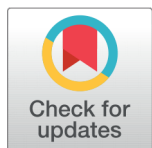


ORIGINAL ARTICLE



To evaluate the outcome of Ilizarov ring fixator using hybrid technique in Tibial trauma

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Rajan Sarad¹, Raj Kumar Aggarwal², Meet Kamal Singh Wadi^{3*}

¹ Associate Professor, Department of Orthopaedics, SGRDIMSAR, Sri Amritsar

² Professor and Head, Department of Orthopaedics, SGRDIMSAR, Sri Amritsar

³ Junior Resident, Department of Orthopaedics, SGRDIMSAR, Sri Amritsar

Abstract

Introduction: The management of infected nonunion of the tibia is challenging, particularly with segmental bone loss, multiple draining sinuses, poor soft tissue cover, osteopenia, adjacent joint stiffness, limb deformity, or multidrug-resistant polymicrobial infection. The Ilizarov method permits early rehabilitation and addresses all the problems such as non-union, infection, shortening, soft tissue loss and deformity simultaneously at single stage. The conventional all wire Ilizarov frame has certain disadvantages when done in diaphysis such as Muscle and tendon transfixation which leads to pain and contracture of adjacent joints, neurovascular injury and patient discomfort. Half pins used in hybrid Ilizarov causes minimal transfixation of the surrounding soft tissues and neurovascular injury thus causing less morbidity and increased range of motion. **Methods:** The present study was a prospective randomized open study in which aim was to evaluate outcome of Ilizarov ring fixator using Hybrid technique in tibial trauma. The study was conducted in 30 skeletally mature patients in Department of Orthopaedics, SGRD University of health sciences, Amritsar from July 2017 to May 2019. The patients were assessed clinically based on history and physical examination. Radiological evaluation using plain antero-posterior and true lateral radiographs of the involved leg was done and evaluated by ASAMI score and complications. **Results:** Mean age was 37.7 years. Out of 30 cases 24(80%) were male and 6(20%) were female. Right tibia was involved in 24 cases out of 30 cases. 29 cases had history of road side accident and 1 had history of fall from height. The bone results were excellent in 21 cases (70%), good in 6 cases (20%), fair in 2 cases (6.67%) and poor in 1 case (3.33%). Functional results were excellent in 17 cases (56.67%), good in 9 cases (30%) and fair in 4 cases (13.33%). No poor functional result was noted. In present study following complications were noted, limp in 12 cases (40%), ankle stiffness in 7 cases (23.33%), pin site infection in 9 cases (30%), limb oedema in 7 cases (23.33%), knee stiffness in 3 cases (10%), loosening of pins in 2 cases (6.67%), deformity in 2 cases (6.67%) and refracture in 1 case

(3.33%). There was no complication of neurovascular injury, malunion, breakage of wires, axial deviation or limb length discrepancy. **Conclusion:** It is thus concluded in present study that with the use of hybrid Ilizarov fixator, bone results are same, functional results are better, post-operative pain is less, less neurovascular injury, decreased joint stiffness, increased range of movements as compared to conventional all wire Ilizarov fixator. Although studies state that pins increase the stiffness of the frame thus decreasing union rate, we found that union rate in hybrid Ilizarov fixator was same as compared to conventional all wire Ilizarov fixator. Thus, we conclude that hybrid Ilizarov fixator is better than conventional Ilizarov fixator in all aspects.

Keywords: Hybrid ilizarov; half pins; ASAMI score

1 Introduction

In the past, patients with open infected and non-union fractures had little treatment available to them and ultimately landed up in amputation. The treatment of such conditions was revolutionised by Dr. Gavril Ilizarov. The ilizarov frame takes its name from Dr. Gavril Abramovich Ilizarov. [1]

Ilizarov has been found to show encouraging results in infected nonunion of tibia as it can not only offer a one-stage solution to infection, shortening and deformity, [2] but also produces regenerate without bone graft. [3]

Conventional ilizarov is all wire fixator. They are stable and elastic type of external fixator and allow axial micromotion allowing “trampoline effect” which are conducive to healing of fractures and regeneration. Conventional Ilizarov fixator with all wires possesses high axial stiffness. [4] The main disadvantage of fine-wires in diaphysis is the relatively narrow anatomic corridors

in which they can be placed to minimize the risk of neurovascular damage. These wires often transfix muscle and irritate tendons, leading to pain, loss of mobility, and potentially increasing the risk of pin site infection and contracture of adjacent joints. Wires are more painful and their removal is difficult. Another disadvantage is increased frame complexity and construction. Reducing the number of wires decreases these problems, reduction in fixation time and lower risk of complications. [5]

Hybrid assembly is an advancement of the original Ilizarov apparatus introduced by the Lecco group in Italy in 1986, where half pins were used in diaphysis in place of wires. [6] Addition of half pins in diaphysis causes minimal transfixation of the surrounding soft tissues and due to its insertion in anatomically safe areas cause less morbidity, increased mobility and improved patient comfort and decreased postoperative pain. [7]

Addition of half pins in metaphysis increases the stability of the construct thereby reduces the incidence of pin site infection, loosening, allows early mobilisation. The Hybrid frame is easy to apply, versatile, and less expensive than other commercially available adaptors and frames. [8, 9]

2 Methods

The present study was a prospective randomized open study in which aim was to evaluate outcome of Ilizarov ring fixator using Hybrid technique in tibial trauma. The study was conducted in 30 skeletally mature patients in Department of Orthopaedics, SGRD University of health sciences, Amritsar from July 2017 to May 2019. Patients with Infected nonunion with or without bone loss, Infected nonunion with or without previous history of internal fixation, Acute open grade III fracture tibia with bone loss >5cms were included in the study. Patients with significant medical comorbidities and uncorrected metabolic disorders, with significant smoking habits and with Irreparable damage to Tibial nerve were excluded from the study. Follow up was done at monthly interval until frame removal. The patients were assessed clinically based on history and physical examination. Radiological evaluation using plain antero-posterior and true lateral radiographs of the involved leg was done and evaluated by ASAMI score (Association for the study and application of the methods of Ilizarov), external fixation time, complications (pin-track infection, axial deviation, loosening of wires, breakage of wires, mal-union, re-fracture, knee stiffness, ankle stiffness, limb edema and neurovascular injury. Results were evaluated in %.

3 Results

The medical records and serial radiographs of all 30 patients were reviewed. In our study mean age was 37.7 years. Out of 30 cases 24(80%) were male and 6(20%) were female. Right tibia was involved in 24 cases out of 30 cases. 29 cases had history of road side accident and 1 had history of

fall from height. Proximal tibial shaft was affected in 4 cases(13.34%), middle and distal tibial shaft was affected in 16(53.33%) and 10 (33.33%) cases respectively. Out of 30 cases, 14 cases(46.66%) were of infected non-union with bone loss and 16 cases (53.34%) were of open fracture IIIB/IIIC with bone loss. The mean consolidation time was 8.2 months and mean bone lengthening achieved was 7.1 cm in present study. According to BONE ASAMI SCORE criteria, in present study union was achieved in all 30 cases(100%) of tibial fracture, pin site infection was present in 9 out of 30 cases(30%), deformity (>7 degree) was present in 2 out of 30 cases (6.67%) and limb length discrepancy (>2.5cm) was absent in all 30 cases(0%). The bone results were excellent in 21 cases (70%), good in 6 cases(20%), fair in 2 cases(6.67%) and poor in 1 case(3.33%). In our study, according to FUNCTIONAL ASAMI, pain was present in 5 cases (16.67%), limp in 12 cases (40%), knee stiffness in 3 cases (10%), ankle stiffness in 7 cases (23.33%), activity in all 30 cases (100%) and reflex sympathetic dystrophy was absent in all cases. Functional results were excellent in 17 cases (56.67%), good in 9 cases (30%) and fair in 4 cases (13.33%). No poor functional result was noted. In present study following complications were noted, limp in 12 cases(40%), ankle stiffness in 7 cases(23.33%), pin site infection in 9 cases(30%), limboedema in 7 cases (23.33%), knee stiffness in 3 cases (10%), loosening of pins in 2 cases (6.67%), deformity in 2 cases (6.67%) and refracture in 1 case (3.33%). There was no complication of neurovascular injury, malunion, breakage of wires, axial deviation or limb length discrepancy.

Table 1. Association for the Study and Application of the Methods of Ilizarov scoring system

ASAMI system	scoring	Description
Bone result		
Excellent		Union, no infection, deformity $<7^\circ$, Limb-length discrepancy <2.5 cm
Good		Union + any two of the following: Absence of infection, $<7^\circ$ deformity, and limb-length inequality of <2.5 cm
Fair		Union + any one of the following: Absence of infection, deformity $<7^\circ$, and limb-length inequality of <2.5 cm
Poor		Non union/re-fracture/union + infection + deformity $>7^\circ$ + limb-length inequality > 2.5 cm
Functional results		
Excellent		Active, no limp, minimum stiffness (loss of $<15^\circ$ knee extension/ $<15^\circ$ dorsiflexion of ankle), no RSD, insignificant pain
Good		Active, with one or two of the following: limp, stiffness, RSD, significant pain
Fair		Active, with three or all of the four figures show wing: limp, stiffness, RSD, significant pain
Poor		Inactive (unemployment or inability to return to daily activities because of injury)
Failures		Amputation

ASAMI – Association for the Study and Application of Methods of Ilizarov; RSD – Reflex Sympathetic Dystrophy

THE ASAMI SCORING we are using is a modification of paley et al. [10]

Table 2. Bone results (According to Asmi Criteria)

Bone Results	Number of Cases	(%)
Excellent	21	70
Good	6	20
Fair	2	6.67
Poor	1	3.33
Total	30	100

Table 3. Functional Results (According To Asami Criteria)

Functional Results	Number of Cases	(%)
Excellent	17	56.67
Good	9	30
Fair	4	13.33
Poor	0	0

Table 4. Complications

Complications	Number of Cases	(%)
Knee Stiffness	3	10
Ankle Stiffness	7	23.3
Limp	12	40
Axial Deviation	0	0
N/V Injury	0	0
Pin Site Infection	9	30
Refracture	1	3.3
Malunion	0	0
Loosening Of Pin	2	6.6
Breakage Of Wires	0	0
Limb Oedema	7	23.3
Deformity	2	6.6
Limb Length Discrepancy	0	0

4 Discussion

The management of infected non-union of the tibia is challenging, particularly with segmental bone loss, multiple draining sinuses, poor soft tissue coverage, osteopenia, adjacent joint stiffness, limb deformity, or

multidrug-resistant polymicrobial infection. Permanent functional deficits, prolonged recovery times, and even amputation can result. [8, 11]

Several methods have been applied successfully in the treatment of infected non-union of tibia including bone grafts, extensive debridement and local soft tissue rotational flaps, packing of the defects with Papineau-type open cancellous bone grafting, tibiofibular synostosis, free microvascular soft tissue and bone transplants and masquet

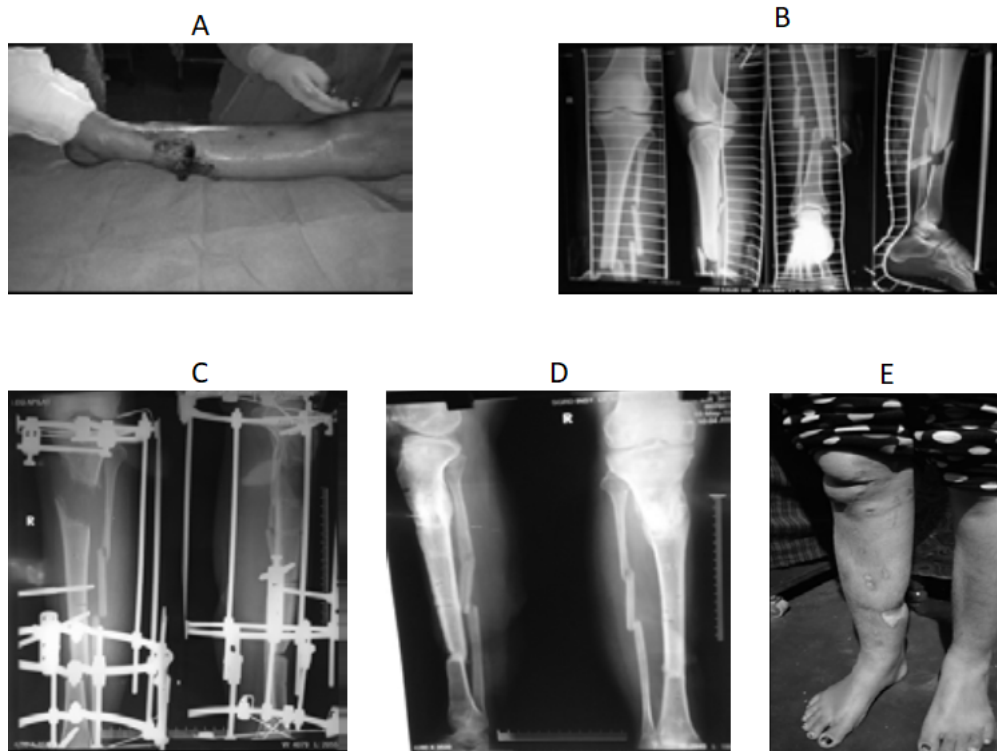


Fig 1. A-Preoperative clinical picture. B-Preoperative X-Ray. C-X-Ray at 6 months. D- X-Ray after removal of fixator at 1 year. E- Clinical picture after removal of fixator.

technique. [12–17] However these treatments have obvious limitations such as donor site morbidity, stress fracture, restriction of the size of bone defects, failure of flaps and skin grafts and multiple surgeries.

Ilizarov pioneered the theory of “tension stress” allowing bone and soft tissue generation to restore defects after excision of associated osteomyelitis, [18, 19] and in non-union treatment. [20, 21]

The Ilizarov method permits early rehabilitation and addresses all the problems such as non-union, infection, shortening, soft tissue loss and deformity simultaneously at single stage. [22]

Conventional Ilizarov is all wire fixator. The conventional all wire Ilizarov frame has certain disadvantages when done in diaphysis² such as Muscle and tendon transfixation which leads to pain and contracture of adjacent joints. Chances of neurovascular impalement are higher. Olive wires are more painful and their removal is difficult and 90-

90 placement of wires is not always possible according to anatomical safe corridors compromising the stability of assembly.

Hybrid assembly is an advancement of the original Ilizarov apparatus introduced by the Lecco group in Italy in 1986, where half pins were used in diaphysis in place of wires.⁶ Addition of half pins in diaphysis cause minimal transfixation of the surrounding soft tissues and due to its insertion in anatomically safe areas cause less morbidity, increased mobility and improved patient comfort and decreased postoperative pain.⁷ Addition of half pins in metaphysis increases the stability of the construct thereby reduces the incidence of pin site infection, loosening, allows early mobilisation. The Hybrid frame is easy to apply, versatile, and less expensive than other commercially available adaptors and frames.^{8,9}

The present study was a prospective randomized open study in which aim was to evaluate

the outcome of Ilizarov ring fixator using Hybrid technique (Combination of wires and half pins). The study was conducted in 30 skeletally mature patients in Department of Orthopaedics, SGRD University of health sciences, Amritsar from July 2017 to May 2019. Follow up was done at monthly interval until frame removal. The patients were assessed clinically based on history and physical examination. Radiological evaluation using plain antero-posterior and true lateral radiographs of the involved leg was done and evaluated by ASAMI score (Association for the study and application of the methods of Ilizarov), complications (pin site infection, axial deviation, loosening of wires, breakage of wires, mal-union, re-fracture, knee stiffness, ankle stiffness, amputation, limb edema and neurovascular injury). Results were evaluated in percentage.

In present study excellent and good bone results were found in 90 percent of cases, fair and poor bone results in 10 percent of cases. In study conducted on conventional all wire ilizarov fixator by Yin P et al (2014) the bone results were excellent and good in 90%, fair and poor bone results in 10%. In study conducted on conventional all wire ilizarov fixator by Rohilla R et al in 2016 the bone results were excellent and good in 91.5%, fair and poor bone results in 8.5% of cases. These studies are comparable to our study.

In present study functional results were excellent and good in 86.67% cases and fair and poor in 13.33% cases. In a study conducted on conventional all wire ilizarov fixator by Yin P et al. in 2014 functional results were excellent and good in 80% cases and 20 % cases had fair and poor functional results. In a study conducted on conventional all wire ilizarov fixator by Chattopadhyay P et al in 2017 excellent and good functional results were present in 67% cases. 33% cases had fair and poor functional results. The study conducted on conventional all wire ilizarov fixator by Shahid et al. in 2013 excellent and good functional results were present in 83.33% cases and fair and poor functional results were seen in 16.67% cases. The func-

tional results of our study on hybrid ilizarov fixator are better than the above studies on conventional all wire ilizarov fixator.

In present study union rate was 100%. This is comparable to studies conducted on conventional all wire ilizarov fixator by Menakaya CU et al. (2014), Yin P et al. (2014), Ferreira N et al. (2015) and Rohilla R et al. (2016). Pin site infection is one of the most common complications of ilizarov. In present study infection at pin site was present in 30% of cases. In studies conducted on conventional all wire ilizarov fixator by Elgazzar AS et al. (2012), Yin P et al. (2014), Rohilla R et al. 2016 and Ali SK et al. (2017) infection at pin site was present in 36%, 60.6%, 68.5% and 45% of cases respectively.

In present study deformity (>7 degree) was present in 6.67% of cases. In studies conducted on conventional all wire ilizarov fixator by Rohilla R et al. (2016) deformity >7 degree was present in 22.8% of cases. In present study limb length discrepancy was absent in all cases. In studies conducted on conventional all wire ilizarov fixator by Farmanullah et al. (2007), Rohilla R et al (2016) and Barawi OA et al. (2018) limb length discrepancy was present in 3.44%, 11.4% and 5% of cases. Our results are better than the above studies.

Post operative pain is a major complication of ilizarov fixator. Pain is due to muscle and tendon transfixation by the wires. In our study postoperative pain was present in 16.67% of cases and reflex sympathetic dystrophy was absent in all cases. In study conducted on conventional all wire ilizarov fixator by Wani N et al in 2011 and Elgazzar AS et al in 2012 postoperative pain was present in 25% and 20% of cases respectively. According to studies conducted on conventional all wire fixator by Farmanullah et al (2007) and Barawi OA et al (2018) reflex sympathetic dystrophy was present in 6.89% and 10% of cases respectively. Post operative pain and reflex sympathetic dystrophy was less in our study done on hybrid ilizarov fixator as compared to the above studies done on conventional all wire ilizarov fixator.

Joint stiffness is a major drawback of ilizarov fixator. In our study done on hybrid ilizarov fixator ankle stiffness as a complication was present in 23.3% and knee stiffness was present in 10% of cases. In studies conducted on conventional all wire ilizarov fixator by Megas P et al in 2010, Gupta SK et al in 2014 and Rohilla R et al in 2016 ankle stiffness was present in 55%, 25% and 51% of cases respectively. In studies conducted on conventional all wire ilizarov fixator by Elgazzar AS et al in 2012, Rohilla R et al in 2016 and Barawi OA et al 2018 knee stiffness was present in 8%, 20% and 10% of cases respectively. Our studies show that hybrid ilizarov fixator decrease the incidence of knee stiffness and ankle stiffness as compared to conventional all wire ilizarov fixator.

We have demonstrated that as compared to all wire ilizarov fixator, hybrid ilizarov fixation is an effective technique. In our study hybrid ilizarov has provided better ASAMI bone and functional results. It is seen in our studies that there were lower rate of ankle and knee stiffness, lower rate of pin site infections, less pain and less chances of neurovascular injury. The hybrid ilizarov construct is biomechanically not inferior to the conventional all wire ilizarov fixator.

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