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Case Series of Comminuted Fractures of Proximal Tibia with Ligament Injuries Treated with Knee Spanning Ilizarov Fixation

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Abstract

Comminuted fractures of the tibial plateau with intra-articular extension and ligament injuries are caused by high-energy trauma. The associated high rate of soft tissue injuries leads to complications like joint stiffness, compartment syndrome, malunion, skin loss, osteomyelitis, knee contractures, and potential amputation. The knee-spanning Ilizarov external fixator minimizes these complications by allowing early mobilization and weight-bearing, reducing soft tissue injury and blood loss, and providing stable fixation. Assessment using the Knee Society Score pre- and post-operatively showed improvement. This prospective study includes 15 patients with comminuted tibial intra-articular fractures and associated ligament injuries, treated with knee-spanning Ilizarov fixation. Clinical and radiological assessments post-procedure indicated positive outcomes. Out of 15 patients, 80% achieved good clinical and radiological outcomes, including early mobilization, normal gait, and successful fracture healing. Complications included pin tract infections (2 patients), knee stiffness (1 patient), and secondary procedures such as arthrodesis and TKR due to arthritis.

Keywords: *Clinical and Radiological Outcomes, Comminuted Tibial Plateau Fractures, Knee-Spanning Ilizarov Fixator.*

Introduction

Comminuted intra-articular tibial fractures with ligament injuries present significant surgical challenges. Associated soft tissue and ligament injuries, neurovascular damage, and compartment syndrome complicate the treatment. [2,3]. The main factors affecting long-term results are ligamentous instability and the inability to restore articular congruity. Traditional management often involves plating or dual plating, which can lead to wound dehiscence and compartment syndrome [5]. The Ilizarov technique addresses joint space restoration, and deformity correction, and has fewer complications, though it requires special training and knowledge [10,11]. This study evaluates post-operative radiological and functional outcomes using the Knee Society Scoring system.

Materials and Methods

Study Design

This prospective study was conducted over 2 years at Sree Balaji Medical College, including 15 patients with comminuted tibial plateau fractures and ligament injuries.

Inclusion Criteria:

1. Type 3 comminuted fractures (C2, C3) with ligament injury
2. Age 18-70 years
3. Closed fractures
4. Ligament injuries (ACL complete tear, PCL, LCL, MCL partial tears)
5. Meniscal injuries

Exclusion Criteria:

1. Pathological fractures
2. Neurovascular injuries

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3. Infections
4. Open fractures
5. Complete tear of PCL, MCL, or LCL

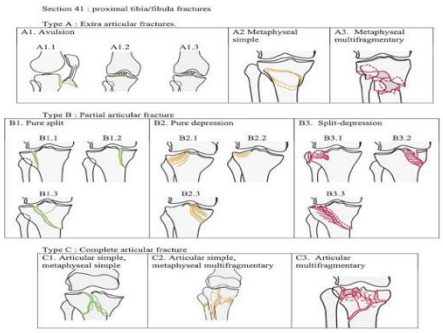
Data Collection

Informed consent was obtained. A systematic pro forma was used for each patient, including demographics, fracture staging, and evaluations. Preoperative assessments included radiographs, CT scans, and MRIs [Case 1,2].

Operative Technique

Surgeries were performed in a supine position under spinal or general anaesthesia without a tourniquet [1]. Prophylactic antibiotics were administered 30 minutes before incision. Ligamentotaxis was performed, and fracture fragments were reduced using C-arm guidance. A four-ring frame was applied with one ring on the distal femur and three on the tibia. Bone grafts were used for severe central depression. The Knee Society Scoring system was used for pre- and post-operative assessment [2][3] [fig1].

AO classification



Case 1




Case 2

Post Operative Care and Rehabilitation

In this study, we operated on cases of tibial plateau type C2 and C3 associated with ligament injury with knee-spanning Ilizarov fixator [4][5]. Postoperatively x-rays were taken immediately post-operative, 1 week, 1 month, 3 months, 6 months and 1 year [case1][case2]. On POD 1 full weight bearing with knee extension exercises, straight leg raising test, Hip AROM and ankle pump exercise were started [6][7]. Four weeks later distal femur and proximal tibia straight rods were changed to hinge rods encouraging knee flexion. At the end of the second month distal femur ring was removed. Four months post-surgery, after adequate fracture healing dynamization was done followed by a stress test in which connecting rods were removed and tibial rings were also removed [8][9]. A synthetic PTB cast was applied and retained for one month later on removed [10]. The patients were assessed with knee society scoring preoperatively and post-operatively. There was an improvement in knee society scoring after the procedure [chart1,2,3].

Master chart [1]

Sr No	Age / Gender	Type of fracture	Ligament injury	Procedure done	Post op outcome	Post op complication	Associated comorbidity	Secondary procedure done
1	60/ M	C3	ACL complete tear and MC L strain	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
2	60/ M	C3	ACL	Knee-	Medial	Knee arthritis	Esophageal	TKR

			complete tear with partial LCL tear	spanning Ilizarov fixation	joint space narrowing		varices	
3	51/M	C2	ACL partial tear	Knee spanning Ilizarov fixation with mini arthrotomy	Adequate anatomical reduction fracture union	nil	nil	nil
4	39/M	C3	ACL complete tear with medial meniscal tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
5	54/F	C2	ACL partial tear	Knee-spanning Ilizarov fixation	Incongruency in joint	Impaired knee room	DMT2	Knee arthrodesis
6	49/M	C2	ACL complete tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	pin tract infection	nil	nil
7	50/F	C2	ACL complete tear with MCL partial tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
8	68/F	C3	ACL partial tear	Knee spanning Ilizarov fixation with mini arthrotomy	Adequate anatomical reduction fracture union	Pin tract infection	DMT2	Change the pin
9	52/M	C3	ACL complete tear with partial MCL tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
10	38/F	C2	ACL complete tear with partial MCL and	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	HTN	nil

			meniscal tear					
11	47/M	C3	ACL complete tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
12	54/M	C2	ACL partial tear with meniscal tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	nil	nil
13	62/F	C2	ACL complete tear with partial MCL tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	HTN	nil
14	48/M	C2	ACL complete tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	DMT2	nil
15	51/M	C3	ACL complete tear	Knee-spanning Ilizarov fixation	Adequate anatomical reduction fracture union	nil	DMT2	nil

Knee Society Scoring System Chart [2]

Sr no	Age/sex	Pre-op KSS score	Post-op 6 months KSS score	Post-op 12 months KSS score
1	60/M	42	70	83
2	60/M	40	75	84
3	51/M	47	73	86
4	39/M	45	78	87
5	54/F	40	70	82
6	49/M	47	75	84
7	50/F	40	68	84
8	68/F	35	65	82
9	52/M	50	70	86
10	38/F	50	78	88

11	47/M	40	80	85
12	54/M	45	76	86
13	62/F	35	73	85
14	38/M	55	78	88
15	51/M	45	75	85

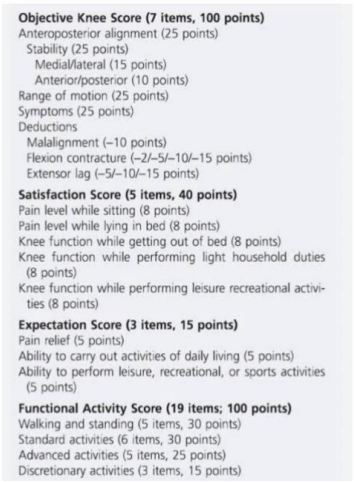
Explanation

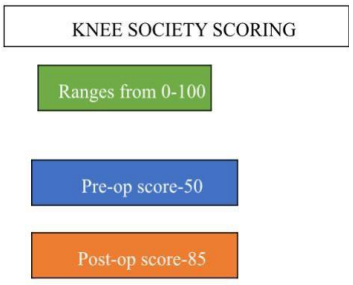
Preop assessment of patients was done clinically, radiologically and using the Knee Society Scoring system. Post-surgery serial X-rays were done to assess fracture healing and anatomical restoration. Dynamisation followed by a stress test was done at 4 months, and knee physiotherapy was started. Overall patient showed improvement clinically and radiologically. The patient also showed improvement in knee society score postoperatively when compared to the scores preoperatively which were used to assess the functional outcome of each patient [chart1,2,3].

Discussion

Comminuted tibial plateau fractures are often associated with ligament injuries [11][12]. The lizarov technique effectively addresses joint space restoration, and deformity correction, and minimizes complications [13]14]. Postoperative monitoring and appropriate modifications, such as switching to hinged rods and dynamization, aid in joint movement and fracture healing [15][16]. Postoperatively, straight rods connecting the distal femur ring and proximal tibial ring were removed and replaced by hinged rods which facilitated knee movements and knee AROM physiotherapy was started [17][18]. Improvement in the knee Society scoring system showed improvement postoperatively [chart 3]. Pin tract infections, knee stiffness, and secondary procedures were observed, primarily due to poor hygiene and inadequate physiotherapy [19][20].

Knee Scoring System [Chart 3]





Conclusion

The knee-spanning Ilizarov external ring fixator is beneficial in treating comminuted tibial plateau fractures associated with ligament injury as it allows for early weight-bearing, causes minimal soft tissue damage, and results in good clinical and radiological outcomes [17][18]. The patients were assessed with knee society scoring preoperatively and post-operatively. There was an improvement in knee society scoring after the procedure.

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