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Original Research Paper

Orthopaedics

COMPARATIVE EFFICACY OF ILIZAROV VS. RAIL FIXATOR IN LONG BONE [TIBIA] NON-UNION

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ABSTRACT

Introduction: Management of long bone non-union, particularly in the tibia, presents a significant orthopedic challenge. Current treatment modalities range from non-invasive techniques (e.g., ultrasound, electrical stimulation) to surgical interventions such as autologous bone grafting and bone transport using external fixators. This study retrospectively compared the outcomes of the Ilizarov circular external fixator (Group A) and the Rail unilateral external fixator (Group B) for the definitive management of long bone non-union, specifically assessing efficacy and patient tolerance. **Materials And Methods:** A total of 30 patients with non-union of long bones were allocated into two groups of 15 each. Patient ages ranged from 21 to 60 years, with mean ages of 37.6 years (Group A) and 40.5 years (Group B). The cohort was predominantly male (90%). The tibia was the most common site, with the middle one-third diaphyseal segment most frequently involved. A high proportion of patients in both groups (nine out of 15) presented with an infected non-union. Pre-operative assessment revealed an average limb shortening of 2.9 cm in Group A and 2.86 cm in Group B, with most patients having undergone a mean of two previous operative procedures. The primary surgical intervention involved acute docking and compression in 12 patients (Group A) and 13 patients (Group B). Compression-distraction osteogenesis was performed in three and two patients in Group A and Group B, respectively. Patients were clinically and radiographically followed up at six, twelve, and twenty-four weeks post-procedure. **Results:** The overall radiological union rate was high, achieved in 13 cases (87%) in Group A and 14 cases (93%) in Group B. The average duration to union was 8.8 months for the Ilizarov group and slightly shorter at 8.1 months for the Rail fixator group. Functional outcome was assessed using the ASAMI scoring system, demonstrating excellent-to-good limb function in 80% of Group A and 86% of Group B. Normal range of motion (ROM) in adjacent joints was preserved in 80% of the total cohort. Complication rates were comparable between the two groups. Critically, the Rail fixator was associated with superior patient tolerance and ease of apparatus management compared to the bulkier Ilizarov device. **Conclusion:** Both the Ilizarov and Rail fixator techniques demonstrated comparable and successful bone union results in the treatment of long bone non-union. The Rail fixator group showed a marginal advantage in both functional outcomes and time to union. However, the decisive advantage of the Rail fixator lies in its enhanced patient comfort, ease of application, and greater tolerability of the distraction phase, suggesting a beneficial marginal role over the traditional Ilizarov apparatus.

KEYWORDS : Ilizarov, Rail fixator, Non union , Long bones, Infection, Tibia.

INTRODUCTION

Fractures of long bones are on the increase in incidence from the last few decades due to increased road traffic accidents and other domestic accidents leading to increased incidence of severe open fractures of limbs. Complications also increase in open fractures which may lead to non union of these bones. Fracture of the shaft of long bone should not be considered a non union until at least 6 months after the injury.[1] Non union were more common when the fractures were -open, infected, segmental, comminuted, insecurely fixed, immobilized for an insufficient time, treated by ill advised open reduction, distracted either by traction or by plate and screws, irradiated bones. Two types of non union have been described in literature.[4] Hypervascular non union in which ends of the fragments are capable of biological reaction and avascular or atrophic non union in which ends are inert and incapable of biological reaction.

Treatment of long bone non union is a very controversial subject to debate as various modes of treatments are available with varying results. Various devices used in treatment of non union are Iliarov fixator, intramedullary nail, dynamic compression plate, locking plate, limb reconstruction system / rail fixator etc.

Internal fixation with plates and intramedullary nails is not without the risk of infection. In case of established infection, bone loss these modalities do not serve the purpose. In these cases a treatment is required which will reconstruct as well as restore the full functional limb. Ilizarov ring fixator[3] has achieved the purpose but its complications like persistent pain in joints and discomfort inspired the discovery of unilateral fixators. A rail road fixator is a type of unilateral fixator.

Due to its simple application and comfort to the patient is more easily tolerated by the patients. Most modern unilateral fixators (rail road fixators/lrs) also have facility to distract or compress fractures and allow the dynamisation of the fractures which is a crucial need in such cases.[4]

Confusion still exists for exact union rates and complications related to Ilizarov & rail road fixator/ LRS in treating non union. So this study was conducted to assess and compare the union rates in fracture non union of long bones and to assess complications associated with the Ilizarov and rail road fixator.

MATERIALS AND METHODS

This study consisted of 30 patients from the age group 21-60 years under two groups (15 cases each), conducted in the orthopaedics department at Trauma centre , Sardar Patel Medical College , Bikaner. Group A consisted of patients treated with Ilizarov fixator and group B of those treated with Rail road fixator. Informed consent of all the patients were taken. Mean age under group A was 37.6 years and that in group B was 40.5 years. 90% of the patients were males. All of our application of Ilizarov and Rail fixator were on tibia. The middle one third was the most commonly involved area in all the bones. 9 out of 15 patients in both groups had infected non union. On an average patient had 1.8 number of previous procedures on group A compared to 1.7 in group B. Average shortening present in group A was 2.9 cm with marginal

difference in group B having 2.86 cm (Range 1-6 cm). 12 patients in group A went through compression mode of treatment in group A and 13 in group B.

The technique for Ilizarov wire insertion includes passing the wire through skin and soft tissue, drilling it through near and far cortices of the bone. Use of lower drill speeds is recommended by some surgeons. The wires are attached to a series of half or full metal rings, which encircle the affected limb, and tensioned to enhance stability. The fixator is completed by connecting the rings with threaded rods aligned.

The rail road fixator was normally mounted laterally on femur and humerus, but in tibia it was mounted medially taking into consideration the safety of soft tissues and neurovascular structures. Careful stab skin incision and deep dissection was required in order to avoid damage to the saphenous vein and nerve. The image intensifier was used to identify important bony landmarks and to define the axis of bone. This axis was parallel to the final position of the fixator.

We did an adequate debridement and resection of nonviable bone. Bone transport using above techniques in non-union of the fracture with bone gap of greater than 5 cm was done. In case of bone defects smaller than 5 centimeters, acute docking was done followed by distraction histiogenesis at the corticotomy site over an fixator. We did corticotomy at a single site. Movements of Joint were started as early as possible after the operation. Transport was initiated after 5-7 days of the corticotomy. The rate of transport in our study was 1.00 mm/day in 4 divided parts. At the conclusion of transport, partial weight bearing was started. The patient was discharged on the 2nd / 3rd postoperative day. We confirmed union on observing bridging callus on AP, lateral and oblique views; this was further confirmed clinically by dynamisation of the fixator and observing the ability of the patient to walk and perform a single-leg stance on the affected limb without apprehension or deformity at site. The fixator was removed when evident signs of union were present on X-ray. The limb was protected with POP cast for 4 weeks in most of the cases after the removal of the rail fixator/ Ilizarov.

RESULTS

Infection was eradicated in 89% cases in either group. Shukla et al in 2013 had also shown eradication of infection in 91.6 % of cases in their study. Average duration of Ilizarov application was 8.8 months and rail fixator duration was 8.3 months (range 6-15 months). Partial weight bearing was started at completion of distraction and full weight bearing started only after complete union. Skin grafting was done in 2 patients in group A and bone grafting was done in 1 case. In group b one patient had skin grafting. Four and six patients in respective group had pin tract infection and loosening in 1 and 2 patients in similar manner. We reinserted the loosened pins. In one case the rail fixator was removed due to failure of treatment. We found range of motion was decreased where pins were close to the joint surface but revived in most cases. Union was achieved in 86.7% in group A and 93.3% in group B. The result was excellent to good in 86.6% cases in both the groups. In Rail fixator group results were Fair in 1(6.66%) and poor in 1(6.66%) patient compared to 2 poor (13.3%) in Ilizarov group as per ASAMI score [Table].

Table 1: Results According To ASAMI Score

	Ilizarov		Rail fixator	
Results (Bone results)	**No. of cases**	**Percentage**	**No. of cases**	**Percentage**
Excellent	8	53.3%	9	60%
Good	5	33.3%	4	26.6%
Fair	0	0%	1	6.6%
Poor	2	13.3%	1	6.6%

$\chi 2$	Df	p-value	Significance
1.50	3	0.682	NS

The Results As Per ASAMI Classification (1995)

Results	Bone results	Functional results
Excellent	Bone union No infection Deformity <7 degree Limb length discrepancy<2.5cm	Ability to perform previous activities of daily living (ADL). No pain or mild pain, no limp, no soft tissue sympathetic dystrophy, knee or ankle joint contracture <5degree loss of ankle & knee motion <15degree
Good	Bone union Failure to achieve one of the above criteria	Almost all ADL with minimal difficulty. Pain absent or mild pain. Failure to meet one of the other criteria
Fair	Bone union Failure to achieve two of the other criteria	Most ADL but with minimal difficulty, no pain or mild pain. Failure to meet two of the other criteria
Poor	Non union or re-fracture Failure to meet three of the other criteria	Significantly limited ADL. Significant pain requiring narcotics Failure to meet three of the other criteria

ADL=Activities of daily living, ASAMI=Association for the study and application of the method of Ilizarov

Case No 1 (Ilizarov)

Fig. 1a: Pre-operative

Fig. 1b: Showing union

Fig. 2: Sitting With Knee Flexed

Case No 2 (Rail Road)

Fig. 3a: Pre- Operative **Fig. 3b:** Showing Union

Fig. 4: Sitting With Knees Flexed

Table 3: Limb Length Discrepancy

Limb length discrepancy	Rail Fixator		Ilizarov	
	No. of patients	Percentage	No. of patients	Percentage
Same as before	11	73.3%	10	46.7%
0-1 cm	2	13.3%	2	6.7%
1-3 cms	2	13.3%	3	6.7%

χ2	Df	p-value	Significance
0.248	2	0.884	NS

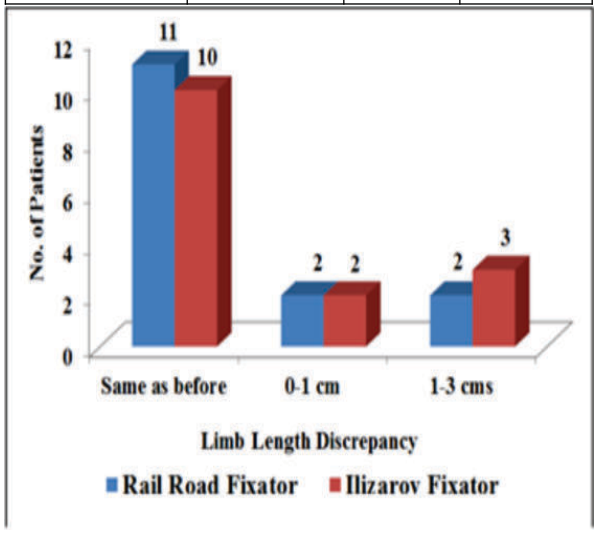

Chart 1:

Table 4: Duration Of Treatment

Duration (months)	Rail Fixator		Ilizarov	
	No. of cases	Percentage	No. of cases	Percentage
< 4 months	1	6.6%	0	0%
4- 6months	-	0%	1	6.6%
6-8 months	9	60%	6	40%
8-10 months	3	20%	5	33.3%
>10 months	2	13.33%	3	20%

χ2	Df	p-value	Significance
3.30	4	0.509	NS

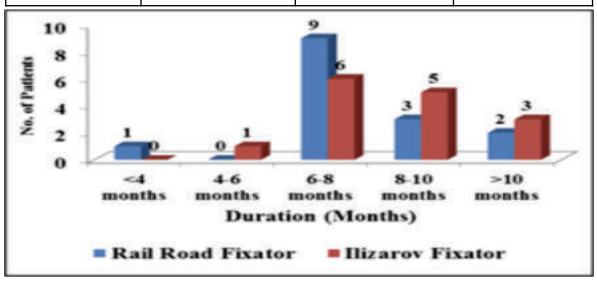

Chart 2

DISCUSSION

Reconstruction for infected non-union is difficult; the associated bone defect, shortening, and deformity may further complicate matters. Ilizarov[5] from more than 60 years back had studied the effect of stabilization in fracture and followed reconstruction of injured limb. Most of the studies were based on the principle of gradual stretching of a biological tissue by distraction and its effects on triggering of tissue growth and regeneration. Based on his studies the basic technique developed by Ilizarov was distraction histiogenesis.[6,7] It is mechanical induction of new bone formation bony surfaces that are gradually pulled apart.

The success of results gained by Ilizarov fixator[8] bear an evidence to the success of this system. However, due to certain complications [9] such as heavy apparatus, persistent pain, deformity of joints and discomfort caused by Ilizarov ring fixator inspired the development of monolateral frame devices. Rail Fixator[10,11] is one such device. Our main objective was to study and compare the union rates and rate of complication in non union cases by use of these devices.

In our study 18 out of 30 patients were in age group of 21 to 40 years whereas 12 patients belonged to the age group of 41 to 60 years. Mean age under group A was 37.6 years and that in group B was 40.5 years .[12] 27 patients were male out of 30 patients, while female were 3 in number. Near similar observations regarding age and sex, nature of trauma have been reported in study by shukla et al[13] Jain et al[14] & wang et al.[15] All of our applications were on tibia[15] in either group. In literature also most studies [13,16-19] are on tibia. Middle one third was most commonly involved in all the bones. 9 patients out of 15 patients had infected nonunion whereas 6 patients had non infected type of non union in both groups. Infection was eradicated in 8 (89%) cases in either group.[13,20]

Average number of previous surgeries was 1.8 (0- 4) in Ilizarov group compared to 1.7 (0-4) in Rail fixator group.[20,21] Average shortening present in the limb was 2.9cm in Ilizarov group[14] compared to 2.86 cm in Rail fixator group.[22] 12 patients underwent acute docking or compression in ilizarov group compared to 13 in the rail fixator group. 2 patients underwent compression – distraction for treatment of non union in the Rail fixator group compared to 3 patients in the Ilizarov group. Distraction was done at the rate of 1.00mm per day in 4 equal installments of 0.25 mm each, every 6 hours after the 14th day of corticotomy. Patients were followed up every 6 weeks, 12 weeks and 24 weeks to look for regenerate radiographically

for the assessment of union. Joint movements were started as soon as possible after the operation. Partial weight bearing was started on completion of distraction and full weight bearing started after complete union in both groups.

Average duration of application was 8.8 months [14] in patients of Ilizarov compared to 8.3 months in rail fixator[18,23] group. Lengthening achieved in 2 patients of compression distraction was of the average 2.33 cm average gain in 3 patients in Ilizarov group compared to 2.5 cm in Rail fixator group. Only 1 patient required split skin grafting as a secondary procedure in the Rail fixator group compared to 2 patients in the Ilizarov group. Further 1 patient in the later group required bone grafting. The most common problem was pin tract infection[24] (6 & 4 patients), followed by loosening of pins (1 & 2cases) in respective groups and decreased range of motion of adjacent joints. In our study union[13] was achieved in 14 patients out of 15 patients (93.3%) in patients of non union of long bones by application of rail road fixator. In the Ilizarov group union was achieved in 13 out of 15 (86.7%)[20] patients.

According to ASAMI criteria for bone results we had 8 excellent, 5 good, 0 fair and 2 poor results in Ilizarov group[20,26,27] and 9 excellent, 4 good, 1 fair and 1 poor results in Rail fixator[14,25] group. Functional results as per ASAMI criteria were 5 good, 1 fair and 2 poor in Ilizarov group compared to 6 good, 1 fair and 1 poor in rail fixator group including 7 excellent in both the groups. Our results compare well with the studies in the literature .14,17,18,20,25

CONCLUSION

ASAMI score comparison tells that bone results and functional results are similar in both the treatment groups. It was observed that rail road fixator and Ilizarov are excellent tools to treat non union of long bones due to any cause (excluding congenital and pathological causes of non union as per exclusion criteria) accompanied with extensive soft tissue damage, shortening, and deformity. Also the complications arising in two modalities are also not much different from each other. Duration of treatment is slightly lesser with rail fixator in our study. Rail fixator had more patient compliance and ease of application. This apparatus is easy to apply with a shorter learning curve and less cumbersome to the patient as compared to ilizarov.

Conflict Of Interest: Nil

Source Of Funding: Nil

Consent: Consent taken from all the patients as per consent form in written.

Ethical Study: Study is done as per ethics committee of the institute.

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