

Role Of Ilizarov Ring Fixator In Tibial Pilon Fractures: An Observational Study

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ABSTRACT:

BACKGROUND: Ankle fractures that involve the weight-bearing distal tibial articular surface are known as pilon fractures, that are often an open fracture. The use of the Ilizarov external fixator in treating pilon fractures is beneficial in preserving the endosteal and periosteal blood supply.

MATERIAL AND METHODS: present study was conducted on 25 patients who attended the Department of Orthopaedics, Government Medical College, Srinagar (Bone and Joint Surgery) from 2020 to 2022, all fractures were classified and management done by using ilizarovs ring fixator. Study was done to assess the results of ilizarov ring fixator in tibial pilon fractures.

RESULTS: overall mean age in study was 37.9 years. Males dominated the study group as they comprise 72% The mean time for surgical procedure and full weight bearing was 103 minutes and 15.6 weeks. The mean duration for radiological union of fracture was 24.2 weeks. The mean functional ankle score was 80.6. out of 12 cases of AO/OTA type C2 fractures , 1 had excellent . Most common complication seen was pin tract infection (PTI)

CONCLUSION: we conclude that Ilizarov Ringfixation a better and effective method in treatment of tibial pilon fractures to promote union with better functional results in patients.

KEYWORDS: Pilon fractures, ilizarov ring fixation, tibial fractures.

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I. INTRODUCTION:

Ankle fractures that involve the weight-bearing distal tibial articular surface are known as pilon fractures. The French word “pilon” was used by Destout who noticed the similarity in shape between the articular surface of the distal tibia and a pharmacist’s pestle (pilon).^[1] Later, Bonin would refer to a similar fracture as a “plafond” fracture.^[2,3] An associated fibula fracture is present in approximately 70% to 85% of cases.^[4] The pilon fracture is often an open injury, and when closed it is usually associated with extensive soft tissue damage. About 10% to 30% (50% in some series) are open injuries with degloving or crushing of the skin.^[5]

The fracture pattern is influenced by two main forces acting either separately or together, Axial compression occurs as the talus is driven into the tibial plafond.^[6] Presence of an associated fibula fracture implicates valgus shear forces, which usually results in damage to the lateral articular surface, valgus deformity and a greater likelihood of axial mal-alignment because of the absence of an intact lateral column.^[7] Open injuries are more commonly associated with displacement into valgus.^[8] primarily related to the extremely thin medial soft tissue envelope. In contrast, an intact fibula is more likely to be associated with a varus compression force, crushing of the medial articular surface and varus angulation.^[8]

Fractures of distal tibia pose management challenges to an orthopedic surgeon because of following reasons,^[9] Being subcutaneous incidence of open fractures is high.^[10] Tendency to displacement after swelling subsides.^[11] Precarious blood supply.^[12,13,14] Recommended treatments range from - Closed reduction and casting to calcaneal pin traction. Percutaneous Kirschner-wire fixation, External fixation, Isolated lateral pillar stabilization by a fibular plate. Limited open reduction of key fragments, Open reduction and internal fixation (ORIF). Biological plating, Primary arthrodesis and even early amputation.^[15]

Various methods are: CONSERVATIVE: include Cast immobilization and Traction (Main use in the management of fractures with intra articular extension complicated by fracture blisters)

II. OPERATIVE:

include Open reduction and internal fixation by Plates and screws or by Intra-medullary nails.

Closed reduction and internal fixation by Plates and screws or by Intra-medullary nails.

External fixators:^[16] include Delta fixator, Ankle spanning type fixator, Ilizarov ring fixator

Ilizarov ring fixator: The most significant advantage of ring fixators is their ability to achieve stability with minimal soft-tissue dissection^[17]. A circular fixator also provides the option of bone transport, ^[18]. The use of the Ilizarov external fixator in treating pilon fractures is beneficial in preserving the endosteal and periosteal blood supply.^[19] The use of an ankle-spanning external fixator has been criticised for causing loss of movement in the ankle joint. ^[20] Although ligamentotaxis with the Ilizarov apparatus does not always achieve an accurate anatomical reduction, It significantly reduces peri-operative morbidity allows early mobilization and weight-bearing and often leads to good or fair results. ^[21] Intra-medullary nailing which is the treatment of choice for shaft fractures has limited role for distal tibial fractures. ^[22,23]

III. MATERIAL AND METHODS:

present study was conducted on 25 patients who attended the Department of Orthopaedics, Government Medical College, Srinagar (Bone and Joint Surgery) from 2020 to 2022. The study was approved by institutional Ethical Committee, after taking a written, informed consent from all the patients were managed

Inclusion criteria: Age >18 years, Both Sexes with Fractures of distal third of tibia (intra-articular), Open tibial pilon fractures (type 1-3b Gustilo and Anderson classification), AO/OTA type B3, C1, C2 and C3

Exclusion criteria: Age <18 years, Peri-implant fractures, All fractures with neurovascular injury, Pathological fractures, Associated fractures of same limb, Bilateral Tibialpilon fracture.

IV. PROCEDURE:

Proper history, systemic Examination and Local examination, Pre-anaesthetic checkup(PAC) was done prior to surgery. Pre-operatively patients were started on intravenous antibiotics prophylaxis one hour before surgery and if patient was having an open fracture prophylactic intravenous antibiotic was started within 30 minutes of admission. AP & lateral view radiographs preferably without cramer wire was taken. Although CT scanning has become a routine part of the radiographic assessment of patients diagnosed with intra articular fracture. These three fracture fragments, which have recently been mapped out using CT scans are: The medial malleolar fragment, The anterolateral (Chaput) fragment, The posterolateral Volkmann fragment. Blood investigations including CBC, KFT, Screening for HIV, Hepatitis B&C, chest X-Ray and ECG was done. Open Injuries were classified according to Gustilo Anderson classification. All fractures were classified as per AO/OTA classification system and inclusion criteria was followed before operation.

V. OPERATIVE TECHNIQUE:

The Ilizarov frame was assembled pre-operatively using appropriate connecting rods as per patient limb length and half rings of size 140, 160 or 180 depending upon circumference of patients leg for good soft tissue clearance and the frame was made for application on the injured limb. Conventional radiographs were analysed again pre-op for proper application of Ilizarov ring. The proximal half of the Ilizarov frame consists of two rings of either 160mm or 180 mm diameter, depending on the circumference of the limb. The first ring is placed at the proximal third of the tibia perpendicular to its long axis allowing at least two finger-breadths between the ring and the skin and more than 90° of flexion at the knee joint. A second ring is placed parallel to the first, just proximal to the fracture. Ilizarov wires, 1.8mm in diameter, were used for fixation and tensioned upto 120kg. These two rings were fixed together by three threaded rods. In the next step, a five-eighths ring was applied at the level of the calcaneal tubercle and connected to the previous ring by three threaded rods. After ligamentotaxis was achieved between the proximal half of the construct and the calcaneal ring, reduction of the fracture was checked. With the rest of the frame maintaining reduction by ligamentotaxis, multiple wires were inserted through the dummy ring for the final fixation of the fragments. Once a satisfactory reduction was confirmed by the image intensifier, additional threaded rods were inserted between the rings to augment the stability of the frame. Whole of the frame was covered with cotton and gauze to avoid the contamination post-op and before shifting the patient to observation ward. The distal pulses were checked.

Postopcare: The patient were monitored in recovery ward for first 24 hours. At 24 hr post operatively, Neurovascular status, pin site condition were checked besides check radiographs, On 2ND post operative day patient's were assessed for pin site discharge, skin necrosis, echymosis and blisters. Active R.O. Mat knee with pin and ring care.

Followup: Each patient were followed for minimum of 1 year. Final assessment were done at the end of one year. Regular checkups were held at weekly intervals for six weeks then at two to three week intervals for up to 18 weeks every two to three month. All the patients were assessed clinically and radiologically. Final assessment was done at one year. Complication include wound breakdown needing cover, neurovascular compromise, malunion, nonunion or amputation. Pin-track infection was defined as any discharge, induration or

pustule formation

VI. OBSERVATIONS AND RESULTS

The following observations were made while treating the 25 cases of tibial pilon fractures in Bones and Joint Hospital Barzulla Srinagar from 2020 - 2022.

TABLE NO 1: Age distribution among study patients

Age in years	Number	Percentage
≥20 -30	7	28
31-40	10	40
41-50	6	24
>50	2	8
Total	25	100
Mean ± SD(RANGE) = 37.9 ± 12.7		

overall mean age in present study was 37.9 years.

TABLE 2: GENDER DISTRIBUTION OF STUDY PATIENTS		
Gender	Number	Percentage
Male	18	72
Female	7	28
Total	25	100

Males dominated the study group as they comprise 72% of the total cases indicating males are more vulnerable to have tibial pilon fracture

TABLE 3: MODE OF TRAUMA AMONG STUDY PATIENTS		
MODE OF TRAUMA	NUMBER	%age
Road traffic accident	7	28
Fall from height	11	44
Fall from standing position	3	12
Fall from stairs	4	16
Total	25	100

FFH was found to be the most common cause

Table 4: Distribution As Per AO Classification		
Type	Number	%age
B3	3	12
C1	2	8
C2	12	48
C3	8	32
Total = 25		

Type C2 fractures comprised of 48% i.e. 12 cases of the total followed by C3 type i.e 8 patients in group which makes 32% in our study group.

TABLE 5 shows associated fibula fracture

Associated Fibula #	Number	%age
Yes	17	68
No	8	32

Total	25	100
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associated fibula fracture incidence in the study patients which was seen in **17(68%)** patients in our study.

TABLE no 6 : OPERATIVE TIME AMONG STUDY PATIENTS		
Operative time(minutes)	No.	%age
<100	7	28
100 -119	14	56
120-139	4	16
Total	25	100
MEAN ± SD = 103 ± 11.74		

In our study the mean time for surgical procedure was 103 minutes which varied from 80 to 120 minutes.

Table no 7 : Removal of 5/8th calcaneal arch among study patients		
Weeks	Number	%age
6	7	28
7	15	60
8	2	8
>8	1	4
Total	25	100
MEAN ± SD= 6.96 ± 0.99		

Table 11 shows that removal of 5/8th calcaneal arch among study patients in most of the cases was **7 weeks** i.e. 15 (60 %) cases

Table 8: Time To Full Weight Bearing Among Study Patients		
Full WEIGHT BEARING (weeks)	NUMBER	%AGE
≤15	11	44
16 – 18	13	52
>19	1	4
TOTAL	25	100
MEAN ± SD=15.62 weeks ± 2.2		

Mean time to full weight bearing in our study was **15.6 weeks**.

TABLE 9: TIME TO UNION AMONG STUDY PATIENTS		
TIME TO UNION(WEEKS)	NUMBER	%AGE
15 TO 20 WEEKS	7	28
21 TO 25 WEEKS	6	24
26 TO 30 WEEKS	12	48
TOTAL	25	100
MEAN ± SD =24.2 ± 4.185		

In our study group of 25 patients took about 15 to 30 weeks for radiological union of fracture with mean duration of **24.2 weeks**.

Table 10: complications among study patients		
Complications	No.	%age
PTI	08	32
Stiff ankle	05	20
Osteoarthritis	02	8
Varus collapse	1	4
Recurvatum	1	4

Neuropraxia	1	4
Hindfoot valgus	1	4
Post op persistent swelling	2	8

PTI was most common complication seen

Table 11: Functional result at final follow up as per ModifiedMAZUR ankle scoring system

Functional result	No.	%age
Excellent (>92)	1	4.2
Good(87 - 92)	8	33.2
Fair (65 - 86)	13	54.2
Poor(<65)	2	8.4
Total	24	100
Mean = 80.6		

VII. DISCUSSION

Tibial pilon fractures account for <10% of lower extremity fractures and occur in adults owing to fall from height or from road traffic accidents. The treatment of distal tibia fractures can be challenging because of its subcutaneous location, poor vascularity and limited soft tissue.

Comparison of age incidence

Study (year)	Range in years	Mean age(years)
S.Vidyadhara et.al 2006 ^[19]	28 to 52	34
S.k Kapoor et.al 2010 ^[21]	26 to 70	42
Jonathan R. Danoff et.al 2014 ^[24]	24 to 82	43
Our study	21 to 75	37.9

Sex incidence

Study(year)	No. of patients	Sex	
		Male	Female
S.k Kapoor et.al 2010 ^[21]	17	16	1
Jonathan R. Danoff et.al ^[24] 2014	28	13	15
H. El-Mowafi et al 2015 ^[25]	23	17	6
Our study	25	18	7

TYPE OF FRACTURE

STUDY(YEAR)	AO CLASSIFICATON			
	Type B3	Type C1	Type C2	Type C3
Bacon et.al 2008 ^[27]	0	1	3	9
S.k Kapoor et.al 2010 ^[21]	1	0	12	4
Jonathan R. Danoff et.al ^[24] 2014	2	0	3	23
Our study	3	2	12	08

ASSOCIATED FIBULA FRACTURE

STUDY (YEAR)	FIBULA FRACTURE	
	YES	NO
S.k Kapoor et.al 2010 ^[21]	16	1
Jonathan R. Danoff et.al 2014 ^[24]	26	2
Our study	17	8

REMOVAL OF 5/8TH CALCANEAL ARCH

STUDY (YEAR)	MEAN REMOVAL OFCALCANEAL FRAME (WEEKS)
Kim et al 1997 [26]	6 TO 10 (8)
Bacon et al 2008 [27]	6 TO 8 (7)
S.k Kapoor et.al 2010[21]	3 TO 6 (3.7)
OUR STUDY	6 TO 8 (6.9)

TIME TO RADIOLOGICAL UNION

Study (year)	Mean fracture union
Mcdonald et al 1996[28]	16 weeks
S.k Kapoor et.al 2010[21]	13 to 23 (15.8) weeks
Our study	15 to 30 (24.2) weeks

Full weight bearing

Study (year)	Mean Full weight bearing
Mcdonald et al 1996[28]	16 weeks
S.k Kapoor et.al 2010[21]	13.1 weeks
Our study	15.6 weeks

Complications

Study(year)	Mitkovic et al 2002 [29]	Elmrini etal 2007 [30]	S.k Kapoor et al 2010[21]	Jonathan R. Danoffet.al 2014[24]	Our study
No. of Cases	26	17	17	10	25
Pin track Infection	3	5	9	2	8
Stiff Ankle	4	3	3	1	5
Malunion	3	3	4	0	3
Post operative persistent swelling	0	1	1	0	2
Osteoarthritis	4	3	1	1	2
Non union	0	0	1	1	0

VIII. CONCLUSION:

Ilizarov Ring fixator being external fixator is non-invasive, stable construct which provides multi planer fixation to the fracture with added advantage of aiding in soft tissue healing and allows early weight bearing and increases the venous and lymphatic return thus preventing disuse osteopenia and swelling of the limb. Moreover the frame can be adjusted during surgery and at different intervals after procedure if needed for correction of any mal-alignment of fracture . So we conclude that Ilizarov Ringfixation a better and effective method in treatment of tibial pilon fractures to promote union with better functional results in patients.

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