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Original Article

Clinicoradiological Assessment of Treatment of Infective Non-union in Fracture Shaft Femur using Ilizarov Ring Fixator

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Abstract

Background: The management of infective non-union of long bones has always been a dare for orthopedic surgeons. Treatment goals were the annihilation of infection and augmenting bony union. For the span of distraction osteogenesis, physiological skeletal loading and active mobilization are vital.

Aim: This study intended at evaluating the clinicoradiological result of using Ilizarov ring fixator in managing patients with infective non-union fracture of shaft of the femur.

Materials and Methods: A total of 40 patients with infective non-union of the femoral shaft were incorporated in the study between 2017 and 2018. The follow-up period lasted for 14–20 months. Skeletal measurements and functional results were calculated, and difficulties were stratified according to the association for the study and relevance of the technique of Ilizarov guidelines.

Results: The infection was eradicated in 32 patients before the fixator removal. Tremendous radiological bone healing was found in 32 patients and excellent functional result in 28 of 40 patients.

Conclusion: Ilizarov ring fixator is a valuable method for the managing of infective non-union of femoral shaft fractures with satisfactory radiological and clinical outcome and less serious complications.

Key words: Femoral shaft fracture, Ilizarov external fixator, Infective non-union

INTRODUCTION

The rising incidence of high-velocity trauma with huge bone, soft tissues damage, and treatment of infective non-union of long bones has always been a challenge for orthopedic surgeons.[1] Traditional methods for managing infective non-union of the long bones include wound drainage, debridement of infective soft tissue, and sequestrectomy of dead bone, bone graft, and external fixation. Limitations of these methods include persistent bone and soft tissue infections, bone defects, deformities, and refracture.[2] The Ilizarov technique allows distraction, compression, lengthening, and correction of the deformity. The construct stability allows immediate weight-bearing and mobilization of joints. Furthermore, bone defects can be filled up by corticotomy and bone transport. Infection control is attained by radically debriding the bone ends.[3] One of the major risks of infected nonunions is amputation of the limb, and the Ilizarov technique is capable of reducing this possible consequence.[4] Merits of this method include control of infection in the presence of osteogenesis, minimal interference with normal local healing process due to the structure of apparatus, stability for weight-bearing, and early patient mobilization.[5]

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Aim

This study was conducted to evaluate the functional and clinicoradiological outcome of using Ilizarov external fixator in treating patients with infective non-united fracture femoral shaft.

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MATERIALS AND METHODS

This prospective study was conducted in the Department of Orthopaedics and Traumatology, KAPV Government Medical College and Hospital in patients having infected nonunion of the shaft of the femur and were treated using the Ilizarov method. Radiological and functional results were evaluated and complications were categorized according to the Association for the Study and Application of the Method of Ilizarov (ASAMI) guidelines.[6,7] All patients returned for routine, clinical, and radiological follow-up every month after operation until the Ilizarov device was removed and every 4 months in the following year. Post-operative radiographs were evaluated for residual malalignment and evidence of union. The radiological union was defined as the absence of a radiolucent line at the site of the non-union and filling of the bone defect with new bone at a minimum of three cortices on standard anteroposterior and lateral radiographs. Bone healing was evaluated on the basis of union, infection, deformity, and limb length discrepancy and classified as excellent, good, fair, and poor. The functional results were classified as excellent, good, fair, and poor and evaluated according to five criteria including the return to activity: (a) Soft tissue sympathetic dystrophy, (b) inactivity (due to unemployment or an inability to return to daily activities due to the injury), (c) observable limping, (d) pain that reduced activity or disturbed sleep, and (e) stiffness of knee or hip (loss of >70 of knee flexion or loss of >15 of extension; loss of >50% hip motion in comparison with the normal contralateral side), significant pain, limping, loss of range of the motion of adjacent joints, and reflex sympathetic dystrophy.

Surgical Procedures

The infected areas were exposed through an extensive lateral approach through the least damaged soft tissues to facilitate radical debridement involving resection of non-viable bone ends before application of the frame, and removal of all loose implants, all infective and non-viable tissue. In intraoperative cultures, sensitivity was sent and antibiotics were administered based on the reports. The bone ends were freshened, the medullary canal reamed and recanalized, and open reduction of the main fragments was done to achieve the best possible anatomical contact. To prevent angulation, in cases with femoral infective non-union, we first used intramedullary femoral nailing and then applied Ilizarov external fixator, and compression-distraction were performed along the femoral nail. Frames were preassembled (preoperatively) for all patients and modified intraoperatively if required. In patients with active infection, the site of non-union was exposed and devitalized tissues including unhealthy bone ends were removed and liberal saline irrigation done. Sclerotic bone ends were chopped off and the medullary canal was reopened. Cortical bleeding served as a tool to determine the completeness of bone debridement. The average lengths of bone defects after debridement were 3.5 cm (2.5–7.5 cm). The preassembled sterilized Ilizarov frame was then applied. Rings were fixed to the bone, distally first, then to the middle and proximal sections to maintain the mechanical axis of the femur by keeping the rings parallel to the tibial articular surface of the knee joint. The frames were applied with a varying number of rings, depending on the size of the limb, site of lesion, and size of bone fragments. Full rings of the middle and distal constructs were reinforced with tensioned 1.8-mm olive wires through the rings. Corticotomy was performed in all cases at the same time as frame application. An intercalary segment of bone, created by corticotomy of either the proximal or distal part of the femoral bone, was stabilized using either wires or a combination of wires and Schanz pins and gradually transported in 10–15 days after the radiographic early evidence of union. In osteoporotic bone, Schanz pins were applied for additional stability. Compression was planned as follows: In cases with hypertrophic non-union, 1.0 mm compression per day divided 4 times (0.25 mm) a day, and in cases with atrophic non-union, intermittent compression, and distraction on 3-day sessions, 0.25 mm 4 times a day. The follow-up period lasted for 14–20 months.

RESULTS

A total of 40 patients having infective non-union of the femoral shaft were treated using the Ilizarov technique. All of the involved patients were male. The mean age of the patients was 34.8 years (range 18–69 years). The causes of injury were motor vehicle accident in 28 patients (66%), motorcycle accident in 8 patients (20%), a fall from height in three patients (7%), and 30 patients (72%) had open fractures and 10 patients (28%) had closed fractures. All 40 patients had received prior conventional treatments. 17 patients (46%) had tubular external fixators, 10.8 patients (27%) had interlocking nail fixation, and four patients (27%) had plate and screws fixation. In the presentation, 31 patients (73%) had non-union with active infection with discharge and 9 (27%) had no signs of active infections.

Bone Healing Evaluation

At the latest follow-up evaluation, 32 patients (80%) had eradication of the infection, bone union, deformities <7, and limb length discrepancy <2.5 cm. This group of patients was rated excellent on ASAMI guidelines. The remaining 8 patients (20%) were rated fair on ASAMI guidelines. This group of patients had bone union, persistence of infection, <7 deformities, and >2.5 cm limb length discrepancies.

Function Evaluation

Most modern follow-up assessment, 21 patients of the 40 patients (52%) involved in this study were actively mobile, had no antalgic gait, had minimal knee stiffness (loss of <15 knee extension), had no reflex sympathetic dystrophy (Sudeck's), and had no significant pain. This group of patients was categorized as excellent in ASAMI guidelines. A group of 11 patients (27%) was categorized to have good function in ASAMI guidelines. These 11 patients were active, had no limp, no significant pain, and no reflex sympathetic dystrophy, and had 20° loss of knee extension. The remaining 3 patients (20%) were active and had limping, knee stiffness, reflex sympathetic dystrophy, and significant pain. The final group of patients was categorized as fair in ASAMI guidelines.

Complications

A total of 15 complications encountered in 40 patients. There were no neurovascular intraoperative complications and none had a neurovascular deficit or compartment syndrome. The most common complication was pin-track infection, particularly in the distal segment as a result of severe osteopenia and poor soft tissue. Pin-tract infection occurred in 22 patients. 19 of them responded well to local care, and in three patients, the wires had to be removed and reinserted under local anesthesia. Noteworthy pain, demanding analgesia was felt in patients during the distraction phase. 20 patients had limping and knee stiffness. One patient had inequality of >2 cm and femoral bowing of 18. Three patients had femoral refracture which occurred 2 months, 3 months, and 2½ months, respectively, after removal of the external fixator, which was treated by reapplication of the Ilizarov frame for 3 months more.

DISCUSSION

Infective non-union is one of the late complications of femoral shaft fractures which makes routine management methods inefficient and needs several operations and long-term treatment. The results of conventional treatment are unfortunate and due to high-velocity primary trauma, multiple surgeries, late presentation, bone and soft tissue infection, non-union, bone loss, osteoporosis, dystrophy, poor vascularity, associated deformities, and limb shortening.[1] In our research, the treatment options of patients diagnosed with infective non-union of the femoral shaft were suppression of infection and bony union. Biologic methods of treatment like Ilizarov that augments the injured site circulation and osteogenesis are the ideal methods of treatment in these injuries. The primary objective of the Ilizarov technique was to eliminate infection by increasing blood supply of the core of the infective bone through biological stimulation of a corticotomy. Mechanically, the Ilizarov frame construct is very defiant to torsion and bending but allows axial compression during regular day-to-day activities. The functional results depend mainly on the prevailing damage of nerves, muscles, vessels, joints, and, to a lesser extent, bones. Patients presented had multiple prior surgeries with major damage to vessels, nerves, muscles, joints, and bone and already had developed a variable amount of joint stiffness. In this study, 32 (80%) and 22 (56%) patients had an excellent union and functional results, respectively, 8 patients (21%) had fair union rates, and 10 patients (25%) had good function. 8 patients (20%) had a good range of functional movements. A total of 15 complications occurred. Complications are inherent to the Ilizarov technique, but their occurrence and severity diminish with practice. The results of this study are consistent with the following studies: Manish *et al.* reported on 25 patients. The results were as follows: Bone results were excellent in 13, good in one, and poor in 11 patients. Functional results were excellent in six patients, good in nine, fair in four, and poor in six patients. A total of 72 complications occurred (2.88 complications per patient). Union was achieved in all except two patients.[8] Saridia *et al.* reported on 13 patients and reported bone union and elimination of infection in all 13 patients. On the other hand, functional results were as follows: Eight patients had excellent, four patients had good, and one patient had fair functional results.[9] Urazgildeev and Roskidailo have recently published the results on 30 patients with infective non-union of the femur with an infection eradication rate of 95.9%.[10] Menon *et al.* in a study with similar results to this study concluded that there was a role for the use of the Ilizarov fixator in resistant long bone diaphyseal non-union treatment. These studies exemplify the applicability of the Ilizarov method in the treatment of infective non-unions.[11]

CONCLUSION

Ilizarov procedure is a novel salvage surgical procedure for infective non-union of the femur. Infective non-union treated by Ilizarov yielded good functional results and no major post-operative complications like joint stiffness. The results when compared to other types of treatment were better. The patient complaints were cosmetic appearance and weight of ring fixator.

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