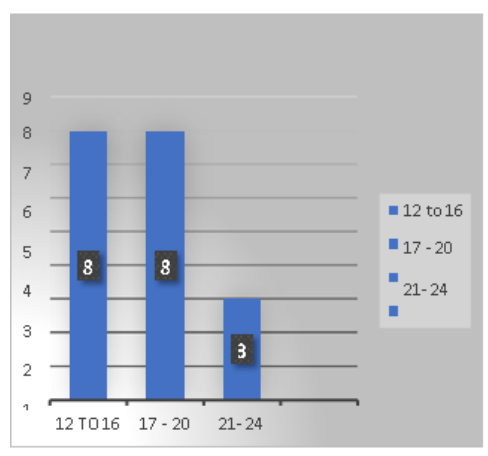
Figure 7. Associated Injuries

Table 5
Segment length to fracture union rate in weeks

SEGMENT LENGTH IN CMS	FRACTURE UNION IN WEEKS
4 - 8	12 -20
9 - 12	18 - 24
13 - 16	22 -32

If the fracture segment length is more fracture union takes more time

Proximal Fracture



Distal Fracture

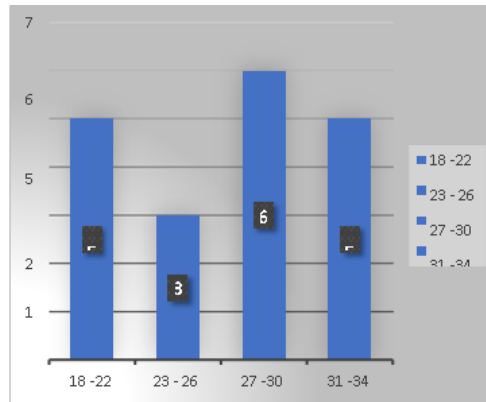


Figure 8. Fracture union in weeks

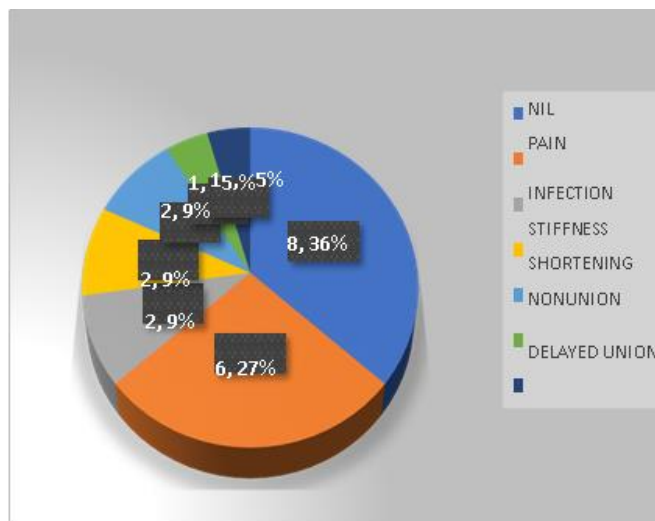


Figure 9. Complications

In our study 36% patients are had no complication ,27% patients developed pain, 9% patients developed infection, 9% patients developed stiffness,9% patients developed shortening,5% patients developed delayed union, 5% patients developed non union

Table 6

Dash Score (upper limb)/Neer-Granthamand Shelton(lower limb).

EXCELLENT	13
GOOD	5
FAIR	-
POOR	2
TOTAL	20

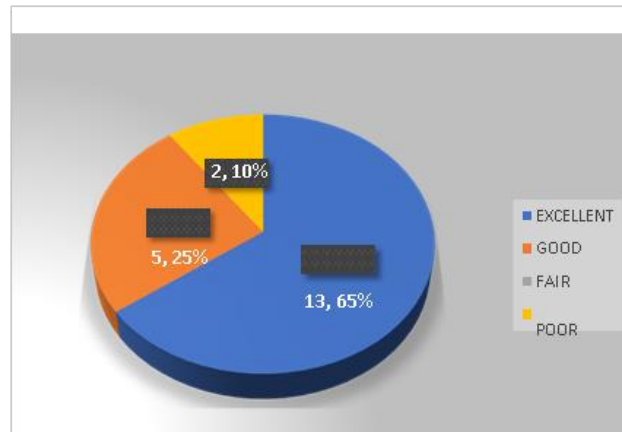
Preop ap view**1 Month Follow Up (Ap View)**

Figure 10. Dash Score (upper limb)/Neer-Granthamand Shelton(lower limb).

Discussion

In our study 20 adult patients with segmental fractures of long bones, satisfying the inclusion criteria, who were treated with various modalities of management were included in the study. Segmental fracture is a fracture of long bone at two different levels, with the intermediate fragment possessing an intact tubular or split structure and usually caused by high energy trauma⁴ and is associated with severe soft tissue injuries⁵. In the present study, most of the patients were men and 50% were of the age group 20-40 year i.e. those who were leading an healthy

active life. All these fractures and hence needed more attention towards preventing infection¹³. All these fractures were associated with significant soft tissue injuries⁵. Out of 10 tibial fractures 2 were treated by manipulative reduction and above knee cast application out of which one fracture resulted in nonunion. 8 were treated by surgery. Out of 8 cases, 6 were treated with interlocking intramedullary nailing which united well. 2 cases were treated with external fixation (ILIZAROV). Malalignment occurred in 1 out of 2 fractures treated conservatively whereas no patients surgically treated had significant malalignment. Shortening was noted in 2 cases.

Open intramedullary nailing technique offers the advantages of producing good reduction and having short operative times, but it increases the risk of infection and union delay, compared with the closed nailing method and can cause cosmetic problems. Closed intramedullary nailing has essentially the major advantage of not exposing the fracture site thus drastically reducing the rates of infection, non-union and avascularity of the middle fragments. The theoretical risk of damaging the blood supply of the middle fragment due to torsion while reaming has been disproved. But this method demands specialized skill, equipment and image intensifiers and it still does not assure rotational stability nor prevents shortening in case of comminution. Closed interlocked nail⁶ used for the femur and tibia^{14,15} is an excellent procedure despite requiring expensive equipment and specialized skill. Static nailing is preferred and dynamization if required can be done after 12-16 weeks. Static interlocking nails prevent shortening and provide rotational stability in addition to the other advantages of closed nailing. In the present study, one patient with segmental fracture of tibia was treated by closed reduction and above knee cast application; but the fracture did not unite.

The number of cases in this group was 12 were treated by open / closed reduction and static intramedullary interlocking nailing. Only 2 cases humeral segmental fractures were encountered one patient with grade I compound segmental fracture humerus treated by plating. Out of 3 cases BB forearm, all cases were treated surgically in which 1 with intramedullary 2 with dynamic compression plate. All these fractures united well. Thus, closed / open reduction with Intramedullary nailing is a common method for the fixation of both closed and open tibial fractures. Intramedullary reaming offers better bending and rotational stability as it allows the insertion of larger-diameter and tighter-fitting nails. Additionally, as it provides higher resistance to axial and torsional forces as insertion of locking screws at both ends of the nail increases the biomechanical strength of the construct⁷. Larsen LB et al⁸ commenced a study to compare healing and complications between reamed and unreamed nailing in tibial shaft fracture patients and found that unreamed nailing may be related with higher rates of secondary operations and malunions compared with reamed nailing. Obrebsky WT et al⁹ conducted a study to evaluate current practice and practice variation among 379 orthopaedic trauma surgeons and concluded that substantial variation is present in the timing of bone graft placement after soft tissue healing as well as the source and form of graft utilized.

Delayed union and mal-union incidence is high in these fractures because of decreased vascularity, stripping of the bone, injury to surrounding muscles and

rotational instability across one of the fractures sites when fixed with intramedullary nailing. The solution lies depending on the individual problem, autogenous cancellous bone grafting, dynamization of a static interlocking nail, use of dynamic compression plate etc¹⁰. The anatomical pattern of the shaft of the humerus makes it vulnerable for residual fracture site distraction, mainly where the sagittal diameter of the distal part is small. Residual fracture site distraction increases the risk of delayed union / nonunion, that demands additional procedures to obtain union. Thus, interlock nailing has not been recommended^{11,12} as standard method of management for a humeral diaphyseal fracture in contrast to more tubular bones like the femur and tibia.

Conclusion

From the results it can be concluded that young males commonly met with segmental fractures. Majority of these are open fractures with more severe soft tissue injury infection rates are higher. Still conservative management plays a significant role particularly in those with undisplaced closed segmental fractures who are either those who have not sustained any other system or bone injury as well as unfit for major surgery. External fixators (ILIZAROV) are significant tools in the correction of Grade III compound fractures. Once the infection is controlled in those with large open fractures static interlocking Intramedullary nailing is the best possible option. The longer the length of the segment, the lengthier the duration required for union. Proximal fracture unites significantly earlier than the distal fracture. The complications which are more commonly seen in cases managed conservatively than surgically are Algesia of bone and Joint stiffness.

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