International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2020; 6(3): 559-563

www.orthopaper.com
Received: 18-05-2020
Accepted: 22-06-2020

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Ilizarov ring fixator for management of Schatzker type v and vi fractures of proximal tibia: A study of 30 cases

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DOI: https://doi.org/10.22271/ortho.2020.v6.i3i.2253

Abstract
Introduction: Bicondylar tibia fractures are mostly treated by ORIF in a staged manner and involve lot of periosteal stripping and soft tissue disruption with potential complications of infection, hardware failures, compartment syndrome and delayed ambulation. Trans-osseous osteosynthesis using Ilizarov ring fixator seems to be a better emerging option for treating such fractures with minimal complications and better clinical and functional outcome. The aim of this study is to evaluate the role of Ilizarov ring fixator in Schatzker type V and VI fractures of proximal tibia.
Methods: 30 patients with these injuries were included in the study after careful inclusion and exclusion criteria. All underwent standard Ilizarov ring fixation method with trans- fixation of knee in type VI fractures, which was removed at around 3 - 4 weeks and knee mobilization was started. Early weight bearing was encouraged in all cases except two with humerus fracture. Clinical followup was done at monthly intervals along with radiological evaluation. Pin site care was repeatedly stressed for and taught. Final follow up was done at six months post frame removal and Karlstrom-Olerud scoring system was used to analyze the final outcome.
Results: There was no incidence of superficial or deep infection. All the fractures healed in time. Incidence of pin tract infection was 26.6% but it resolved with proper dressings and antibiotics. Average union time was around 17.46 weeks. There was no incidence of deep vein thrombosis or compartment syndrome or peroneal nerve injury. Overall result was Excellent in 12 cases, Good in 11 cases, Fair in 4 cases and Poor in 3 cases.
Conclusion: Ilizarov fixator is a good, reliable and easily reproducible method of treating such fractures with early return to pre-injury levels in most of the cases.

Keywords: Ilizarov fixator, proximal tibia fracture

Introduction
High velocity injuries are often the most common cause of complex tibia fractures. These fractures have a significant component of associated soft tissue injuries along with collateral ligament injury, cruciate ligament injury and neurovascular damage also. Intense nature of trauma often results in open injures and subsequent wound problems. Schatzker *et al.* had published their classification in 1979 based on radiological interpretation. After that many different classifications were proposed but still this is the most universally accepted one. Type V and VI constitute bicondylar tibia fracture with metaphysio-diaphysial dissociation and pose many challenges in deciding the most optimal mode of treatment [2]. Irrespective of the different modalities of treatment in such fractures, the rate of complications encountered remains high and include joint stiffness, malunion, osteomyelitis, arthritis, and vascular injuries and its potential sequelae. In our study of 30 cases we have attempted to evaluate the clinical, functional and radiological outcome of Ilizarov ring fixation in treatment of Schatzker type V and VI proximal tibia fractures.

Materials and Methods
A prospective study was conducted at Gmers, Gotri Medical College, Vadodara, a tertiary care hospital from 2014 to Mar-2020. A total of 30 cases were included with type V and VI injury of proximal tibia based on following criteria. Inclusion Criteria: Age between 18 to 70 years. Medically fit person. Upto open grade II injuries. Exclusion Criteria: Associated other systemic injuries. Patient not willing for ring fixation method of treatment.

Associated neuro-vascular injury. All patients with proximal tibia fractures were initially evaluated for other skeletal and systemic injuries. Open injuries were classified based on Gustilo Anderson's classification [3]. Antero-posterior and lateral radiographs of affected knee with leg were taken. Those patients with type V and VI fracture were included in the study. They were counselled for circular Ilizarov ring fixator method of treatment after explaining the benefits and limitations of the procedure. Those patients who gave written informed consent to undergo the procedure were finally included in the study. All patients underwent computed tomogram to assess extent of intra-articular involvement. Open fractures were treated with thorough debridement and appropriate antibiotics as part of primary care. Once patient was stable he or she was posted for surgery. All underwent standard ilizarov procedure on traction table after giving calcaneal pin traction. Knee joint was aspirated in all cases to drain haemarthrosis. Axial traction coupled with ligamentotaxis was done to achieve maximum anatomical articular reduction under fluoroscopic guidance. Some intra-articular fractures needed percutaneous manipulation to achieve reduction. In few cases temporary kirschner wires were used to hold the reduction. Once reduction was satisfactory, olive wires were used in medio-lateral direction in metaphyseal region and fixed to circular ring of appropriate size. Step by step assembly of frame was completed by passing remaining wires and transfixed to ring. All type VI injuries underwent across knee fixation with additional ring in distal femur which was kept for around 3 to 4 weeks and removed subsequently. Post operative antero-posterior and lateral radiographs were taken for records. Gentle knee mobilization exercises were started in all type V fractures after 24-48 hours as per pain tolerance capacity of patient. All type VI fracture patients were encouraged to start weight bearing by 48 to 72 hours. Subsequent followup was done at one month interval till frame removal was done and then final followup at six months was done. Patients were taught the standard " kurgan protocol " for pin tract care [4]. Frame removal was done at the end of clinical and radiological union under short general anaesthesia and it was not considered as re-operation. Final outcome assessment was done using the " Karlstrom – Olerud " scoring system [5].

Table 1: Karlstrom olerud score evaluating the results in points

No.	Measures	3 points	2 points	1 points
1	Pain	No	Little	Severe
2	Difficulty in walking	No	Moderate	Severe limp
3	Difficulty in stairs	No	Supported	Unable
4	Difficulty in previous sports	No	Some sport	Unable
5	Limitation at work	No	Moderate	Unable
6	Sttus of skin	Normal	Various colors	Ulcer/fistula
7	Deformity	No	Little, up to 7°	Remarkable, >7°
8	Muscle atrophy	< 1 cm	1-2 cm	> 2 cm
9	Shortening	< 1 cm	1-2 cm	> 2 cm
10	Loss of motion at keen joint	< 10°	10-20°	> 20°
11	Loss of subtalar motion	< 10°	10-20°	> 20°

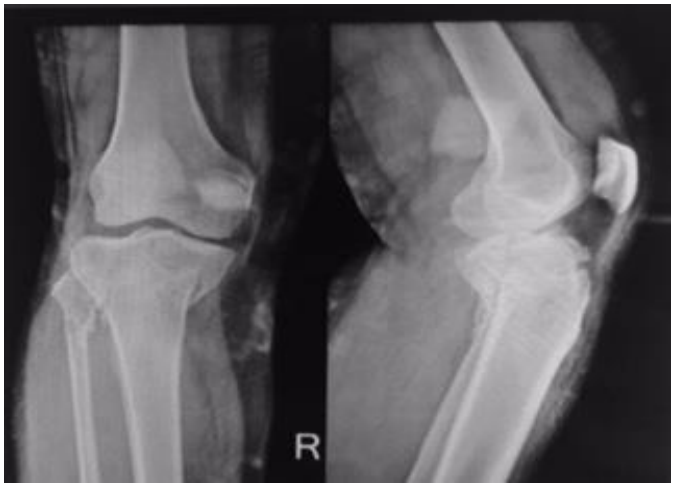

Fig 1: Pre-Op X-ray of Case no. 18.

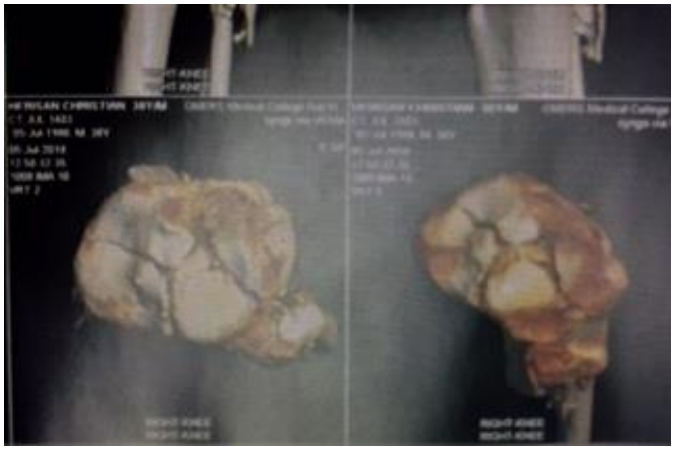

Fig 2: 3-D CT Scan image.

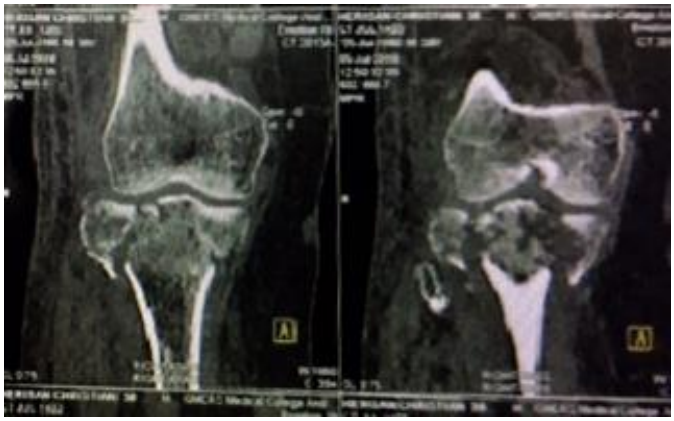

Fig 3: CT Scan image

Results

Of the 30 patients, 26 were male and 4 were female. Mean age of incidence was 42.2 years with a range of 18 to 65 years. All the patients had high velocity injury in form of road traffic accidents or fall from height. Duration of admission to operation interval was from 1 to 13 days with a mean of 4.5 days. Duration of hospital stay was from 1 to 22 days with an average of 7.9 days. Of the 30 cases 24 were close injuries, 4 were O.G- I and 2 were O.G.- II. 21 patients had Schatzker type V injury and 9 patients were having type VI injury. Average duration of frame application was 122 days with a

range of 77 days to 158 days. Based on Karlstrom – Olerud scoring system the results were as per table no. 2. Pin tract related problem was seen in 8 cases but could be managed timely by regular dressings and antibiotics. There was no incidence of wire breakage or loosening. Open wounds healed with either primary closure or secondary healing. There was no incidence of nonunion, osteomyelitis or deep infection. Swelling of calf was observed for around a month in most of the cases but eventually resolved. All patients could return to preinjury work levels at the end of 3 months of frame removal. One patient with poor knee range of motion underwent arthroscopic arthrolysis but still there was no significant improvement till his last follow up.

Table 2: Pin tract related problem was seen in 8 cases but could be managed timely by regular dressings and antibiotics

	score	No. of. pts	percent
Excellent	33	12	40%
Good	30-32	11	36.66%
Fair	24-29	4	13.33%
Poor	<24	3	10%

Fig 4: Post-Op knee flexion

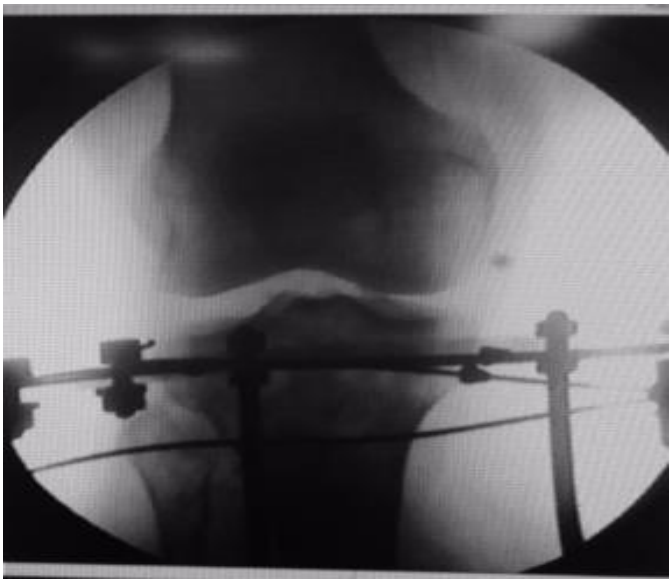

Fig 5: Post Operative X-ray AP view.

Fig 6: Post-Op X-ray Lat view

Fig 7: AP X-ray showing union

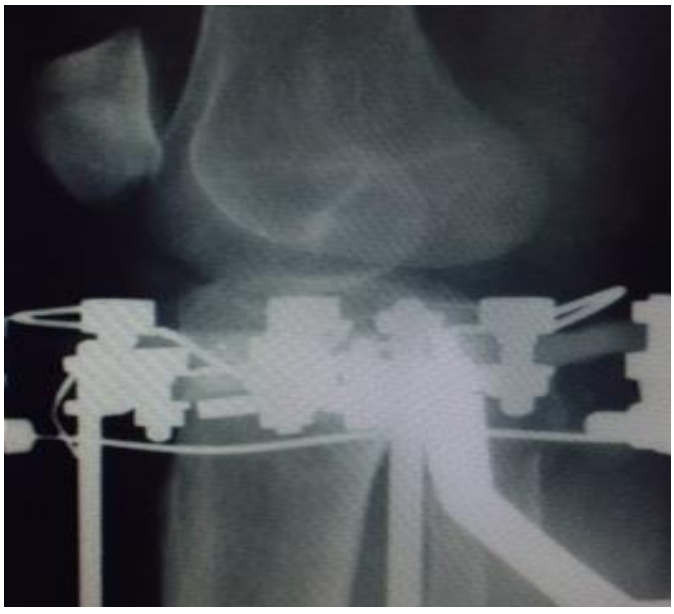

Fig 8: Lateral X-ray showing union

Discussion

Bicondylar tibia fractures are usually a direct effect of high velocity injury resulting in extensive soft tissue damage, both internal and external and associated with ligament and meniscal injuries as well. Conservative management of type V and VI fractures has consistently given poor functional outcome [6]. Traditional methods of external fixation using monoplanar fixator have been associated with higher incidence of pin tract infection, loosening and subsequent loss of reduction during the course of treatment [7]. Nowadays their use is getting restricted to initial stabilization until soft tissue healing occurs and definitive fixation can be done at a later stage. Open reduction and internal fixation (ORIF) of such fractures with dual plating has been considered as the best mechanical stabilizer as it achieves both medial and lateral column integrity [8]. However initial soft tissue injury often delays this procedure. Also ORIF results in extensive secondary soft tissue disruption thereby jeopardizing the soft tissue envelope. Numerous studies conducted at different setups have quoted the incidence of wound dehiscence, superficial and deep infections, loss of reduction and metal implant impingement or irritation later on. Moore and Harvey *et al*. had reported an incidence of 23% with ORIF [9]. Baeri *et al*. had reported deep infection rate of 8.4% in their series of 83 patients [10]. Yang *et al*. had reported infection in 5 out of 16 cases that is 31% [11]. In our study we have proposed the use of Ilizarov ring fixator as a definitive management protocol for such fractures. This technique has certain distinct advantages over the traditional methods of ORIF. It causes minimal soft tissue injury in an already compromised soft tissue envelope. Periosteum is not disturbed in this method which is very essential for osteo-induction. Early range of motion exercises can be initiated and weight bearing could be started which itself acts as a stimulus for healing. Minor adjustments and realignment is always possible during the course of the treatment. However this technique has its own sets of limitations. Anatomical restoration of articular surfaces is not always possible. Entrapped meniscus can impede in achieving reduction by closed means and may necessitate mini open reduction. Concomitant cruciate ligament injuries are not addressed which may be a cause of early onset of osteoarthritis and late knee instability. There is always a risk of losing the terminal range of flexion or extension which can at times limit certain future activities of the patient.

The incidence of superficial infection in study by Keigthley *et al*. was 51.3% and that of El Sayed *et al*. was 41.8% [12]. In our study the incidence of pin tract infection was 26.6%, 8 out of 30 cases. We strictly followed the Kurgan Protocol and could bring down the infection rate to this level.

Dendrinos *et al*. in their series of 24 patients had no case of osteomyelitis or septic arthritis [13]. Chin *et al*. had similar results in their series of 18 patients [14]. There was no incidence of osteomyelits or septic arthirits in our study group.

Anatomical restoration of articular surface is essential to prevent late osteoarthritis of knee [15]. However this is not always possible with Ilizarov fixator. There are ample number of studies which have inferred that good functional results were achieved even when articular anatomy was not restored perfectly [16, 1, 17]. In our series, two patients had depressed fragment which could not be elevated by closed means and a mini-open incision was done to reduce the fragment. In one patient 6.5 mm Cannulated cancellous screw with washer was used to provide additional stability and compression.

Knee mobilization could be initiated within 24 to 48 hours in type V fractures. In few cases use of 5/8 ring proximally was helpful in achieving early range of motion beyond 90 degrees. However in type VI fractures they underwent across knee fixation and took more time after proximal ring removal to achieve functional knee range of motion, but eventually they could also achieve good range of motion. Krupp *et al*. had reported better knee range of motion in ORIF group, however it was statistically insignificant [18].

Average union time in series of N. Ferreira *et al*. (13 cases) was 22 weeks with a range of 17 to 39 weeks by Ilizarov fixator [19]. I.R. Ranatunga reported an average union time of 3.72 months that is approximately 16 weeks [20]. H. EL Barbary *et al*. reported union time of 16.3 weeks with a range of 14 to 24 weeks [21]. Mohamed M. H *et al*. had union at an average of 17 weeks with a range of 13 to 21 weeks [22]. Ivica Lalic *et al*. in their series of 50 patients had average union time between 16 to 18 weeks with a range of 12 to 26 weeks [23]. In our series the average time of union was 17.46 weeks with a range of 11 weeks to 22.5 weeks which is comparable to most of the other studies.

There was no incidence of deep vein thrombosis in our series which could most probably be attributed to early ambulation and weight bearing in most of the cases.

David Metcalfe *et al*. in their comparative study of ORIF and External Fixation documented the incidence of compartment syndrome in 9.1% in ORIF group and 5.4% in other group [24]. There was no incidence of compartment syndrome in our series.

Chances of peroneal nerve injury during ORIF are high as compared to external fixator method [25] and can result in foot drop and difficulty in walking. No such incidence was reported in our study.

Based on Karlstrom – Olerud scoring system we had Excellent results in 12 cases (40%), Good results in 11 cases (36.66%), Fair results in 4 cases (13.33%), and Poor results in 3 cases (10%). Poor result in two patients was due to concomitant humerus fracture in them which delayed their post operative rehabilitation protocol.

Conclusion

Primary external fixation by Ilizariov ring fixator in Schatzker type V and VI fractures of proximal tibia is a safe and effective method. It can be done in same surgical sitting thus avoiding staged procedures as in other methods. It avoids potential complications of skin necrosis, infection, extensive soft tissue stripping, and long term metal or hardware irritation and discomfort to patients. Early trans-osseous skeletal stabilization and aggressive post-operative physiotherapy hold the key to achieving functional knee range of motion. Limited mini-open incision can be additionally done to achieve intra-articular reduction.

Limitations of Study

The sample size is small. No comparative study was done with ORIF procedure. Post operative 3D computed tomography was not done to assess intra-articular congruity.

Conflict of interest: The authors have no conflict of interest to declare.

Funding: The authors have not received any funding or government grant or institutional funding for the above mentioned study.

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