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Treatment of Tibial Non-Union with the Ilizarov Method

Pervaiz Iqbal, Muhammad Afaq, Hamid Qayum
Department of Orthopaedics, Shaikh Zayed Hospital, Lahore.

SUMMARY

Twenty five patients of tibial non union were treated with the Ilizarov method during last five years. Two patients were female and the mean age was 31 years (10-50 years). Ten patients had closed fractures and nineteen patients had infected non union. Non unions were classified according to Paley et al classification and all the problems as non union, infection, shortening and angulation were addressed simultaneously by using four ring prototype Ilizarov external fixator. The mode of treatment was planned according to the need of individual case. There was an average bone defect of 2.96cm (2.0-7.0cm). The total duration of treatment was an average of 147 days (65-286 days) and the average bone length achieved was 2.36 cm (1-7cm). All patients were available for follow up, with mean follow up period of 16 months (5-48 months). Results were evaluated according to the protocol of the Association for the Study of Application of the Method of Ilizarov. The bone results were found excellent in eighteen patients good in four patients and poor in three patients. The functional results were found excellent in three cases, good in sixteen patients, fair in two patients and poor in four patients. The Ilizarov method is strongly recommended in the treatment of tibial non union, specially complicated with soft tissue problems and bone infection.

INTRODUCTION

Of approximately 2 million long bone fractures per year in USA, about 100,000 (5%) result in nonunions[1,2]. Among various long bone fractures, tibial fractures are being more encountered. In 1935, Sever[3-4] stated that delayed union and nonunion occur more often in the shaft of humerus than any other long bone. In 1960, Boyed[5-6] and associates reported a fairly even distribution among the long bones of body but 15 years later, Connolly[2] reported that the tibia predominated as the location of nonunion (62%). This change in the distribution of nonunion is attributed to many factors. Treatment of humerus fractures with cast, forearm bone fractures with DCP and femur shaft fracture with IM nailing has controlled many healing problems in these fractures. But all this does not hold true with tibial fractures, rather problems seem to be increasing.

Due to being subcutaneous in its length and having relatively less blood supply; tibial fractures are usually associated with complications of infections and nonunions. Various treatment options, described by various authors for the treatment of tibial nonunions are valid. These options can be discussed under the headings of:

* Modalities to enhance biologic repair process include.
  - Weight bearing.
  - Partial fibulectomy and weight bearing.
  - Bone grafting
    - Posterolateral bone grafting.
    - Sub-cortical bone grafting
    - Open cancellous bone grafting
    - Onlay bone grafting
    - Dual onlay bone grafting
    - Cancellous insert grafting
    - Massive sliding grafting

- Free vascularized bone graft.
- Tibiofibular synostosis.
- Bone marrow injection
- Composite grafting

* Modalities for reduction and stabilization of bone fragments include
  * Internal fixation devices
    - IM nailing
    - Plates and screws
  * Treatment with external fixators

Usually various combinations of these modalities are adopted to treat the tibial nonunions. If the nonunion of tibia is associated with infection, then it requires further considerable judgement for proper treatment. Various targets as control of infection, bone stability, wound healing, bone healing and soft tissue coverage are to be achieved with various methods.

With Ilizarov method it is possible to stabilize the bone fragments without disturbing the biologic repair process at fracture site. In addition bone as well as soft tissue can be regenerated under tension stress effect.

PATIENTS AND METHODS

From mid 1992 - mid 1997, 25 cases of tibial nonunions were treated with the Ilizarov method, in the Department of Orthopaedic Surgery Shaikh Zayed Hospital, Lahore.

The mean age was about 32 years and only 2 patients were female (Table 1). Majority of the patients had injury to their legs after a road traffic accident (Table 2), while 10 of 25 patients had initially closed fractures (Table 3). There were 6 cases of non infected non union while of 19 cases of infected nonunion, 7 patients had initially closed fractures (Table 4). Infection was classified according to AO classification into active, drainage and oniescent. Diagnosis was made according to the Paley et al classification of pseudarthrosis and majority of the patients belonged to group B2 and B3 (Table 5).

Patients presented about 16 months after initial injury and have had average 4 procedures done previously (Table 6). 13 patients had an average angular deformity of 29.23 degrees (Table 6).

Table 1: Age and sex distribution of cases of tibial non-union (n=25).

	Minimum	*Maximum*	*Averag*
Age	10 year	50 year	32:12 year
	Male	*Female*	*Ratio*
Sex	23	2	11.5:1

Table 2: Mode of injury in cases of tibial non-union (n=25).

Mode	*No. of Cases*	*Percentage*
Road traffic accident	21	84
Gun shot injury	3	12
Fall from height	1	4
Total	**25**	**100**

Table 3: Initial injury in tibial non-union (n=25).

Grade	*No. of Cases*	*Percentage*
Grade III open	7	28
Grade II open	8	32
Closed	10	40
Total	*25*	*100*

Twenty patients of type-B pseudarthrosis had total average bone defect of 2.96cm (Table 6). Of 19 infected nonunions, 11 patients showed growth on deep cultures. Majority of them had Staph. aureus with one MRSA. A standard 4 ring prototype Ilizarov external fixator was used and all the components were manufactured locally.

Table 4: Infection - AO classification in tibial non-union (n=25).

	No. of Cases	*Percentage*
Non infected	6	24
Infected	19	76
infected (Active)	5	20
infected (Drain)	8	32
infected (Quiescent)	6	24

Table 5: Diagnosis (Paley et al classification of pseudarthrosis 1989) (n=25).

	Type	*No. of Cases*	*Percentage*
	A1	0	0
A	A2	2	8
	A3	3	12
	B1	3	12
B	B2	12	48
	B3	5	20
	Total	**25**	**100**

Table 6: Pseudarthrosis.

		Min.	*Max.*	*Av.*
Delay in presentation	Ms	6	58	16.32
Previous procedures	No.	2	13	4
Angular deformity	Degrees	70	45	29.23
Bone defect	cm	2	7	2.96
Bone length achievement	cm	1	7	2.36
Hospitalization	Dys	5	96	20.28
Fixator removal	Dys	65	286	147
Follow up	Ms	5	48	15.28

All cases were managed according to the type of pseudarthrosis. Type-A pseudarthrosis was treated with either compression or distraction at nonunion site with correction of angulation if needed. Type-B pseudarthrosis was managed either with compression/distraction osteogenesis or segment transport as indicated. Average bone length achieved was 2.36cm and 20 days was average duration of hospitalization (Table 6). The average fixator removal time was 147 days.

All the patients were available for follow up and average follow up period was 15.28 months (Table 6).

RESULTS

We evaluated our results according to the criteria established by the Association for the Study and Application of the method of Ilizarov (ASAMI)[13].

Bone results were based on 4 criteria, union, infection, deformity and LLD. There were 18 excellent, 4 good and 3 poor bone results (Table 7).

Functional results were based on 5 criteria, limp, joint stiffness, soft tissue sympathetic dystrophy, pain and inactivity. There were 3 excellent, 16 good, 2 fair and 4 poor functional results (Table 8).

Table 7: Bone Result (Based on criteria of ASAMI) in tibial non-union (n=25).

Grade	*No. of Cases*	*Percentage*
Excellent	18	72
Good	4	16
Fair	None	Zero
Poor	3	12
Total	**25**	**100%**

Table 8: Functional results in tibial non-union (Based on criteria of ASAMI) (n=25)

Grade	*No. of Cases*	*Percentage*
Excellent	18	72
Good	4	16
Fair	None	Zero
Poor	3	12
Total	25	100%

Complications

Complications noted during the treatment were classified according the Paley et al classification of complications of distraction osteogenesis with the Ilizarov method. They were mainly divided into problems, obstacles and true complications. Twenty five patients had total 68 complications; 43 problems, 9 obstacles and 16 true complications (Table 9).

Table 9: Complications (Paley et al Classification) (n=68).

Complications	*No. of Cases*	*Percentage*
Problems	49	2.0
Obstacles	9	0.36
True complication	16	0.64
Total	68	2.72

DISCUSSION

Nonunion of tibia taxes the ingenuity of orthopaedic surgeon[7]. Various modalities for the treatment of tibial fractures, have variable percentage of nonunion. Ilizarov and coworkers[8-10] critically analysed all the treatment modalities available for fracture treatment. They concluded that none of them is applicable to all the aspects of fracture healing. They considered the four factors very important to provide optimum biologic environment for bone healing.

i. Preservation of blood supply, both of the limb as well as at fracture.
ii. Preservation of osteogenic tissue. Periosteum, end osteum and marrow.
iii. Functional activity of limb.
iv. Early patient mobilization

Ilizarov proved both clinically end experimentally that the congruent reduction and contact of bone ends and preservation of blood supply are of utmost importance for quick fracture healing[11-13]. In addition he proved the biomechanics and effects of compression, distraction forces on the cellular elements, concluding that under tension stress, connective tissue osteogenic activity is stimulated and bone is formed by the cellular elements. Thus he concluded that osteosynthesis needs "hormonic combination between mechanical and biological factors" and he achieved union in nonunions with his external fixator device which provides excellent stability to bone fragments while on the other hand preserves the osteogenic tissue for reparative process[13-14].

"Osteomyelitis burns in the flame of regenerate"[8]. With these words Ilizarov explains the philosophy behind his method of dealing with chronic osteomyelitis. He proved that regenerated new bone burns out the bone infection as well as acts as bone graft to fill the bone cavities. He never used any antibiotic or bone graft to treat the bone infection.

Using Ilizarov method for the treatment of tibial nonunions, we achieved bone union in all types of nonunion. Fragment stability and reduction are the basic need in all types of nonunion. In addition, osteosynthesis was stimulation either by compression, distraction or both, where needed, the gap nonunions were treated with compression/distraction or segment transport.

Most of the patients had already gone under various procedures and had developed contractures of knee or ankle joints. Thus the bone results in our series were better than the functional results.

CONCLUSION

Ilizarov method provides an exceptional deal to treat the challenging problem of tibial nonunion, specially complicated with infection and soft tissue problems and has ability to target all the related problems simultaneously. This method is strongly recommended to treat the tibial nonunion.

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The Authors:

Pervaiz Iqbal
Assistant Prof. of Orthopaedics,
FPGMI Shaikh Zayed Hospital,
Lahore

Dr. Muhammad Afaq
Student FCPS-II,
Department of Orthopaedics,
FPGMI Shaikh Zayed Hospital,
Lahore

Prof. Hamid Qayum
Head of the Department of Orthopaedics
FPGMI Shaikh Zayed Hospital,
Lahore

Address for Correspondence:

Pervaiz Iqbal
Assistant Prof. of Orthopaedics,
FPGMI Shaikh Zayed Hospital,
Lahore