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Role of Ilizarov ring fixator as a definitive treatment in management of compound comminuted paediatric tibia fractures

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Abstract

Introduction: Tibia shaft fractures are very common in children usually they are following fall. Generally they are very well treated with conservative management, but surgical intervention becomes mandatory in the presence of unstable, comminuted fractures with poor skin condition and compartment syndromes .

Material and Methods: There were 6 compound comminuted tibia fractures in between age group of 5 – 15 years. All were treated with ilizarov ring fixator application in department of orthopaedics of Pravara institute of medical science (DU) from April 2019 to January 2021.

Results: Early mobilization was initiated in all patients as per pain tolerance by post-operative day 2 or 3. Fracture united in all cases, no residual deformity seen in any case. Mild pintract infection was seen in 3 cases which were treated with regular dressings & oral antibiotics. No delayed union, re fracture, limb length discrepancy was seen in any case, no bone grafting, corrective osteotomy was required in any case. All cases returned to their pre injury functional status. All cases completed their one year follow up. With little initial hesitation all patients well tolerated frame.

Conclusion: Ilizarov ring fixator can be considered as safe effective definitive treatment option for paediatric compound comminuted tibia fractures as its minimally invasive, biomechanically stable, dynamic, versatile treatment modality which promotes not only fracture union but also allows rapid early rehabilitation and functional recovery.

Keywords: ilizarov ring fixator, compound tibia fractures, paediatric fractures

1. Introduction

Tibia shaft fractures are very common in children usually they are following fall. Generally they are very well treated with conservative management, but surgical intervention becomes mandatory in the presence of unstable, comminuted fractures with poor skin condition and compartment syndromes, neurovascular injury.

Variety of treatment modalities are available for their treatment like Elastic nails, rigid nails, plates, external fixators. All of them are time tested and have their own merits and demerits. Elastic nails are one of the commonly used and preferred modality. Its minimally invasive but requires additional stability in the form of splints and immobilization. Incidence of nail migration are frequent, Non union, Limb length discrepancy may occur with elastic nails. Rigid nails cant be used in the presence of open physis. Plate fixation is also used but it may further damage the soft tissue cover. Risk of infection is always there with any form of internal fixation in the presence of compound fractures. In the presence of poor skin condition external fixators are preferred. External fixation is minimally invasive, suitable method and it's relatively easy. It can be done in the form of Mono lateral external fixation which is frequently used or with Ilizarov ring fixator or Taylors special frame or even by Supracutaneous plating. Once fracture union is achieved external fixator is removed & there is no need for implant removal surgery as seen in internal fixation.

Withmonolateral external fixator early mobilization can be facilitated, wound care becomes easy as compared to internal fixation. But it doesn't permit weight bearing & Malunion, residual deformity are frequently seen complications following its application.

Considering the pros&cons associated with monolateral external fixator and other internal

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fixation methods, it was decided to use ilizarov ring fixator in management of compound comminuted paediatric fractures. Ilizarov ring fixator has a three dimensional versatile dynamic construct, which is biomechanically stable allowing wound care and permits full weight bearing during entire duration of treatment. Fracture management and dynamic deformity correction is simultaneously possible in this method. Fixator removal after fracture union is easy. Even this method also has its own set of advantages & disadvantages.

Material & Methods

It was observational study carried out in department of orthopaedics of Pravara institute of medical science (DU) from April 2019 to January 2021 in which 6 compound & comminuted paediatric tibia shaft fractures treated with Ilizarov ring fixator were studied. Approval from institutional ethical committee was taken for this study.

Aims & objectives

To study role of ilizarov ring fixator as a definitive treatment in management of compound and comminuted paediatric tibia fractures. To study complications To study literature All cases were males between age group of 5 to 15 years. Road side accident was mechanism of injury in all cases. Amongst 6 cases 2 were Grade II and 4 were Grade III compound tibia fractures as per Gustilo Anderson classification. 2 patients had associated clavicle fractures.

Inclusion criteria

Compound and comminuted tibia shaft fractures in children between age group of 5 to 15 years

Exclusion criteria

Tibia fractures in children less than 5 years Pathological fractures Fractures with neurovascular injury After detailed clinical evaluation of patient standard AP & Lateral x ray of affected limb were taken.

5 cases were having fractures with Meta- diaphyseal comminution and one was with purely distal metaphyseal fracture.

After thorough debridement of wound in operation theatre wound closure was done. In all cases primary skin closure was achieved no need for plastic surgery was required.

Average duration between admission and operation was one day.

Followed by closure standard Ilizarov 3 to 4 140 degrees rings progressive construct was applied with help of 1.5 – 1.8mm percutaneously passed trochar and olive wires under image intensifier control. Frame construct was made as per fracture pattern. All wires were juxtaphyseal & no wire was passed through fracture site. Fracture compression was achieved by olive wires. Tension of around 100 to 110kg was applied to

wires. Fracture reduction was achieved by spanning it between rings. Ankle spanning was done in two cases. Excellent remodelling potential is seen in fractures of this age group but as per literature this potential reduces in more than 10 yrs of age, so emphasis was given to achieve near anatomical or anatomical reduction of fractures with the help of frame.

Post operative Protocol

IV Antibiotics were administered for 3 days post operatively. Regular dressing was done at periodic intervals. Active knee movements, straight leg *raising* was encouraged from post operative day one. As per pain tolerance in all patients full weight bearing with help of walker was started from post op day 2 or 3. Parents were taught at home pin tract dressings. Compression distraction cycle at the rate of 2mm per day which was required in two cases 2 weeks. Average hospital stay was 10 days. X-rays were taken at 4 weeks interval.

Results

Wounds healed in all cases at around 2 weeks. Average fracture union time was 12 weeks (14 – 16 weeks). Fracture union achieved in all cases. Mild pin tract infection was seen in 3 cases of grade III compound fractures which settled with oral antibiotics and regular dressings.

After 4 weeks active staircase climbing was also permitted. Follow up visits were made initially at 2 weeks interval till wounds healed and then every 4 weeks till fracture union.

Fracture union was assessed clinically by absence of tenders at fracture site and radiologically by callus formation in at least 3 cortices in AP and Lateral view.

Before frame removal all patients were made to walk with out support after disconnecting rods from rings, if patients were able to walk then again rings were connected and 3 weeks after that frame was removed. Frame removal was done after complete fracture union. Following frame removal posterior splint was applied for 2 weeks for protection.

In 2 cases of age less than 10 years fracture united with less than 5 degrees of deformity but it did not affect the functional outcome of patient.

All patients completed follow-up which were done at 3, 6 and 12 months following fracture union. All cases with little initial hesitation well tolerated the frame all throughout treatment span. Post splint removal active knee ankle and foot mobilization was encouraged in all patients. All patients returned to their pre injury functional status.

No premature frame removal, Limb length discrepancy, osteomyelitis, compartment syndrome, delayed union, neurovascular injury was seen in any case No case required bone grafting or corrective osteotomy.

No refracture was seen in any case following fixator removal

Table 1: Distribution & pattern of cases

Age in years	Number Of cases	Compound fracture type As per Gustilo Anderson	Anatomical location	Ankle spanning Yes /No	Pin tract infection	Residual deformity In degrees	Limb length discrepancy
5	1	II	Diaphysis	No	No	No	No
7	1	II	Diaphysis	No	No	< 5 recurvatum	No
9	1	III	Diaphysis and comminuted	No	Yes	< 5 recurvatum	No
9	1	III	Diaphysis and comminuted	NO	Yes	No	No
11	1	III	Distal metaphysis	Yes	Yes	No	No
15	1	III	Comminuted meta diaphysis	Yes	No	No	No

Discussion

It was observational study in which 6 compound & comminuted paediatric tibia shaft fractures between 5 – 15 yrs of age treated with Ilizarov ring fixator were studied.

2 cases were grade II and 4 cases were grade III compound tibia fractures. As per pain tolerance early mobilization and weight bearing was started by post op day 2 or 3 following frame application. Wounds healed in all cases at around 2 weeks. Average fracture union time was 12 weeks (14 – 16 weeks). Fracture union achieved in all cases. No premature frame removal, Limb length discrepancy, osteomyelitis, compartment syndrome, delayed union; neurovascular injury was seen in any case. No refracture was seen any case following fixator removal. All patients returned to their pre injury functional status. No case required bone grafting or corrective osteotomy. All cases completed one year follow up. Low energy tibia fractures in children are often simple and can be treated with immobilization in cast [6, 11, 17] however high energy fractures are associated with soft tissue injury so selection of treatment modality becomes difficult [1, 11] Unlike adults there are no clear cut guide lines for management of open tibial fractures in skeletally immature patient [1, 12, 13]

As per literature open fractures with more than 10 yrs of age are associated with outcomes and complications like adults as compared to children less than 10 yrs of age [1]. Remodelling potential decreases with age more than 10 years [1] which may lead to residual deformity, therefore aim of treatment should be fracture union with minimal deformity in children more than 10 years [1, 11]

Many treatment modalities are available from conservative to operative. Operative treatment ranges from elastic nails, rigid nails, plates, monolateral external fixator & ilizarov ring fixator, Taylors special frame, Supracutaneous plating [2, 4, 5, 6, 11, 17]

Tibia has relatively poor soft tissue envelop & variable blood supply which can be affected by initial trauma and further internal fixation may even reduce tissue viability leading to impairment in fracture healing [3, 4] Risk of infection can be more in open fractures fixed internally [4, 7]

Elastic nails are minimally invasive and most favoured method by orthopaedic surgeons, but they are less stable in comminuted fractures [6, 15]. Internal fixation by them also needs immobilization and support with splint for certain duration of time [15, 16].

Internally fixed implant needs to be removed after certain duration this requires surgery which may lead to hypertrophic scar, wound breakdown if implant removal is delayed for considerable period of time then it becomes difficult as well and may need extensive surgery [3]

Mono lateral external fixator is one of the times tested method in presence of open wounds and unstable fractures [17] it is easier to apply as compared to ring fixator [17], but lack of rotational stability, Residual deformity are some of the shortcomings associated with this method [1] it also doesn't permit early full weight bearing unless its applied in ankle spanning manner [1, 18].

Why we decided to use Ilizarov ring fixator ???

Considering the pros & cons associated with monolateral external fixator and other internal fixation methods, it was decided to use ilizarov ring fixator in management of compound comminuted paediatric fractures.

Ilizarov ring fixator has stable construct with rotational stability due to its three dimensional design [1, 6], it permits early weight bearing, dynamic deformity correction by means

of gradual compression –distraction cycles [14] This also prevents occurrence of residual deformity [1, 14]. Tensioned wires fixed with rings and rods provides stable construct with trampoline like effect which promotes axial micro motion of fractures fragments permitting union [1]. Early reduction & stable fixation with ilizarov ring fixator is very useful & reliable method of treatment for compound paediatric tibia fractures [1]. This method often proceeds to rapid union with few complications in comparison to other methods [1, 6] passing of juxta physal wires also doesn't disturb growth plate. Early mobilization and rehabilitation of patients promotes early functional recovery [1, 3]. Like every method it also has some advantages & disadvantages such as

Advantages of Ilizarov method

Minimally invasive [1, 3, 6] Biomechanically stable & versatile construct [1] Permits early mobilization, weight bearing on affected limb and rehabilitation [1, 3, 6] Dynamic method Permits residual deformity correction even after final frame application is done [1].

Easy implant removal once fracture union is achieved

Disadvantages

Frame can be cumbersome Pin tract infection [1, 6] Difficulty may be encountered during clothing, sleeping, washing [6] High learning curve Thus prior application of frame detailed counselling of parents regarding nature, method, duration of treatment and post operative care is a must.



Fig 1: Pre operative clinical photo case 1



Fig 2: Pre-operative X ray Case 1

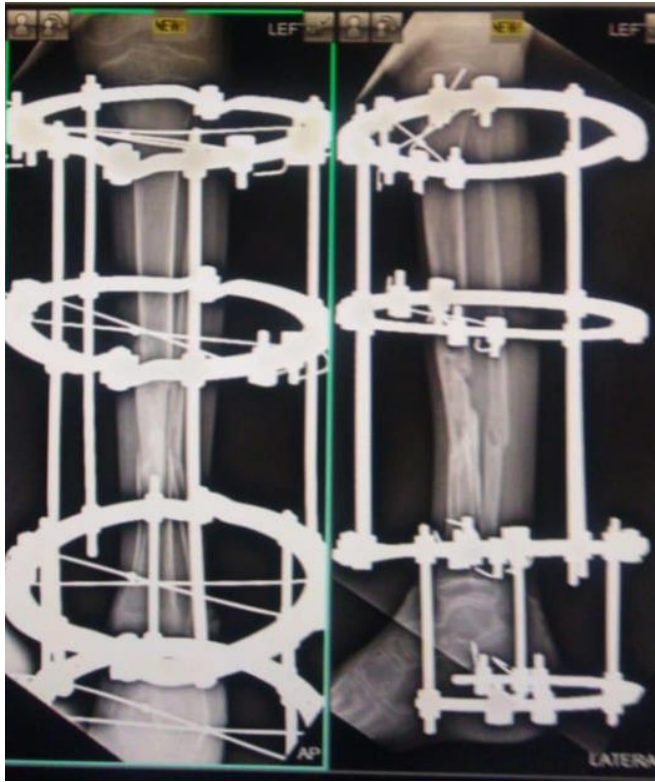


Fig 3: Post operative x ray case 1



Fig 6: union X ray case 1



Fig 4: frame application case 1



Fig 7: clinical photo Case 2



Fig 5: Early mobilization case 1



Fig 8: Pre operative X ray case 2



Fig 9: Post-operative X ray case 2



Fig 11: Union Xray Case 2



A.



A.



B.

Fig 10: Healed wound



B.

Fig 12: functional out come case 2

Conclusion

Iizarov ring fixator can be considered as safe effective definitive treatment option for paediatric compound & comminuted tibia fractures as its minimally invasive, biomechanically stable, dynamic, versatile treatment modality which promotes not only fracture union but also allows rapid early rehabilitation and functional recovery, how ever larger sample size & longer follow up will be needed to prove the same.

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