

RESULTS OF ILIZAROV METHOD OF TREATMENT FOR INFECTED NON UNION OF LONG BONES.**Dr. Vijay Kumar Meena*, Dr. Devendra Solanki, Dr. Siddharth Sharma, Dr. Ankesh Goyal and Dr. Guvvanti Meena**

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Article Received on 08/12/2016

Article Revised on 28/12/2016

Article Accepted on 18/01/2017

ABSTRACT

Background: infected nonunion of long bone is a very difficult task for surgeon to treat. Ilizarov emerged as the miraculous procedure to tackle this complication. So we have performed this study to look out the outcome of Ilizarov in our setup **Materials and methods:** 60 cases of infected nonunion of long bones of lower limb which were treated by Ilizarov method from 2011 to 2014 were included in the study. Average age of patients with tibial nonunion was 31.4 years and for femoral nonunion was 22.7 years. In our study 40 tibial and 20 femoral fractures were having infected nonunion. Ratio of male: female was 5:1. Ilizarov fixator was used to treat patients. All patients had minimum follow up for 6 months. D Paley's criteria were used to evaluate results. **Results:** 56.6%, 26.6% patients had excellent and good bony and functional results. 6.6 % patients had poor results. On an average 2 to 3 complication occurred in every patient. Most common complication was pin tract infection. **Conclusion:** Ilizarov is good option to treat infected nonunion. However expertisation is required to reduce complications. It requires immense patience on both sides, doctor as well as patient.

KEYWORDS: Ilizarov, tibial, femoral fractures.**INTRODUCTION**

It is very challenging to treat patients of infected nonunion of long bones, specially infected tibial nonunion with gap. Ilizarov fixator method emerged as a good option to treat nonunion of long bones because it allows the use of compression, distraction, bone lengthening and correction of deformity. Although many tibial and femoral nonunions can be treated by other methods (change of intramedullary nail, antibiotic treatment etc) with or without bone grafting. However, infection, bone exposure, bone loss, deformity or failure of previous surgeries absolute use of internal fixation. The traditional procedures, however, usually require multiple surgical procedures, no weight bearing during treatment, and have limited extent of bone defect reconstruction. The bone restored by cancellous bone grafting may require years of remodeling to achieve the radiological appearance that is obtained by distraction regeneration of the Ilizarov method. For these cases the Ilizarov method is useful. There is no necessity for bone grafting in most of the cases.^[1,2] With above background, this study has been undertaken to evaluate results of Ilizarov method for infected nonunion of long bones.

MATERIALS AND METHODS

It was a retrospective study. Sixty cases (40 tibial and 20 femoral) of infected nonunion of long bones of lower limbs were included in the study and treated by Ilizarov

method. The study was conducted from 2011 to 2014. The inclusion criteria were.^[1] patients of infected non union of long bones of lower limbs with age of 18 or more.^[2] without neurological impairment of ipsilateral lower extremity. Average age of patients with tibial nonunion was 31.4 years and for femoral nonunion was 22.7 years. Ratio of male and female was 5:1. The mean interval from original injury to Ilizarov fixator application was 25.7 months (range 9 to 108 months). The average shortening was 5.07 cm in tibia and 3.7 cm in femur (combined 4.6 cms.). Infection was active with purulent drainage in 50% cases and rest was quiescent without discharge at present. The culture samples were collected from infected nonunion sites and results were positive for 86% while rest were incomplete. Bacterial species grown in the culture were shown in table.

All patients had mean follow up for one year. In our study nonunion were classified according to classification of D Paley's modification of Ilizarov classification.^[5,6] Thirty tibial fractures and ten femoral fractures were open fractures with previous failed treatment (i.e. external fixation, plaster cast, intramedullary nail) resulting into infected nonunion; while four tibial and eight femoral fractures were closed fracture with infected implants. Six tibial fractures and two femoral fracture were associated with bone loss due to acute osteomyelitis with fracture. Ilizarov fixator was

considered in these patients after failure of other methods to treat infected nonunion such as exchange intramedullary nail, antibiotic impregnated cement etc. Before Ilizarov fixation patients were evaluated clinically and radiologically by X-rays in two planes i.e. anteroposterior and lateral view. Preoperative shortening, gap, presence of infection, level of nonunion, neurovascular status of limb and joint motion were recorded. X-ray examination of affected limb segment was done to find out level of nonunion, presence of sequestrum, abscess or cavities and condition of bone ends.

Operative technique: Patients were operated under general/spinal anaesthesia in supine position. Frame was constructed a day before surgery to save time during surgery and was modified during surgery if required. Ring size was selected so as to have 3 cm clearance all around between skin and ring. Total 4 to 5 rings were used depending on the requirement; two near the nonunion, two near the corticotomy and two near metaphyseal end of the bones. After painting and draping limb was placed on metallic supports. First, reference wires were inserted parallel to joint lines at proximal and distal joints. Assembly was opened like clam shell and brought around the limb. Most proximal and distal ring were fixed to reference wires and tensioned. Then other wires were inserted through safe corridors to fix other rings. Each ring must have atleast 2-3 wires. Olive wires were used for cancellous bone, osteoporotic bone to correct deformity and for inter fragmentary compression. Bayonet tip wires were used for hard cortical bone. Slow drilling was used during wire insertion to prevent thermal necrosis of bone. Wires were tensioned manually or by dynamometric tensioner, 130 kg tension was given for wire fixed to full rings and 90 kg tension to the wire fixed to half rings and support posts. Frame was extended across the joint if nonunion was near a joint. Italian arch and Schanz screws were used to fix proximal femur. Foot assembly was added if nonunion was at lower third of tibia.^[7,8]

Corticotomy

It was done at metadiaphyseal region using percutaneous method. Medial and lateral cortex were broken using a corticotome after lifting the periosteum while preserving the medulla. Posterior cortex was broken by turning the handle of corticotome by 90 degree. Completion was checked by rotational stress. Periosteum was sutured. In leg bones osteotomy of Fibula was also done. Intra operative decision of debridement of the bone ends was taken according to need. Pin tracts were dressed with povidine iodine gauzes and frame wrapped in sterile dressing.^[6]

Post operatively sensitive antibiotics were given for 4 weeks. Physiotherapy was started very next day and patients were allowed and encouraged to stand and walk with support as soon as pain and edema subsides. Distraction and compression was started after a latency

period of 5-7 days of operation and the rate was kept .5 to 1.5 mm per day at the rhythm of 4 times a day. Pin care and distraction/compression were taught to the patients. Check X-ray was taken after 7 days to confirm whether corticotomy is distracting or not. X-ray of the part taken at the interval of 2 weeks to access the amount of distraction and correlated clinically with the distance moved on threaded rods, to detect union at fracture site and to detect early deformity. Rate of distraction was changed if needed by evaluation of X-ray and clinically. Limb was over hanged by 7-10 mm and compressed back to hasten consolidation. Consolidation time was double the time of distraction/ compression period.

Removal of fixator was done in OPD without anaesthesia on the basis of these criterias:-

1. A month too late was better than a day too early.
2. Radiograph showing atleast 3 cortices out of 4 (i.e. anterior, posterior, medial and lateral in AP and lateral view of limb) with sharp cortical outline.^[8,9]
3. Nuts and bolts were loosened 15 days prior to implant removal and patients were encouraged to bear weight with loosened fixator. If there was no pain during this period fixator was removed. After removal of fixator; casts and braces were applied if thought necessary.^[8]

Results were evaluated according to ASAMI (Association of the study and application of the methods of Ilizarov criteria).^[5]

Bone results were based on the status of union, infection, deformity and limb length discrepancy:

1. Excellent result: consisted of union, without infection, deformity less than 7 degrees and limb length discrepancy less than 2.5 cm.
2. Good result: consisted of union plus any of other two criteria.
3. Fair result: means union plus any one of other criteria.
4. Poor result: were considered when nonunion or refracture and none of others.

Functional results were evaluated on the basis of criteria which consist of significant limp, equinus deformity of ankle / flexion contracture of knee, soft tissue dystrophy, pain and inactivity (unemployment or inability to return to daily activities because of leg injury). Based on above criteria:

1. Excellent result:- means active individual + none of other four criteria.
2. Good result:- active individual + one or two of other four criteria.
3. Fair results:- active individual + three or four of other four criteria.
4. Poor results:-inactive individual regardless of other criteria.

Patients visited every two weeks for follow up during distraction/ compression phase and every 4 months

during consolidation phase. Results were evaluated 6 months after removal of fixator.

RESULTS

In our study 40 tibial and 20 femoral fractures were having infected nonunion. In 54 patients lower and middle third of the shaft of bone involved. Most common type of non union was B3 type. Maximum interval was 9 years and minimum interval was 6 months. Average shortening in my study was 5.07 cm in tibia and 3.7 cm in femur (combined 4.6 cm). However Ilizarov fixator was used in cases with insignificant shortening to maximum gap of 12 cm in tibia. Active infection in form of discharging sinus was present in half of the cases preoperatively. After removal of fixator, active infection in form of discharging sinus was present in only 10 % cases. In rest of cases infection was healed after removal of fixator.

In most of the cases single corticotomy was done. Double corticotomy was done in cases of large gap and shortening. Average duration of distraction/ compression and fixator application was 2.61 months and 9.33 months, respectively. Maximum duration of fixation was 18 months and that of minimum duration 5 months.

According ASAMI's criteria.^[5] results were given in table 2. Bone and functional results were good to excellent in 70-80% of the cases. Complications we faced were given in table 3. At least 2 to 3 complications per patient were encountered in the study. Pin tract infection was most common complication. However it was superficial in 2/3 patients, controlled by dressing and antibiotics, but infection was deep seated in 1/3 cases requiring removal of wire and drainage. Flexion contracture of knee was present in 11 patients of cases requiring physiotherapy. One patient required quadricepsplasty. Equinus foots were corrected by addition of foot assembly. Premature consolidation was treated by osteoclasts followed by increased rate of distraction 1.5 mm/day. Delayed consolidation at regeneration site was managed by decreasing rate of distraction and at nonunion site by bone graft. A V fistula was treated conservatively. Hip dislocation in one patient was reduced with difficulty by closed manipulation under image intensifier. Refracture at fracture site or nonunion site in two patients was treated conservatively.

TABLES Table 1 Showing patients related datas.

		Tibia	Femur	Total	%
Site of bone involved	Upper 1/3	4	2	6	10
	Middle 1/3	18	10	28	46.6
	Lower 1/3	18	8	26	43.3
Type of nonunion	B1	10	2	12	20
	B2	14	6	20	33.3
	B3	16	12	28	46.6
causes of nonunion	open# with post traumatic osteomyelitis	30	10	40	66.6
	infected implants in close #	4	8	12	
	Bone loss due to hematogenous osteomyelitis	6	2	8	13.3
Shortening or gap	0-2cm	2	6	8	
	2-4	12	4	16	
	4-6	20	10	30	
	6-8	4	-	4	
	>9	2	-	2	
Infection	Active	20	10	30	50
	Quiescent	20	10	30	50
Corticotomy	Proximal	32	4	36	6
	Distal	4	10	14	
	Double	4	0	4	
	None	0	6	6	
Duration of distraction / compression	0-2 month	16	10	26	
	2-3	14	6	20	
	3-4	6	4	10	
	4-5	4	0	4	

Table 2 Results of our series on the basis of ASAMI's Criteria.

Bone results	Tibia	Femur	Total	%
Excellent	24	10	34	56.6
Good	10	6	16	26.6
Fair	-	4	4	6.6
Poor	4		4	6.6

Functional results	Tibia	Femur	Total	%
Excellent	24	10	34	56.6
Good	10	6	16	26.6
Fair	-	4	4	6.6
Poor	4		4	6.6

*One patient expired during treatment so his results were not included.

Table 3:- Complications of our series.

S. No.	Complication	No of patients	%
1	Pin tract infection	25	83.3
2	Implant failure	17	56.6%
3	Flexion contracture or knee stiffness	11	36.6
4	Equinus foot	5	16.6
5	Valgus deformity at corticotomy site	1	3.3
6	Premature consolidation	1	3.3
7	Delayed consolidation	7	23.3
8	A.V. fistula	1	3.3
9	Post D/L hip	1	3.3
10	Refracture	2	6.6

Table 4: Criteria for functional and bony results

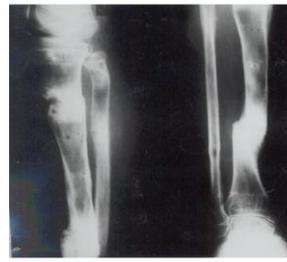
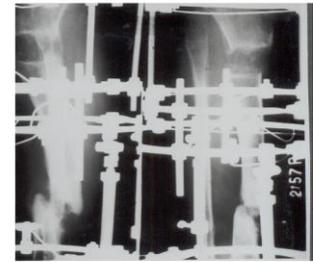
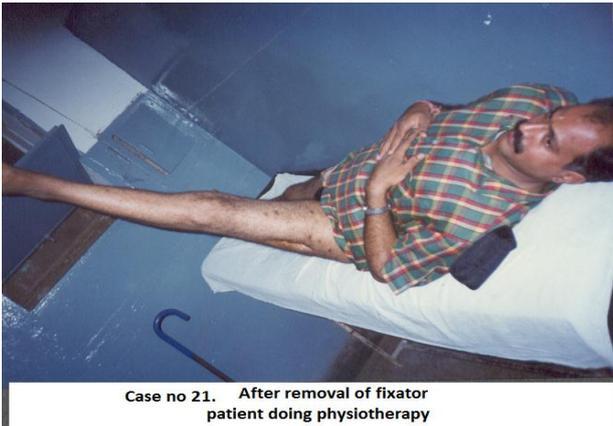
Results	Functional results were evaluated on the basis of criteria which consist of significant limp, equinus deformity of ankle / flexion contracture of knee, soft tissue dystrophy, pain and inactivity (unemployment or inability to return to daily activities because of leg injury).	Bony results were based on the status of union, infection, deformity and limb length discrepancy.
Excellent	Active individual + none of other four criteria.	consisted of union, without infection, deformity less than 7 degrees and limb length discrepancy less than 2.5 cm.
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Fair	Active individual + three or four of other four criteria.	Consisted of union plus any one of other criteria.
Poor	Inactive individual regardless of other criteria.	Were Considered when nonunion or refracture and none of others

Table 5:- Comparison of results of various studies according to ASAMI's (association of the study and application of the methods of Ilizarov).

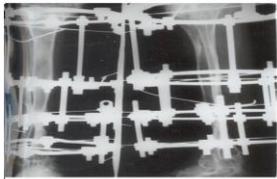
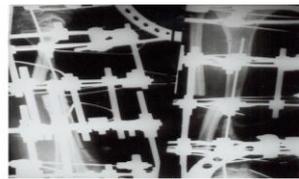
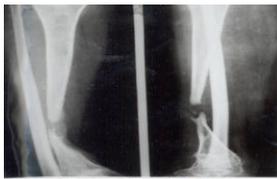
Author	Bone union	Functional results E/G/F/P*	Bony results E/G/F/P*
Madhusudhan	13/13 9/9	1/3/6/2 0/1/3/2	4/3/4/2 0/3/4/2
Chaddha	92%	6/9/4/6	13/1/0/11
Saridis	39/41	14/14/2/2/2	17/14/4/6
Our study	100%	17/8/2/2	17/8/2/2

*E means excellent, G means good, F means fair, P means poor.

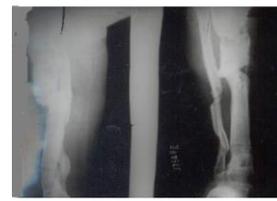
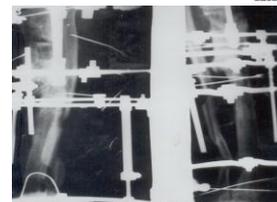
PHOTOS



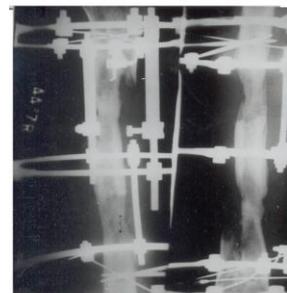
Case 1



Case no B



Case no 2



Case no 23



Case 23 : photograph of patient after removal of fixator and developing # of regenerate

Bone and functional result - Fair



DISCUSSION

The mean age of patients in my series was 28.5 years which was more or less similar to series of D. Paley.^[9] (34 years), Bobroff.^[9] (32 years), A. Saridis.^[10] (34.6 years) and Abdel A.^[9] (30.4 years). Male predominance in our series was similar to the study of Peng Y³ and M Kiran^[7]. Male predominance can be attributed to the fact that males have more responsibilities for outdoor activities as compared to females. In our study most of the patients had type B3 nonunion which was similar to the report of Patil^[11]. Contradictory to Patil's^[11] report none of our patients had type A1 and A2 nonunion. This was due to poor initial management at our peripheral centers due to lack of facilities and expertise.

Most common cause of nonunion in our series was open fractures in 66% patients which was similar to Madhusudhan's⁵ series. It was similar but percentage was higher than that of us. In western countries hematogenous osteomyelitis was rare cause as early diagnosis and better treatment was possible as patients were also aware as well as easy availability of health facilities. Patil.^[11] also reported similar causes of nonunion.

The average interval between injury and Ilizarov fixator application in our series was similar to that of the report of Peng Y³, Sanders⁹, Laursen⁹ and Ring⁹, while in the series of Manish K⁷, Paley⁹, Green⁹ and Cattaneo⁹ it was 10.58 months, 3.5 years, 30 months and 25 months, respectively.

Average shortening in our series was similar to that reported by Paley⁹ and Green⁹. Average shortening in series of Peng Y³, Manish K⁷ and Chaddha M⁴ was 6.27 cm, 6.53 cm and 8.9 cm, respectively.

In our series of 60 cases, 30 cases were having infection in form of discharging sinuses when the fixator was applied. The infection healed in 24 out of 30 patients when fixator was removed. Tang L^[12] in his series noted that active infection was present in 80% patients at the time of application of fixator and all the patients achieved bony union and subsidence of infection at the time of removal of Ilizarov fixator.

Corticotomy in our study was done in metaphysis or metadiaphysis mostly in proximal tibia. Double corticotomy was done in two cases due to large gap.

Average duration of distraction and compression in present series was similar to series of Peng Y (68.7 days).³ The relatively shorter period of distraction/compression in our study was because in some cases we did only compression of nonunion; we ignored limb length discrepancy < 2.5 cm.

In our series average duration of fixation was similar to report of Abdel -AM⁹ (12.27 months), Peng Y³ (9.46 months) and Dendronos⁹ (10 months). Relatively longer duration of fixation when compared to length of gaps / shortening was because we were more conservative in our approach. Average limb lengthening index in our study (30-40 days /cm) was similar to series of Tang L⁹ (40.7day/cm).

Bony and functional results were discussed in table no 4, from table it is clear that bony and functional results in our series were poor as compared to the series of the Sala⁹, Madhusudhan⁵, Chaddha⁴ and Magadam⁹

In our series 2 to 3 complications per patient have occurred during treatment which was similar to series of Madhusudan⁵, Chaddha⁴.

Most common complication in our series as well as in series of Peng YIN³ was pin tract infection. Blum¹³ reports pin tract infection in all patients of his series. 6.6% patients had refracture at the docking site in our series, which was similar to the series of Peng Y³.

Incidence of Equinus deformity in our series was similar to series of Manish K⁷. Knee stiffness in our series was higher than series of Manish K⁷. Bone union in our study was higher than the study Chaddha⁴.

CONCLUSION: Ilizarov method of treatment of nonunion is good method to treat nonunion. All patients gave the informed consent prior being included into the study. All procedures involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments. The study was approved by the Research Ethics Committee. There is no conflict of interest between authors.

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