e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(12); 126-132

Original Research Article

Study on Clinical and Functional Outcome of Proximal Tibial Fractures Treated With Illizarov External Fixator

Ch. Mohan Reddy[1], K. Krishna Chaithanya[2], Shambu[3], N. Ravi Kiran[4]

[1,3]Assistant Professors, Department of Orthopaedics, GMC, Nizambad
[2]Assistant Professor, Department of Orthopaedics, GMC, Jagtial
[4]Professor and HOD, Department of Orthopaedics, GMC, Nizambad

Received: 01-09-2025 / Revised: 15-10-2025 / Accepted: 21-11-2025
Corresponding author: Dr. N. Ravi Kiran
Conflict of interest: Nil

Abstract

Background: High-energy proximal tibial fractures challenge surgeons due to articular disruption and soft tissue injury. Because of soft tissue injury the treatment is usually challenging, and this study promises to assess the outcome with ilizarov external fixator which promises to be a good solution.

Objective: To assess the clinical and functional outcome of proximal tibial fractures treated with ilizarov external fixator.

Methods: This prospective study evaluated 30 patients (mean age 40.3 years) treated with Ilizarov circular fixators from 2015-2017. All of them were treated with wound debridement followed by ilizarov ring fixator application along with bone grafting or preliminary knee spanning fixator if the soft tissue damage demands. Outcomes were assessed using Ramussen clinical and functional criteria.

Result: Most were Schatzker V-VI (57%) from road traffic accidents (70%). Mean union time was 16.2 weeks, knee flexion averaged 120°, and alignment stayed within 10° varus/valgus in 83%. Modified Rasmussen scores showed excellent/good results in 87% (26/30). Pin-site infections occurred in 37%, compartment syndrome in 7%.

Conclusion: Ilizarov fixation delivers reliable outcomes with early weightbearing, suitable for complex fractures with soft tissue compromise.

Introduction

The knee is a complex joint and being one of the major joints of locomotion, injuries of the knee directly influence basic activities of daily living. The superficial nature of location further makes it vulnerable to injury by external forces commonly such as road traffic accidents and sports related trauma [1].

High-energy proximal tibial fractures are difficult to treat, as they entail articular depression, condylar displacement, dissociation of comminuted metaphysis from diaphysis, and open wounds or extensive closed de-gloving injuries. Injury mechanisms involve a combination of axial loading and valgus forces.

The goal of the treatment of these fractures is to achieve a stable, well-aligned, mobile, pain-free joint and to minimise the risk of post-traumatic osteoarthritis [2,3].

Fractures of the articular surface of the tibia, even in fractures with minimal joint extension, are usually the result of a high-energy direct blow [5]. Because of the type of trauma involved and the relatively high frequency of major soft-tissue injuries [6] the complication rate is high, regardless of treatment [7]. The relatively large surgical incisions that are used for internal fixation also add a considerable risk of soft-tissue complications [8]. If the classic Ilizarov technique is used according to the original recommendations [9,10], the reduction and fixation of the fracture fragments can be made with almost no soft-tissue exposure and blood loss. This technique does not leave screws and plates when the fracture has healed. The fixator also allows for the adjustment of the alignment and for compression/distraction both during and after surgery. Another advantage when it comes to using the Ilizarov technique is that the fixation is stable enough to allow early weight-bearing [11,12], which is the rationale for using the Ilizarov method in unicondylar fractures.

Methods

This prospective case series included all patients with proximal tibial fractures admitted to our

institutional trauma center between September 2015 and October 2017. Of 37 eligible patients, 30 met inclusion criteria and were included in the final analysis.

Inclusion Criteria:

- All patients above 18 years
- Patients with open and closed proximal tibial fractures
- Medically fit for surgery

Exclusion Criteria:

- All Pathological fractures
- Patients not fit for surgery
- Previous trauma, surgery or deformity of the limb
- Associated pelvic, femur and ankle fractures
- Associated neurovascular deficit

Institutional ethical committee approval was obtained prior to study initiation. All patients or guardians provided informed consent.

Clinical Evaluation and Imaging: Acutely injured patients underwent hemodynamic stabilization and resuscitation according to trauma protocols. Clinical and radiological evaluation included standard anteroposterior and lateral knee radiographs in all patients. Computed tomography was performed in cases with significant articular involvement or comminution identified on plain radiographs.

Fractures were classified according to the Schatzker classification system. Soft tissue injury severity was assessed clinically. In open fractures, thorough wound cleansing and serial wound assessment guided decisions regarding timing of definitive fixation.

Surgical Technique: All patients underwent surgical treatment with Ilizarov ring fixation. In cases with severe soft tissue damage requiring additional procedures, a temporary knee-spanning fixator was applied initially, with conversion to definitive ring fixation performed after three weeks.

The standard construct consisted of a proximal ring and two distal rings, with additional tensioned wires applied based on fracture location and geometry. In fractures with intra-articular depression exceeding 2 mm, mini-open reduction was performed with autologous bone grafting to restore articular congruity.

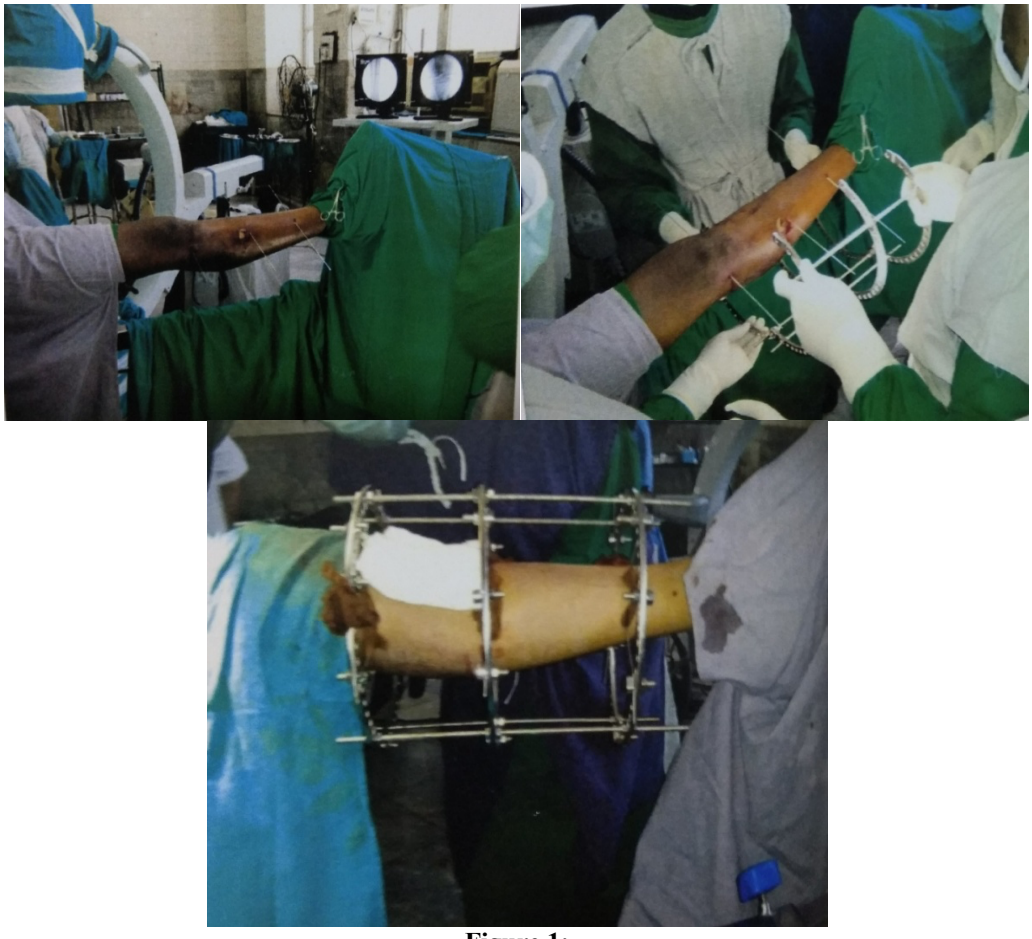

Figure 1:

Postoperative Management: Patients received instruction in pin-site care and fixator maintenance. Range-of-motion exercises and quadriceps strengthening began within 24 hours of surgery. Toe-touch weight-bearing was initiated immediately, progressing to full weight-bearing once radiological evidence of fracture union was evident, typically between 12-18 weeks. Fixator removal was performed 3-4 weeks after radiological and clinical evidence of union.

Clinical and Radiological Assessment: Clinical and functional outcomes were evaluated at one-year follow-up using modified Rasmussen criteria incorporating pain, swelling, range of knee motion, walking ability, and radiological assessment of alignment and articular surface healing. Results were classified as excellent, good, fair, or poor based on composite scores.

Results

Demographics and Injury Characteristics: The study cohort comprised 25 males (83.33%) and 5 females (16.67%) with a mean age of 40.3 ± 10.58 years (range 20-65 years). Age distribution showed 13 patients (43.33%) in the 20-35 year age group and 13 patients (43.33%) in the 36-50 year age group.

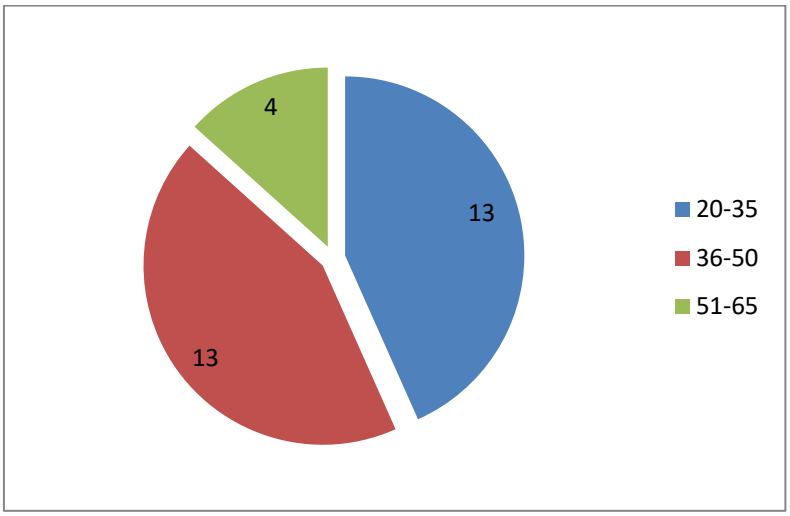

Figure 2:

Laterality was nearly equally distributed, with 18 patients (60%) sustaining right-sided injury and 12 patients (40%) left-sided injury. Road traffic accidents accounted for 70% of injuries (n=21), workplace incidents 20% (n=6), and domestic falls 10% (n=3).

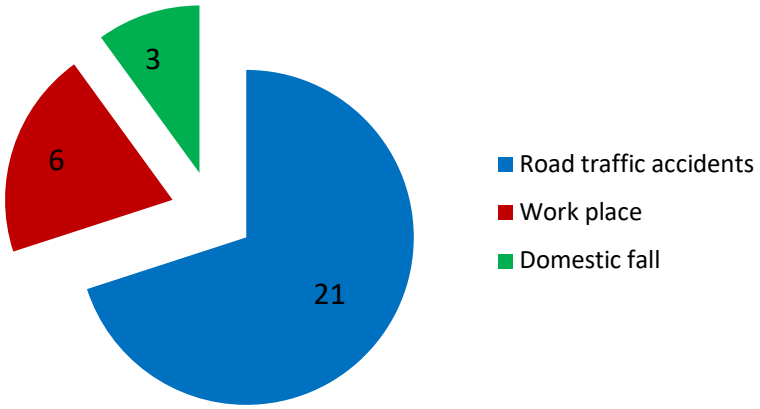

Figure 3:

Fracture Classification: According to Schatzker classification, 9 patients (30%) presented with type I-IV fractures, 17 patients (56.67%) with type V-VI complex injuries, and 4 patients (13.33%) with proximal third tibial fractures without articular involvement.

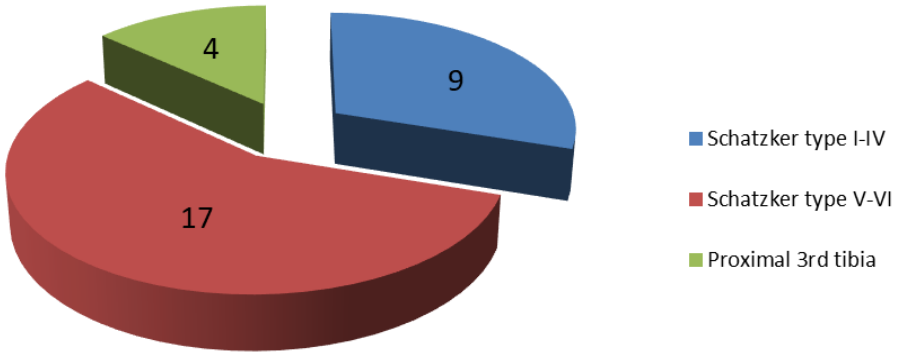

Figure 4:

Operative Parameters: The mean time from presentation to definitive surgery was 4.1 days.

Thirteen patients (43.33%) were operated within 3 days, 15 patients (50%) within 7 days, and 2 patients (6.67%) after 8 days.

Mini-open reduction with bone grafting was performed in 18 patients (60%) to address intra-articular depression. Mean hospital stay was 15.1 ± 7.2 days, with 13 patients (43.33%) hospitalized for 8-21 days.

Fracture Healing: All 30 fractures achieved radiological union. Eight patients (26.66%) demonstrated union between 7-12 weeks, while 22 patients (73.33%) achieved union between 13-18 weeks, with a mean union time of 16.2 ± 2.60 weeks.

Functional Outcomes

Table 1: Functional and Radiological Outcomes

Parameter	Number of Patients	Percentage
Knee Flexion		
<90°	4	13.33
90-120°	12	40.0
>120°	14	46.67
Mean ± SD	120.0 ± 13.47°	
Limb Alignment		
<10° varus/valgus	25	83.3
>10° deviation	5	16.7
Mean ± SD	5.67 ± 2.33°	

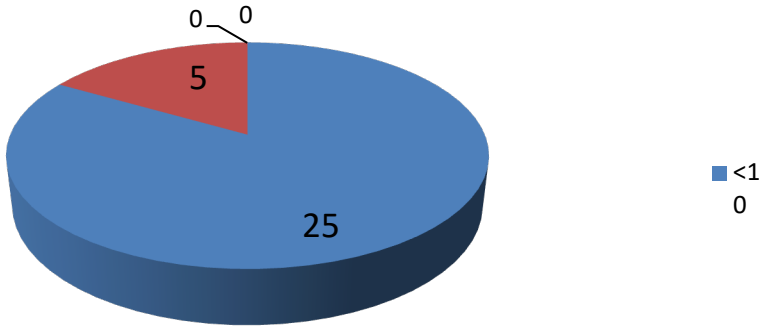

Figure 5:

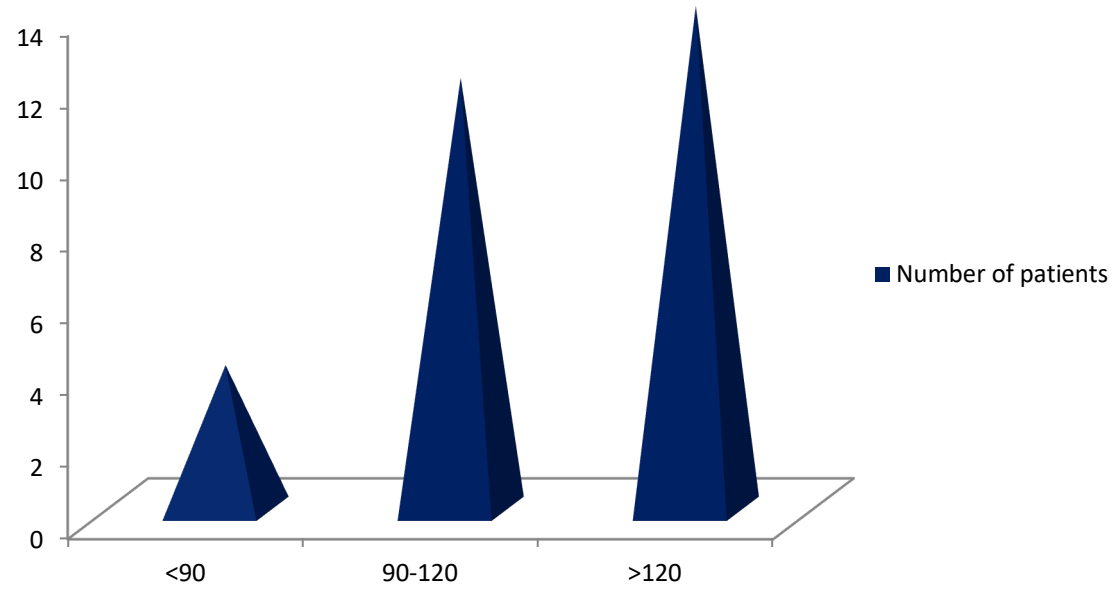

Figure 6:

The mean range of knee flexion at final follow-up was 120° ± 13.47°, with 14 patients (46.67%) achieving flexion exceeding 120°. Four patients (13.33%) achieved less than 90° of flexion.

Limb alignment was excellent in 25 patients (83.3%), with varus or valgus deviation less than 10°. Mean deviation from mechanical axis was 5.67 ± 2.33°.

Overall Clinical Outcomes: Using modified Rasmussen criteria for integrated clinical and radiological assessment:

- Excellent results: 14 patients (46.67%)
- Good results: 12 patients (40%)
- Fair results: 1 patient (3.33%)
- Poor results: 3 patients (10%)

The mean Rasmussen score was 28.4.

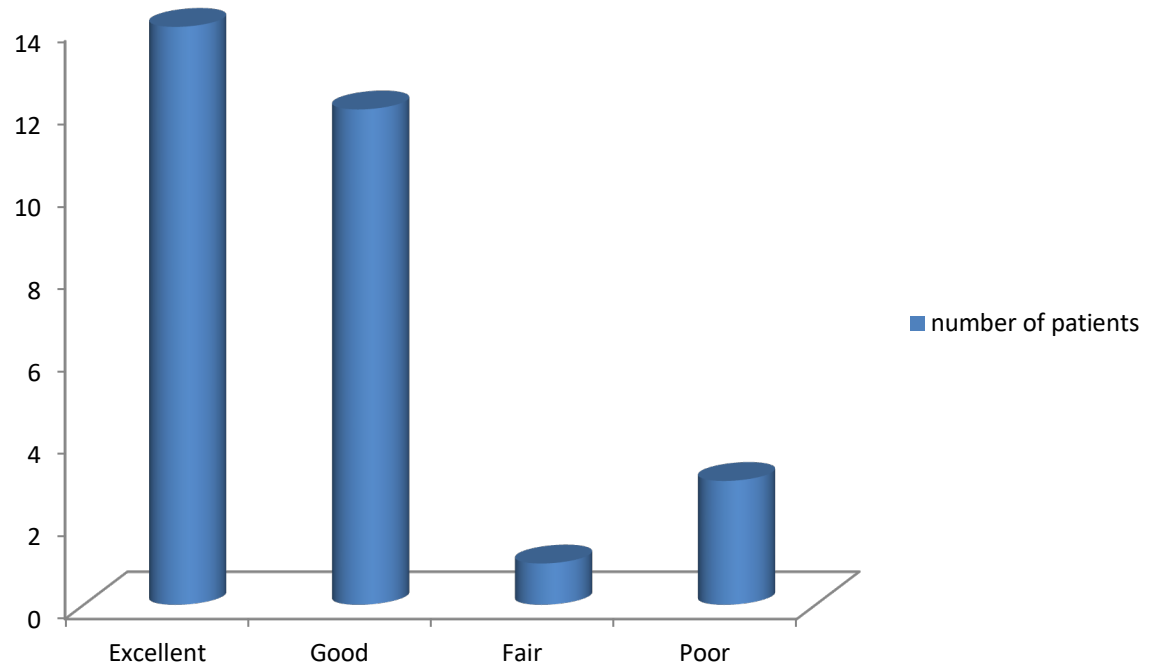

Figure 7:

Complications

Superficial pin-tract infections occurred in 11 patients (36.67%). All infections responded to conservative management consisting of regular pin-site dressing changes, with no patient requiring debridement or pin removal.

Two patients (6.67%) with Schatzker type VI fractures developed compartment syndrome. One developed compartment syndrome at initial presentation; the second developed it 2 days postoperatively. Both underwent fasciotomy followed by Ilizarov ring fixation. One patient developed lateral compartment muscle necrosis and permanent peroneal nerve palsy despite appropriate fasciotomy, while the other healed without sequelae following complete debridement.

Discussion

Ilizarov achieved 87% good/excellent Rasmussen scores, matching Chan (28.8 external vs 27 internal) and Mankar series.

Union time (16.2wks) comparable to Babis (14wks hybrid), Ramos (11-12wks). Knee motion (120°) exceeded Babis (115°), reflecting minimal soft tissue disruption.

Male predominance and RTA etiology align with literature; younger cohort (vs Rasmussen's 55yrs) reflects active population.

Pin infections higher than ring fixators (4%) but manageable without hardware removal, unlike ORIF wound issues. Compartment syndrome in type VI cases required vigilant monitoring.

Table 2:

Parameter	This Study	Babis	Ramos
Union (wks)	16.2	14	11-12
Flexion (°)	120	115	-
Rasmussen	28.4	-	Good V/VI

Limitations:

Single-center, no ORIF control. Strengths: uniform high-energy cohort, consistent technique. Ilizarov remains valuable for soft tissue-challenged fractures, enabling early rehab without permanent implants.

Conclusion

This prospective case series demonstrates that Ilizarov external fixation achieves excellent clinical and functional outcomes in high-energy proximal tibial fractures, regardless of fracture complexity. The technique's key advantage lies in its ability to provide rigid fixation and maintain soft tissue integrity simultaneously, permitting early weight-bearing and mobilization without jeopardizing fracture healing.

The 86.67% rate of excellent or good results, combined with mean knee flexion of 120° and excellent limb alignment in 83.3% of cases, demonstrates outcomes comparable to contemporary literature and equal to the results achieved with internal fixation methods. Critically, these outcomes were obtained while avoiding the complications associated with extensive surgical dissection in an already traumatized soft tissue envelope.

While the superficial pin-tract infection rate of 36.67% is higher than some published series, the responsive nature of these infections to conservative management and their lack of association with adverse functional outcomes or delayed healing should be contextualized. These infections represent a manageable morbidity rather than a treatment failure, particularly when contrasted with the deep infection and necrosis rates following extensive open procedures in highly contaminated trauma.

The Ilizarov method remains a valuable and appropriate treatment choice for complex proximal tibial fractures, particularly in settings with significant soft tissue compromise or open wounds. The technique's versatility accommodates all Schatzker fracture types with equal efficacy, and staged protocols are unnecessary.

We advocate for expanded use of Ilizarov external fixation in institutional trauma programs managing high-energy proximal tibial injuries

References

1. Campbell's operative orthopaedics: Fractures of lower extremity, tibial plateau. Philadelphia: Mosby; 2015.
2. Gustilo RB. Fractures of the tibial plateau. In: Fractures and dislocations. St. Louis: CV Mosby; 1993. p. 945.
3. Schatzker J. Tibial plateau fractures. In: Skeletal trauma. Edited by Browner BD, Jupiter BB, Levine AM. Philadelphia: WB Saunders; 1993. p. 1745.
4. Rockwood and Green's fractures in adults. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2006.
5. Baratz M, Watson AD, Imbriglia JE. Orthopaedic surgery: the essentials. New York: Thieme Medical Publishers; 1999. p. 517.
6. Colletti P, Greenberg H, Terk MR. MR findings in patients with acute tibial plateau

fractures. Comput Med Imaging Graph 1996; 20(5):389–394.
7. Papagelopoulos PJ, Partisinevelos AA, Themitocleous GS, et al. Complications after tibial plateau fracture surgery. Injury 2006; 6:475–484.
8. Tscherne H, Lobenhoffer P. Tibial plateau fractures: management and expected results. Clin Orthop 1993; 292:87–100.
9. Ilizarov GA. A new principle of osteosynthesis with the use of crossing pins and rings. Collected Scientific Works of the Kurgan Regional Scientific Medical Society. Kurgan: Union of Soviet Socialist Republics; 1954. p. 145–160.
10. Ilizarov GA. Transosseous osteosynthesis. 1st ed. Berlin: Springer Verlag; 1992.
11. Fleming B, Paley D, Kristiansen T, Pope M. A biomechanical analysis of the Ilizarov external fixator. Clin Orthop Relat Res 1989; 241:95–105.
12. Ylmaz E, Belhan O, Karakurt L, et al. Mechanical performance of hybrid Ilizarov external fixator in comparison with the Ilizarov circular external fixator. Clin Biomech 2003; 18(6):518–522.