Original article

Medial transport of the fibula using the Ilizarov device for reconstruction of a large defect of the tibia

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ABSTRACT

Background: Large tibial defects are always a challenging to treat, especially those associated with soft tissue compromise and infection. There are different treatment options available for bridging such gaps. Therefore, current study undertakes to test Ilizarov technique for transport of fibula to establish its usefulness in bridging large tibial defects.

Patients and Methods: This prospective case series was carried out from April 2013 to December 2016 at Orthopedic ward Lahore General Hospital in which 11 patients with large tibial defects having associated compromised soft tissue were treated by medial transport of fibula using Ilizarov external fixator.

Results: Among total 11 patients, 63.6% were male while 36.4% were female. The mean age of the patients was 31.6 years. There were 45.5% patients reported with right side while 6 (54.5%) were reported with left side tibia with bone defect. Most of the patients (54.5%) had open fracture with bone loss while 45.5% patients had chronic osteomyelitis. Average time to union was 5.2 months. Average tibial defect size was 10.7 cm. Among them 72.7% patients regained normal walk. All patients had multiple previous surgeries on their limbs.

Conclusion: Use of Ilizarov for medial transport of fibula is an effective procedure for reconstruction of large tibial defects especially in those patients who underwent multiple previous surgeries and with compromised soft tissue.

Keywords:
Medial transport; fibula; Ilizarov; tibial defect.

INTRODUCTION

Fracture shaft of tibia are treated surgically, and common complications of these fractures are delayed union and non-union.[1,2] These complications occur due to the disturbance of fracture biology and mechanical reasons.[3] The vital biological reasons are de-vascularization of bone ends which occurs due to many reason including high-energy trauma, prior surgery and infection after open reduction and internal fixation. Inappropriate fixation, bone defects, technical mistakes and poor screw purchase in osteoporotic bone may be mechanical reason of non-union.[4]

Challenging therapeutic difficulties for both the doctor and the patient are large segmental bone defects of the tibia. The most common reasons of bone defects are high-energy comminuted fractures, infections, congenital diseases (tibial pseudarthrosis) and tumors. For preservation of limb different surgical techniques have been described for treating these defects.[5] In developing countries, the use of expansive surgical techniques is not possible so that amputation is occasionally offered. This choice is not always tolerable for the patients and their family.

There are various surgical procedures described including: free-vascularized graft of opposite fibula to bridge the defect[6,7] or the same side fibula either by tibio-fibular synostosis[8] or medial transport of the fibula. Large tibia bone defects bridging can be done by medial transfer of ipsilateral fibula. In this procedure, the fibula can be raised on a pedicle of two muscles including peroneal and anterior tibial with peroneal vessel was first explained by Chacha and colleagues.[9] Bone segment transport, ipsilateral fibula medial transport, hemifibula transport can be done with Ilizrov external fixator.[10,11]

Patients with large tibial defects may end up with below knee amputation due to trauma, and secondary infection. Additionally, it not only impart economic burden but also mental stress due to longer hospital stays, multiple visits and due to limb loss. Therefore it is important to utilize effective mode of treatment in the best interest of the patient. Therefore, Ilizarov technique for transport of fibula was tested in this study to establish its usefulness in bridging large tibial defects especially in difficult cases complicated by infection and soft tissue problems.

Competing interest: The authors have declared no competing interests exist.
Citation: Malik AL, Hanif M. Medial transport of the fibula using the Ilizarov device for reconstruction of a large defect of the tibia. J Fatima Jinnah Med Univ 2018; 12(1): 2-5.

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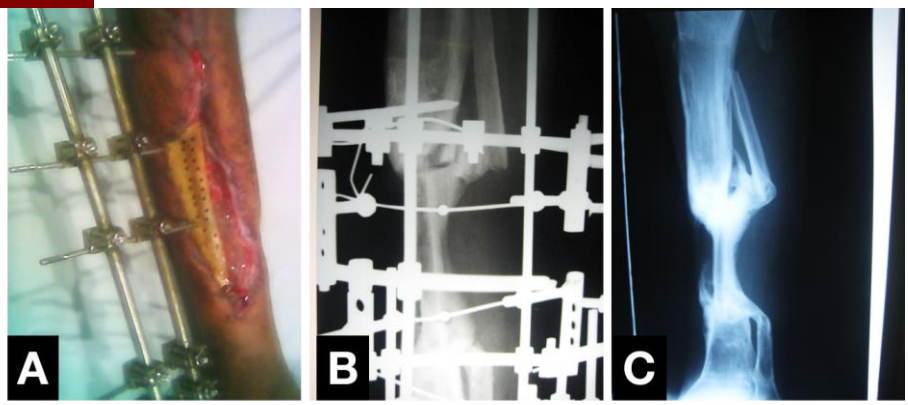

Figure 1. A) AO Ex-fixator for open tibial fracture. B) Medial transport of fibula by Ilizarov. C) Bridging of defect by fibula

PATIENTS AND METHODS

Study was conducted after approval of Hospital Ethical Review Committee. A written informed consent was taken from the patients or their caregivers. It was a prospective case series in which we followed-up 11 patients with large tibial defects bridged by medial transport of fibula with Ilizarov in Orthopedic Department Lahore General Hospital. All Patients were followed up for a minimum of one year. Standard radiographs antero-posterior and lateral views were taken. Essential blood tests were done. All patients underwent surgical procedure of fibula medial transport using Ilizarov external fixator. Under spinal, epidural or general anesthesia the proximal fragment of bone was applied with two appropriate size Ilizarov rings and fixed by four tensioned 1.8 mm K-wires (two on each ring). Distal fragment was also applied two rings of appropriate size and also fixed by four tensioned 1.8 mm K-wires. Rings were connected in assembly with four threaded rods. From postero-lateral to poster-medial direction the shaft of the fibula was drilled by two olive wires. Motor was used for fibula medial transport and connected these wires with Ilizarov frame. Two incisions were made including one at the level of the proximal ends and second at the distal tibial fragments and fibular osteotomy was completed. The wounds were closed in layers. On second post-operative day fibula medial transport was started at a rate of 0.5 mm every twelve hours (1 mm/day). Immediately post-operatively active non-weight-bearing movement of the knee and ankle joints were started. As soon as the pain permitted patients were encouraged to full weight bearing. Bone grafting was done in docking sites to accelerate union in some patients. Ilizarov was removed after consolidation and PTB brace was applied. The primary goal was stable filling of the gap and full weight bearing as early as possible. Intra-operative fluoroscopy was used to assess the level of the fibular osteotomies and ensure wires did not transgress the knee or ankle joints.

RESULTS

There were 7 (63.6%) male and 4 (36.4%) female patients. The mean age of patients was 31.6±6.9 years (range 18-45 years). There were 5 (45.5%) patients reported with right side while 6 (54.5%) were reported with left side tibia with bone defect. Most of the patients (54.5%) had open fracture with bone loss while 45.5% patients had chronic osteomyelitis. Average time to union was 5.2±2.7 months. Average tibial defect size was 10.7 cm. Among them 8 (72.7%) patients regained normal walk.

The mean BMI of the patients was 23.9±2.2. Among total 11 patients, 08 (72.7%) were non-diabetic and 03 (27.3%) were diabetic. Functional outcomes were measured as range of motion around knee, majority 07 (63.6%) had excellent, 03 (27.3%) had good while one (9%) had poor functional outcome in terms of continuous pain on bearing weight.

DISCUSSION

Segmental post-traumatic bone defects resulting from injuries of the extremities can have a serious negative long-term effect on the patients' lives and present multifaceted treatment challenges. Established methods of treatment of segmental post-traumatic bone defects to restore limb function include limb shortening, bone transport distraction osteogenesis, autologous non-vascularized cancellous bone grafting, and vascularized fibular grafting. Each method has its pros and cons. In this study, the management of large tibial defects using Ilizarov fibular transport was tested aiming to establish

Table 1. Summary of demographic, medical history and functional outcome of the surgical reconstruction using Ilizarov device of all cases

Age (years)	Initial Lesion	Previous Surgery	Bone Defect (cm)	Time to Union (months)	Functional Outcome
20	Open fracture with bone loss	External fixator soft tissue flap rotation	7	6	Walking with limp
18	Open fracture with bone loss	External fixator	6	5	Normal walking
25	Tibia osteomyelitis	Sequestrectomy	10	6	Normal walking

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40	Tibia osteomyelitis	Sequestrectomy	10	5	Normal walking
45	Tibia osteomyelitis	Removal of DCP and sequestrectomy	6	4	Normal walking
37	Open fracture with bone loss	External fixator	15	5	Walking with limp
29	Tibia osteomyelitis	Sequestrectomy	15	7	Normal walking
32	Open fracture with bone loss	External fixator soft tissue flap rotation	12	5	Normal walking
27	Open fracture with bone loss	External fixator flap rotation	10	4	Normal walking
29	Tibia osteomyelitis	Sequestrectomy, distraction osteogenesis with ilazarov	15	6	Walking with limp
30	Open fracture with bone loss	External fixator	12	5	Normal walking

a protocol for managing this complex problem.

It was found that, the average filled defect size was 10.7 cm, we had achieved satisfactory functional results (excellent and good) in 72.7% of patients. Further, the average union time was 5.2 months. There is problem with early weight bearing of patients with large bone defect tibia, while Ilizarov has advantage of early weight bearing.

Green and colleagues[12] reported intercalary bone transport with Ilizarov amongst 17 cases of segmental skeletal defects. On average, he measured 5.14 cm redeveloped new bone, corresponding to the formation of new osseous tissue equivalent to 13.7% of the original length of the bone. The average time for fixation was 9.6 months, including 4.8 months to transport the bone fragment throughout the limb.Dendrinos and associates[13] reported in his data of 28 patients tibial infected non-union which were treated with Ilizarov method. In his case series, there was mean of 6 cm bridged bone defect. Sixty-four percent of the patients revealed excellent to good functional results. In comparison to this study the results were compared with this study it was found 72.7% which showed high successful rate.

In a case series of 19 cases by Paley and Maar[14] in which they reported a mean of 2.9 operations per patients with tibial bone defects secondary to osteomyelitis or tibial fractures were treated with Ilizarov bone transport method. The mean duration of application of fixator was 16 months for a mean bone defect of 3.9 cm and a mean transport gap of 10.7 cm compared with 6.9 months for the 4.1 cm bone defect in this study. The healing index reported in their study was 1.7 months/cm, compared with 2.06 months/cm in this study.

Cattaneo and group[15] treated 28 patients of infected non-unions or segmental tibial bone defects. Bones healed in all of them. The mean length of redeveloped bone was 6 cm. The mean duration of the treatment in all cases was 9 months.

Tu and Yen[16] reported on 267 patients who underwent free vascularized fibular grafting for reconstruction of segmental long-bone defects caused by lower limb osteomyelitis at the authors' institutes, with 240 followed up for at least 5 years (range 5–14 years; mean, 7.5 years). The age range of the 201 male and 39 female patients was 14 to 69 years (mean, 45.3 years). There reported high 92.9% success rate with free vascularized fibular grafting. The mean duration of radiographic union was 4.7 months. The mean duration of commencement of full weight bearing was 8.5 months (range 6–14 months) after solid union and positive hypertrophy of the grafted bone had been established.

Current study reports that Ilizarov fibular transport has advantage in early weight bearing, restoration of function, limb length inequality and in those with severe infection. The results of this study are consistent with other studies.[17-20] Pin tract infection was the main complication. Patient's tolerance of the fixator was also an issue with some.

CONCLUSION

Medial fibular transport by Ilizarov is a good method for management of large tibial defects. Bone grafting of the docking site is necessary in some cases to achieve union and to shorten the time of external fixator application. Ilizarov provided early weight bearing and rehabilitation.

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