

Ligamentotaxis by Ilizarov Method in the Management of Tibial Plateau Fractures

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Abstract: *Objective:* To evaluate the reduction with ligamentotaxis, union time and functional results of tibial plateau fractures by Ilizarov method. Thirty patients admitted with 20 to 50 years age from October 2010 to November 2012. Proximal tibia fractures type Schatzker type I, III, IV, V & VI on the basis of radiographs were included. In this study the functional outcome was assessed according to Neer scoring system. Out of 30 cases of proximal tibia fractures there were 27(90 %) male and 3(10 %) female with ratio of 9:1. The mean age was 32.9+ 5.08 years. We had 13 (42.5%) open fractures and 17 (57.5%) close fractures. Out of 13 open fractures Gustillo IIIA were 9 (69.2%), 3 (20%) were Gustillo II and 1 (10%) was Gustillo I. Union time range 16 to 19 weeks with mean healing time was 1.8+ 1.03 weeks. The partial weight bear walking ranged from 01 to 03 days with mean 2.17+ 0.60 weeks. Full weight bear walking ranged from 3 to 07 days with mean 5.2 +0.98 weeks. The complications were followed by Knee Joint Stiffness in 29(96.6%) cases was observed. 18(60%) patients had pain during walking as well as swelling at lower leg, 15(50%) patients had pin site over granulation, 12(40%) patients had pin loosening during follow-up in out patient department, quadriceps wasting was found in 10(33.33%) patients, 03(10%) patients had pin breakage, 02(6.6%) patients had delayed union, 02 (6.6%) patients had muscle sagging, 01(3.33%) patient had deep pin tract infection and 01(3.33%) patient had mal union. Duration of removal of Ilizarov external fixator range between 12 to 15 weeks with mean was 1.43+ 0.77 weeks. Final functional results were 09 (30%) excellent, 12 (40%) good, 6 (20%) fair and 2 (6.66%) poor. In conclusion: The management with Ilizarov external fixator is better method of treating proximal tibia fractures. The functional outcome results of this method of treatment are more predictable, high rate of union with a low complication rate. The technique can be learnt easily.

Key words: Ligamentotaxis • Tibial Plateau Fractures • Ilizarov

INTRODUCTION

The high-energy trauma due to road traffic accidents, firearm injuries and fall from height may lead to fracture of proximal tibia [1]. The internal reduction and fixation with plates and screws were popular in 1980s, however deep infection and wound breakdown was frequently seen. Such procedures requires prolong operating time and yet

the reduction of fracture can be a challenge. Circular external fixation, a non-invasive procedure, re-establishes continuity of the diaphysis to metaphysis without damage to the other soft-tissue, allowing fine-tuning of reduction post-operatively [2].

The patterns and severity of proximal tibial fracture with pattern can be classified either by Schatzker *et al.* [3] or AO/OTA comprehensive [4] classifications.

Ilizarov, a Russian orthopedic surgeon, in 1981 during AO meeting introduced his new technique for the first time to western countries. The technique and external fixators introduced were different from those that were in use at that time since 1950. [5]. As an external fixator, the Ilizarov apparatus allows gradual mechanical correction of a deformity in three dimensions including rotation, translation and angulation [6]. This technique showed excellent results, even where the existing methods failed to achieve the minimum acceptable results. The Ilizarov external fixator is best suited for tibia fractures, because of its advantage of allowing early weight bearing [7].

Proximal tibia fractures with small bone defects can be managed by external or internal fixation with equal satisfactory results, whereas the management of extensive and complex defects is challenging, as often, it result in nonunion, mal-union, loss of congruity and shortening. Limb shortening is also responsible for asymmetric gait and posture deformity. The management of open fractures includes meticulous debridement, stable external fixation and provision of viable soft tissue coverage. The use of external fixation has brought revolutionary changed in the field of Orthopaedic surgery. The introduction of external fixation has considerably reduced the number of amputation, mal unions and non-unions. By providing skeletal stability, it allows early mobilization and thus reduces the hospital stay of the patient. With improved design and better understanding of the principles that govern safe and effective use, the external fixation has become indispensable tools in the hands of experienced trauma surgeons [8]. The use of external fixator provides immediate reduction of the fracture, allowing attending surgeon to address soft tissue injury and infection in time. External fixation has emerged as safest method for initial skeletal stabilization of open fractures [9].

The objectives of this study are to assess union time and functional results of tibial plateau fracture tibia with ligamentotaxis by Ilizarov method.

MATERIALS AND METHODS

The study was carried out in department of Orthopedic Surgery & Traumatology, Liaquat University of Medical & Health Science Jamshoro during October 2009 to November 2013. Thirty patients, aged between 20-50 years of either gender, with proximal tibia fractures were admitted through the outpatient/casualty department of the hospital. The data was entered in a specified proforma designed for this purpose.

Proximal tibia fractures type open Gustilo type II, IIIA, Schatzker type and I, III, IV, V& VI on the basis of clinical examination and X-rays were included. Proximal tibia fractures type Gustilo type B & IIIC and Schatzker type II were excluded.

Post operatively all Cases were followed with immediate postoperative radiographs & clinical assessment. Variables of interest noted and clinical assessment performed at each OPD visit, weekly for six weeks then twice-monthly 12 weeks. These include general condition of the patient, wound & union of fracture, radiological assessment, complications and functional outcome. Data was analyzed through SPSS software version 16.0.

After initial evaluation and establishing the extent of injury / injuries per-entrant antibiotic and analgesics were given. After further necessary investigations and arrangements Ilizarov external fixator was applied.

Operative Procedure: Epidural anesthesia was given to all patients. After draping, three or four ring construct was preassembled according to the fracture configuration. Fracture reduced and one plain wire in distal femur and another in distal ring over tibia inserted percutaneously under image intensifier to maintain the position of fracture during Ilizarov external fixation. The ring than fastened followed by tensioning the wire either with wire tensioner or manually with spanners and another wire passed near the distal part extension of the fracture over the tibia then 6mm half pins with rancho cube system passed proximal to the first wire inserted into the femur and fastened with the arch system. After tension to the wires and stability of the shanz, distraction started and reduction of the fracture and joint congruity was assessed under image intensifier. After completion of fracture reduction by distraction through ligamentotaxis 1.8mm Olive tip wires for compression of intra articular or longitudinal fracture line to maintain the joint congruity was inserted through medial & lateral sites as per configuration of the fracture. Then other one half pin over the arch was applied and three wires were inserted and fastened with each ring to maintain and increase the stability over the fracture. In few cases, we used drop wires and attached them with the help of multiple holes plates. All the rings were larger by two-finger breadths around thigh, knee and tibia. The wire sites washed with hydrogen per oxide, pyodine, normal saline and dressed with pyodine soaked gauzes pieces.

On return from Operation Theater, epidural analgesia (2mls of 0.5% Abocain/Bupicain + 8mls of normal saline making 10ml solution) was given 6 to 8 hourly through epidural catheter for 2-3 days and then switched to oral analgesics. Patient mobilization and weight bearing walking was decided on individual basis depending upon condition of wound, patient's general status and confidence.

A parenteral antibiotic, 2nd generation cephalosporin was given for 2-3 days. The 3rd generation cephalosporin alone or in combination with aminoglycosides, as guess antibiotics, was also given in some cases depending on the status of the wound. Sample for gram stain, culture and sensitivity were taken at the time of first debridement and antibiotics thereafter were given according to the sensitivity reports.

Check x-rays were done on very next day and adjustments if required, were done on 2nd or 3rd day. Patients were trained for wash of fixator, care of pins, cleaning and care of pinholes, mobilization of joints and other relevant exercises.

Upon follow up visit in out-patient department, fixators were checked thoroughly – and every nut and bolt tighten, wire tensionized if needed, pins sites cleaned with pyodine solution and hydrogen per oxide and washed thoroughly with normal saline. The antibiotics commenced initially, modified depending upon the results of culture & sensitivity report.

Radiographs taken at every 3rd week; Fixators were dynamized on callus formation and removed without anesthesia or in few cases under anesthesia after 3-4 weeks of dynamization. Before removal of the fixator the interconnecting threaded rods between the proximal and distal construct were removed and union was assessed. If there was tenderness and movement at the fracture site the inter connecting rods were put back and fixator left in situ for further 3-4 weeks. In case when fracture clinically found united, first the wire bolts were loosened, wires of distal construct cut. Distal rings and wires were removed then similarly proximal construct removed. All the pin site wounds were washed with saline and dressed with gauzes soaked in pyodine. Above knee walking cast applied for 3 weeks and patient instructed to walk full weight bear, preferably unaided. After 3 weeks x-ray, out of plaster cast, was taken and if satisfactory patient sent home then to be reviewed after one month. In case where fracture line still visible the leg put into a cylindrical cast for further 2-3 weeks. All patients were then reviewed

every month for 3 months and their functional status was assessed and exercised and rehabilitations advised accordingly. In cases where further rehabilitation or any other care was required they were reviewed as necessary.

RESULTS

Among 30 cases of proximal tibia fractures treated by Ilizarov method, 27(90 %) were male and 3(10 %) female with male: female ratio of 9:1. There was wide variation of age ranging from a minimum of 20 year to 50 year. The mean age was 32.9+ 5.08 year.

We had 13 (42.5%) open fractures and 17 (57.5%) close fractures. Out of 13 open fractures Gustillo IIIA were 9 (69.2%), 3 (20%) were Gustillo II and 1 (10%) was Gustillo I.

The most common cause (40%) of proximal tibia fractures in our study was road traffic accident (RTA). 05 (16.6%) cases had fractures of proximal tibia after fall from height, 08 (26.6%) cases had fractures shaft after assault, 04(13.33%) had open fracture due to firearm injury and 1 (3.33%) due to machine injury (Chart 1).

Out of 30 cases fresh-fractures were 27(90%) and 3(10%) cases were old-fractures (Chart 4). Whereas out of 27 fresh cases, 15(55.55%) cases was open fresh and 12(44.44%) cases was closed fresh. Among 15 open fresh cases we observed 8(53.33%) were fresh/ contaminated, 4(26.66%) cases were fresh/ infected and 3(20%) cases was fresh/ clean.

Union time range 16 to 19 weeks with mean healing time was 1.8+ 1.03 weeks (Table 1, Chart 2). The partial weight bear walk ranged from 01 to 03 days with mean 2.17+ 0.60 weeks. Full weight bearing walk ranged from 3 to 07 days with mean of 5.2 +0.98 weeks (Table 2). The hospital stay ranged from 06 to 14 days with mean 8.96+2.73 days.

The complications seen in this study include pin site inflammation and superficial pin tract infection in all cases, followed by Knee Joint Stiffness in 29(96.6%) cases was observed. 18(60%) patients had pain during walking as well as swelling at lower leg, 15(50%) patients had pin site over granulation, 12(40%) patients had pin loosening during follow-up in out-patient department, quadriceps wasting was found in 10(33.33%) patients, 03(10%) patients had pin breakage, 02(6.6%) patients had delayed union, 02 (6.6%) patients had muscle sagging, 01(3.33%) patient had deep pin tract infection and 01(3.33%) patient had mal union (Chart 3).

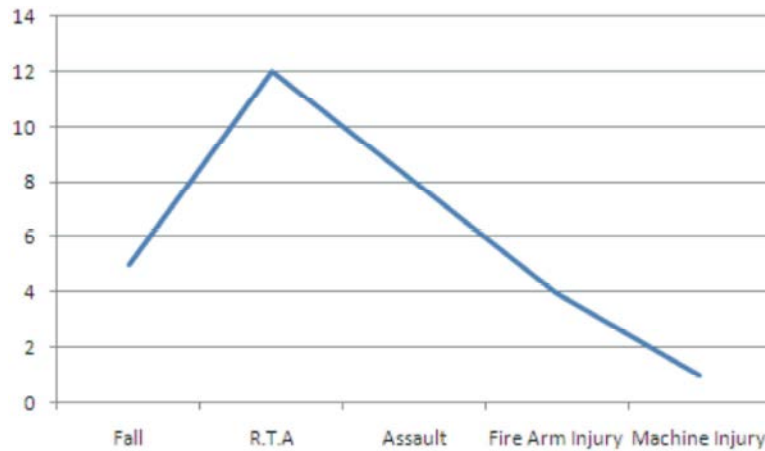


Chart 1: Mode of injury

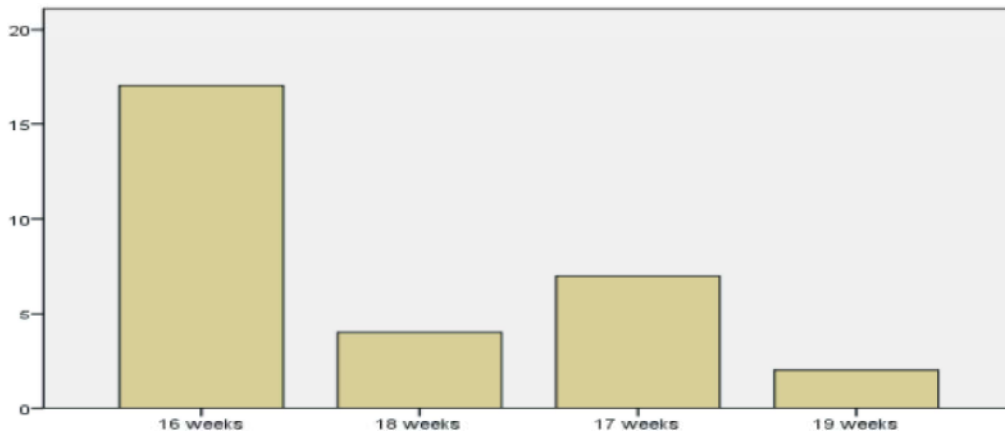


Chart 2: Union Time

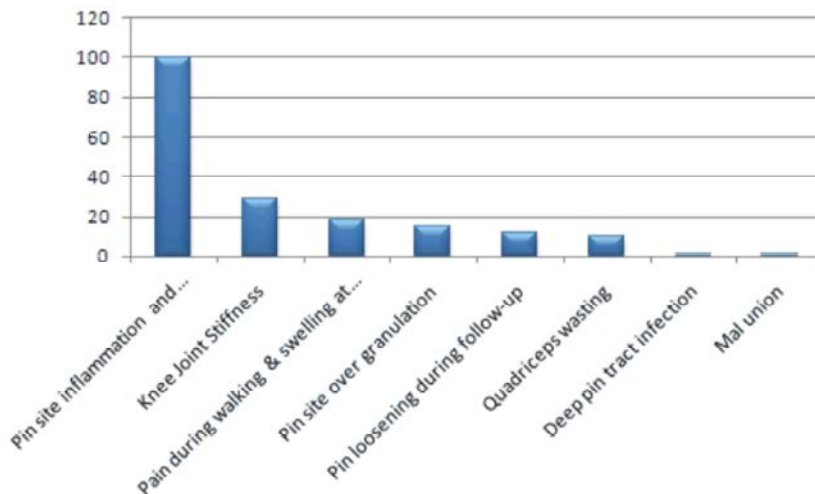


Chart 3: Complication Post Operative

In this study the duration of removal of Ilizarov external fixator range between 12 to 15 weeks with mean was 1.43+ 0.77 weeks. In this study the functional

outcome was assessed according to Neer scoring system. The final functional results were 09 (30%) excellent, 12 (40%) good, 6 (20%) fair and 2 (6.66%) poor (Table 3).

Table 1: Union Time

In Weeks	Mean	Median	Mode	SD
16-19	1.8	1.0	1.0	1.03

Table 2: Weight Bearing

In Days	Range	Mean	Median	Mode
Partial Weight Bearing	01-03	2.17	2.0	2.0
Full Weight Bearing	03-07	5.2	5.0	5.6

Table 3: Functional Outcome

Quality	No. of Patients	Percentage
Excellent	09	30%
Good	12	40%
Fair	6	20%
Poor	2	6.66%

DISCUSSION

In 1950s, G.A. Ilizarov introduced not only a new apparatus but also even more importantly a new understanding of the biology of lengthening. His technique enables correction of angular, rotational and translational osseous deformities as well as restoration of limb length equality [10, 11]. The system consists of many parts and allows application to almost any limb segment, limb size or limb deformity. The application of this treatment modality leads to healing of the nonunion, functional recovery of the limb, correction of leg length discrepancy, recovery of mechanical axis [12].

In our series majority of patients were males. The male to female ratio was 9:1. This can be attributed to our Pakistani setup where the female population largely work indoor or in agricultural field and do not travel much and therefore less likely to be a victim of accidental injury. The higher rate of fracture in male clearly correlated with the life style of male, especially, in our part of world. The males are more involved in outdoor activities and the young male are more enthusiastic about life and careless drivers. Female usually have sedentary life style and less involved in driving which is a common cause. However the male to female ratio given by Camacho [13] 4:1 and Ozturkmen Y [15] is 2.1:1.

The age ranged from 25-40 years with mean age 32.9+5.08. The fractures were most common in the 3rd decades in our study. The other series also show higher incidence of fractures in younger age groups. However Kataria H showed age range from 20 to 60 year with the mean age was 32 years [15] and Shrestha [16] showed average age was 37 years.

In our study 13 (42.5%) were open fractures and 17 (57.5%) close fractures. Out of 13 open fractures

Gustillo IIIA were 9 (69.5%), 3 (20%) were Gustillo II and 1 (6.66%) was Gustillo I. An other study conducted by Ocguder [17] stated the fractures according to the Gustilo-Anderson classification, 8, 12 and 13 fractures were grade I, II and III respectively.

The most common cause of proximal tibia fractures in our study was road traffic accident (RTA). There were 12 (40%) patients who sustained fractures of the tibia following road traffic accidents, 05 (16.6%) cases had fractures of proximal tibia after fall from height, 08 (26.6%) cases had fractures shaft after assault, 04 (13.33%) had open fracture due to fire arm injury and 1 (3.33%) due to machine injury. In the study of Ngim [18], road traffic accident (RTA) was the leading cause of limb injury accounting for 76.8% of cases (53 patients).

In our study reported 27(90%) cases were fresh and 3(10%) cases were old. Whereas out 27 fresh cases, 15(55.55%) cases was open fresh and 12(44.44%) cases was closed fresh. In out 15 open fresh cases we observed 8(53.33%) was fresh/ contaminated, 4(26.66%) cases was fresh/ infected and 3(20%) cases was fresh/ clean.

Weight bearing is very important for callus formation during fracture healing. Weight bearing increases the formation of bone in fracture healing and lack of weight bearing decreases the amount of woven bone that is formed in healing of fractures. Weight bearing is essential for articular cartilage regeneration. Weight bearing is also helpful in preventing deep vein thrombosis. Movements of the ankle and weight bearing improve venous peak velocity and aid in thrombo prophylaxis. Factors that did adversely affect stability following fixation, include the degree of initial comminution and displacement of the fracture, failure to adequately reduce or fix the fracture and severe demineralizing of bone [19]. In our study partial weight bearing walking was 2.17 + 0.6 weeks with the range from 1 to 3 weeks. While full weight bearing was 5.2 + 0.98 weeks with the range from 3 to 7 weeks. Compare the study conducted by Behrens & Searls [20], in their study of external fixation of the tibia showed 36 days average time to partial weight bearing walking and 65 days to full weight bearing walking. Full, unsupported weight bearing was started after a median period of 65 days in 52 patients (71.2%).

Longer the duration of hospital stay, greater the burden on the patient financially and psychologically. Ideal treatment should therefore minimize the duration of hospital stay. The mean hospital stay in this study was 15.23 + 1.9 days with the range from 8 to 19 days. It is comparable to other studies given by author Camacho SP the mean hospitalization period is 21.25 days [21].

In our study most common postoperative complications were pin site inflammation and superficial pin tract infection occurs in all cases, followed by Knee Joint Stiffness in 29(96.6%) cases was observed. 18(60%) patients had pain during walking as well as swelling at lower thigh, 15(50%) patients had pin site over granulation, 12(40%) patients had pin loosening during follow-up in out patient department, quadriceps wasting was found in 10(33.33%) patients, 03(10%) patients had pin breakage, 02(6.6%) patients had delayed union, 02 (6.6%) patients had muscle sagging, 01(3.33%) patient had deep pin tract infection and 01(3.33%) patient had mal union. However in the study of Barbieri R. *et al.* [22], described the complications occurred in 12 patients (35%) and included 1 skin slough, 5 pin tract infections, 3 deep infections, 3 non-unions and 3 loss of reductions necessitating frame revision.

In this study the functional outcome was assessed according to Neer scoring system [11]. The results were observed 09 (30%) excellent, 12 (40%) good, 6 (20%) fair and 2 (6.66%) poor. However Sahibzada [23] showed results were excellent in seven (35%) cases, good in eight (40%) cases and fair in four (20%) cases.

CONCLUSION

Fracture of proximal tibia is most common among young males. Road traffic accident is the major contributing cause and motorbike accident is the major contributing factor. The management with Ilizarov external fixator is better method of treating proximal tibia fractures. The functional outcome results of this method of treatment are more predictable, high rate of union with a low complication rate. The technique can be learnt easily.

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