

# Randomized, Comparative Assessment of the Functional and Radiological Outcome in Management of Type IIIB Tibial Fractures Using Two Different Methods

**Dr. Pankaj Kumar<sup>1</sup>**

<sup>1</sup>Assistant Professor, Department of Orthopedics, Vardhman Institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India.

Corresponding Author: Dr. Pankaj Kumar

---

## Abstract

**Aim:** to determine the comparison of Radiological & Functional outcome & complications of the open tibial type IIIB fractures treated with primary Ilizarov external fixator and AO external fixators

**Methodology:** This is a Randomized, comparative study conducted on Patients with open tibial class IIIB fractures admitted in Vardhman Institute of Medical Science, Pawapuri, Nalanda, Bihar, India. A number of 40 patients satisfying the inclusion criteria have been treated by Ilizarov technique and 40 patients treated by AO external fixator in the previous 2 years. The follow up would be for one year. Initially for every 3 weeks in first 6 weeks for wound care, every 6 weeks for one year and assessed by Radiological evidence of union of fracture and Functional assessment by Patient's Functional and Bone results are assessed based on ASAMI (Association for the study and application of the methods of Ilizarov) criterion and complications. The data was recorded and analyzed.

**Results:** Most of the fractures were observed in 31-40 age groups. Mean Age in AO group is 47.4 + 12.5 years and Ilizarov group is 41.6 + 14.7 years with male preponderance in the Gender Distribution of both Groups, being 87.5 % and 85 % in Group A and B, respectively.

ASAMI bone results & functional results were Excellent (25%), Good (67.5%) & Poor (7.5%) in AO group, whereas in Ilizarov group Excellent (62.5%), Good (32.5%) & Poor (5%). Ilizarov has good Functional scoring when compare to AO group most common complications encountered were Pin Tract Infections, pain, stiffness, limp. In AO group pin tract infections were seen in 21, pain in 13, stiffness 10, limb length discrepancy in 4, Non-union in 3 and malunion in 1 patient. In Ilizarov group pin tract infections were seen in 15, pain in 9, stiffness in 7, limb length discrepancy in 3, Non-union in 2 & malunion in 2 cases.

**Conclusion:** It can be concluded that the efficacies of treatment with Ilizarov was higher than AO external fixator in treatment of tibia open type IIIB fractures.

**Keywords:** Tibial fractures, Ilizarov external fixator, Pin tract infections.

---

## Introduction

If a bone breaks in such a way that bone fragments stick out through the skin or a wound penetrates down to the broken bone, the fracture is called an open fracture. Open fractures, sometimes called compound fractures, can occur when there is a small cut to the skin that communicates to a fracture, or they can occur with severe soft-tissue injuries that threaten the survival of the limb. Gustilo-Anderson system of classification is the most common

---

classification system to classify open fractures. Grade III open fractures represent the most severe injuries and include three specific subtypes of injuries: IIIA, IIIB and IIIC. Grade IIIA fractures include high-energy fractures, as evidenced by severe bone injury (segmental or highly comminuted fractures) and/or large, often contaminated soft-tissue wounds. Grade IIIB fractures have significant soft-tissue damage or loss, such that bone is exposed, and reconstruction may require a soft-tissue transfer (flap) to be performed in order to cover the wound. Grade IIIC fractures specifically require vascular intervention, since the fracture is associated with vascular injury to the extremity.

The tibia, or shinbone, is the most commonly fractured long bone in the body. A tibial shaft fracture occurs along the length of the bone, below the knee and above the ankle. It typically takes a major force to cause this type of broken leg. Insufficient blood flow and lack of soft tissues in antero-medial aspect of tibia length predisposes tibia open fracture to non-union and development of infection.[1] Currently, non-surgical procedures like using casts, brace or interventional attempts like inserting of plate, intramedullary nailing and external fixators are used for treatment of open tibial fractures.[2] Reamed intramedullary are not frequently advised in open fractures, especially in Gustilo type III fractures due to damage to endosteal blood supply during the reaming process [3, 4]. The use of plates and screws has been discouraged by many authors due to potential damage to the periosteal blood supply during soft tissue stripping and increased risk of septic complications [5]. The use of secondary intramedullary nailing after initial temporary external fixation have been advocated. Secondary intramedullary nailing provides advantage of early weight bearing and enhances union as well as functional rehabilitation.

External fixation has gained more popularity as primary and definitive management of compound tibia fracture. Recently, external fixators like Ilizarov or AO external fixator are used extensively in developing countries. So in this study, we compare conventional AO unilateral external fixator and Ilizarov external fixator to evaluate functional and radiological outcome in patients with compound tibia type IIIB fractures.

## Materials and Methods

This is a Randomized, comparative study conducted on Patients with open tibial class IIIB fractures admitted in Vardhman Institute of Medical Science, Pawapuri, Nalanda, Bihar, India during for two years. A number of 40 patients satisfying the inclusion criteria have been treated by Ilizarov technique and 40 patients treated by AO external fixator in the previous 2 years. Cases will be randomized by simple random sampling.

### Inclusion criteria

Patients between 18-60 years of age Fresh, Open Tibia fractures (type IIIB) were included in this study.

### Exclusion criteria

We excluded Patients who are not willing to provide informed consent, Closed Tibia fractures, Pathological fractures, Type I, IIIA & IIIC fractures, Intra Articular Fractures, Floating knee and Polytrauma patient.

**Methodology**

Patients were divided into two groups based on method of treatment they will get. These patients will be randomized by simple random sampling and treated with Ilizarov and AO Biplanar external fixator. Early wound swab taken. All patients were started on triple antibiotics which includes 3<sup>rd</sup> generation Cephalosporins, Metranidazole for Anaerobic bacterial coverage and Aminoglycoside for gram negative bacterial coverage. All wounds were given thorough wound wash with normal saline in the emergency room as soon as the patient is received. Patients who required plastic surgery interventions were operated in the same sitting with plastic surgery procedures like flap coverage, if the wound was less contaminated. Frames will be removed after clinico-radiological union. The follow up would be for one year. Initially for every 3 weeks in first 6 weeks for wound care, every 6 weeks for one year and assessed by Radiological evidence of union of fracture and Functional assessment by Patient’s Functional and Bone results are assessed based on ASAMI (Association for the study and application of the methods of Ilizarov) criterion and complications. The data was recorded and analyzed.

**Results:**

In our study, most of the fractures were observed in 31-40 age groups. Mean Age in AO group is 47.4 + 12.5years and Ilizarov group is 41.6 + 14.7 years with male preponderance in the Gender Distribution of both Groups, being 87.5 % and 85 % in Group A and B, respectively.

**Table 1: demographic details of patients and complications after procedure**

Variable		AO group	Ilizarov group
Sex	Male	35	34
	Female	5	6
Age (in years)		47.4 + 12.5	41.6 + 14.7
Duration of fixators (weeks)		20.5 + 3.8	25.6 + 3.4
Radiological union time		24.65 + 3.1	26.5 + 4.6
Complications	Pain	13	15
	Pin tract infection	21	9
	Stiffness	10	7
	Non union	3	2
	Limb length discrepancy	4	3
	Malunion	1	2

**Table 2: ASAMI score – BR (Bone results and functional results)**

ASAMI score	AO external fixator	Ilizarov external fixator	Total
Excellent	10 (25%)	25 (62.5%)	35 (42.5%)
Good	27 (67.5%)	13 (32.5%)	40 (50%)
Poor	3 (7.5%)	2 (5%)	5 (7.5%)
Total	40(100%)	40 (100%)	80 (100%)

Ilizarov external fixator is a Ring fixator, we used 4 Rings construct in 70% of cases and 3 Rings in 30% of cases. In AO external fixator we used BIPLANAR external fixator in all cases. In AO group 6 pins construct were 24 (60%), 5 pins -14 (35%) & 7 pins - 2 (5%). In Ilizarov group majority were 8 pins construct - 32 (80%), 9 pins - 6 (15%), 6 pins -2 (5%). Mean duration on Fixator was 20.5 + 3.8 weeks in AO group, and 25.6 + 3.4 weeks in Ilizarov group. Mean Radiological Union Time was 24.65 + 3.1 weeks in AO group, 26.5 + 4.6 weeks in Ilizarov group.

In our study ASAMI bone results & functional results was Excellent (25%), Good (67.5%) & Poor (7.5%) in AO group, whereas in Ilizarov group Excellent (62.5%), Good (32.5%) & Poor (5%). Ilizarov has good Functional scoring when compare to AO group most common complications encountered were Pin Tract Infections, pain, stiffness, limp. In AO group pin tract infections were seen in 21, pain in 13, stiffness 10, limb length discrepancy in 4, Non-union in 3 and malunion in 1 patient. In Ilizarov group pin tract infections were seen in 15, pain in 9, stiffness in 7, limb length discrepancy in 3, Non-union in 2 & malunion in 2 cases.

Pin tract infections were easily managed by oral antibiotics and local Neomycin skin ointment, stiffness was improved by extensive physiotherapy, pain was managed with analgesics and reassurance. Limb Length Discrepancy (shortening) was less than 2cm, which was corrected by shoe rise. No case developed deep Infection.

## Discussion

Fractures of the tibia more commonly result in open fracture than any other long bone due to subcutaneous position of tibia. External fixators offer several advantages in management of open tibial fractures. AO and Ilizarov are types of external fixators. Ilizarov technique is cost effective, primary and definitive treatment and offer acceptable stability for the fracture, minimal operative trauma and good access to soft tissues and offers high union rates [6, 7]. AO is simple and safe to apply can be used in management of open tibia fractures [8, 9].

In this study, no differences were found regarding the mean time for union, malunion and refractures when we used Ilizarove or AO external fixator for the treatment of open tibia fractures. Wani et al. and Hosney et al. found similar mean time for union of fractures that were 6 and 5.6 months respectively when they used Ilizarov for treatment of tibial open fractures and were similar to that found in our study.[10, 11] Sen et al. found longer duration of time for union of fractures (7.5 months) with Ilizarov and was higher than that we found in this study. In their study, all patients had Gustillo III fractures with mean bone loss of 5 centimeters and 2.5×3.5 centimeters soft tissue loss with extension of fractures to adjacent articular space.[12] Qureshi et al. reported that 3.3% of their patients who were treated with Ilizarov had nonunion which was lower than the results of our study. In their study, both open and closed tibial fractures were included in the study and those who needed flap were excluded [13]. Ocguder et al. reported the rate of delayed union to 15.5% when they used Ilizarov and was longer than our findings. The reason for delayed union in their study was insufficient fixation of the fractures [14]. Wani et al. reported the rate of malunion to 10% when they treated open tibial fractures with Ilizarov and was similar to our findings.[10]

Another study performed in Gustillo fracture III with AO external fixator, delayed union was noticed to be 40% and was more than the results obtained by our study [18]. With AO external

fixator, another study showed malunion to be 31% [15]. Henly et al. reported that delayed union or nonunion were related with extensive soft tissues damages.[16] Papaioannov showed nonunion in 20% of their patients when treated with AO external fixator. They also showed that the rates of nonunion with Gustillo II and III when compared with Gustillo I and lost fractures were higher [17].

Results of ASAMI score of ilizarov external fixators was comparable to study by Ajmera et al [19], Patil et al [20] and Pal et al [21] where they found excellent results in 76%, 67% and 68.75% respectively; good results in 12%, 25% and 18.75% respectively; fair result in 4%, 4% and 10% respectively; poor results in 8%, 4% and 2.5% respectively.

In our study, it was found that radiological union time is almost same in both techniques. Bone loss, Malunion, non-union, and limb length discrepancy can be addressed with both the fixators along with fracture treatment because of its versatility. Pin tract infection is the most common problem faced, higher with AO External fixator than Ilizarov technique.

### Conclusion

It can be concluded that the efficacies of treatment with Ilizarov was higher with less complications than AO external fixator in treatment of tibia open type IIIB fractures.

### References

1. Bhandari M, Guyatt GH, Swiontkowski MF, Schemitsch EH. Treatment of open fractures of the shaft of the tibia: A systematic overview and meta-analysis. *J Bone Joint Surg Br.*2001;83:62–8.
2. Petrisor BA, Bhandari M, Schmitsch E. Tibia and fibula fractures. In: Bucholz RW, Court-Brown CM, Heckman JD, Tornetta III P, editors. *Rockwood and Green's fractures in adults.* 7th ed. Philadelphia: Lippincott Williams and Wilikins; 2010. pp. 1867–1923.
3. Giannoudis P.V., Papakostidis C., Roberts C. A review of the management of open fractures of the tibia and femur. *J Bone Joint Surg Br.* 2006;88(March (3)):281–289.
4. Bhandari M., Guyatt G.H., Swiontkowski M.F., Schemitsch E.H. Treatment of open fractures of the shaft of the tibia. *J Bone Joint Surg Br.* 2001;83(January (1)):62–68.
5. Bach A.W., Hansen S.T., Jr Plates versus external fixation in severe open tibial shaft fractures. A randomized trial. *Clin Orthop Relat Res.* 1989;241(April):89–94
6. Foster PAL, Barton SB, Jones SCE, Morrison RJM, Brittany S. The treatment of complex tibial fractures by ilizarov method. *J Bone Jt Surg.* 2012;94(12). doi:10.1302/0301-620X.94B12.29266.
7. Singh LB, Singh ID, Singh CA. Treatment of open fractures by ilizarov technique. *IOSR - Journal of dental and medical sciences.* *J Dent Med Sci.* 2016;15(12):18–22.
8. Sanaullah KS, Ali B, Hakeem A, Ahmed I, Khan MA. AO external fixator in the management of open fracture of tibia. *Rawal Med J.* 2016;41(4):459–61.
9. Piwani M, Bhutto IA, Ahmed I. Evaluation of AO external fixator in the management of open diaphysial fracture of tibia Gustilo type IIIA and III B. *Gomal J Med Sci.* 2015;13:66–9.
10. Wani N, Baba A, Kangoo K, Mir M. Role of early Ilizarov ring fixator in the definitive management of type II, IIIA and IIIB open tibial shaft fractures. *Int Orthop.* 2011;35:915–23. doi: 10.1007/s00264-010-1023-7.

11. Hosny G, Fadel M. Ilizarov external fixator for open fractures of the tibial shaft. *J Inter Orthop*. 2003;27:303–6.
12. Sen C, Kocaoglu M, Levent E, Gulsen M, Cinar M. Bifocal compression-distraction in the acute treatment of grade III open tibia fractures with bone and soft-tissue loss: A report of 24 cases. *J Orthop Trauma*. 2004;18:150–57.
13. Qureshi PA, Makhdoom A, Laghari MA, Siddiqui KH. Ilizarov external fixator in the management of fractures of tibia. *J Pakistan Orthopaedic association*. 2006;18:71–9.
14. Oçgüder DA, Ozer H, Solak S, Onem RY, Ağaoğlu S. Functional results of the Ilizarov circular external fixator in the treatment of open tibial fractures. *Acta Orthop Traumatol Turc*. 2005;39:156–62.
15. Dunbar RP, Gardner MJ. Initial management of open fractures. In: Bucholz RW, Court-Brown CM, Heckman JD, Tornetta III P, editors. *Rockwood and Green's fractures in adults*. 7th ed. Philadelphia: Lippincott Williams and Wilkins; 2010. pp. 283–300.
16. Henley MB, Chapman JR, Harvey EJ, Whorton AM, Swiontkowski MF. Treatment of type II, IIIA and IIIB open fractures of the tibial shaft: A prospective comparison of undreamed interlocking intramedullary nails and half-pin external fixators. *J Orthop Trauma*. 1998;12:1–7. doi: 10.1097/00005131-199801000-00001.
17. Papaioannou N, Mastrokalos D, Papagelopoulos PJ, Tyllianaksi M, Athanassopoulos J, Nikiforidis PA. Nonunion after primary treatment of the tibia fractures with external fixator. *Eur J Orthop Surg Traumatol*. 2001;11:231–35.
18. Inan M, Halici M, Ayan I, Tuncel M, Karaoglu S. Treatment of type IIIA open fractures of tibial shaft with Ilizarov external fixator versus undreamed tibial nailing. *J Arch Orthop Trauma Surg*. 2007;127:617–23.
19. Ajmera A., Verma A., Agrawal M. Outcome of limb reconstruction system in open tibial diaphyseal fractures. *Indian J Orthop*. 2015;49(August (4)):429–435.
20. Patil M.Y., Gupta S.M., Kurupati S.K.C. Definitive management of open tibia fractures using limb reconstruction system. *J Clin Diagn Res*. 2015;10(July (7)):RC01–RC04.
21. Pal C.P., Kumar H., Kumar D. Comparative study of the results of compound tibial shaft fractures treated by Ilizarov ring fixators and limb reconstruction system fixators. *Chin J Traumatol*. 2015;18:347–351.