Use of the Ilizarov Method in the treatment of Nonunions, Infected nonunions, Infected nonunions with bone defects, malunions, infected malunions, infected /open fractures of the femur.

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We present a series of 33 patients with various complications of femoral fractures involving 34 limb segments (1 bilateral) treated by the Ilizarov method at the Pakistan Society for the Rehabilitation of the disabled Orthopaedic Hospital, Sir Ganga Ram Hospital and Services Hospital Lahore From July 1996 to January 2001. At the time of writing 3 patients had been lost to follow-up (9.1%), and 4 had not completed treatment (12.1%) and were excluded from the study. Of the remaining 26(78.8%) there were 20 males (76.9%) and 6 females (23.1%). The mean age was 28.1±15.6 years (±1 sd, Range 4-60 years) the indications for surgery were infected nonunions of the femur 8 (29.6%), infected femoral nonunions with bone defects 7 (25.9%), infected/open femoral fractures 6(22.2%), femoral malunions with or without shortening 4(14.8%), non-infected nonunions of the femur 2 (7.4%). Treatment was successful in 25 cases (92.6%) and failed (failure of healing) in 2 (7.4%). The mean time to fixator removal was 305.4 ± 164.4 days (mean ± 1sd, Range 59 to 637 days) or approximately 10.2 months. According to Paley's criteria for the assessment of bone results we achieved 15 excellent (55.6%), 8 good (29.6%), and 2 fair (7.4%) with 2 failures (7.4%). 20/27 cases had 31 problems, obstacles and complications. 20/27 (74.1%) cases had one or more episodes of Grade I or II pin track infections. There were 3 cases of saphenous nerve irritation leading to pain and paraesthesiae. There was one case of multiple half-pin loosening, which required revision. 8 cases (29.6%) developed significant knee stiffness. One case with a distal femoral infected malunion underwent spontaneous bony ankylosis of the knee during treatment. In two cases (7.4%) there was pin track osteomyelitis, which settled following curettage. 2 cases (7.4%) refractured and were considered failures because up to the time of writing they had not agreed to further treatment. We feel that with attention to detail and patience on the part of both surgeon and patient excellent results can be obtained with this technique in patients with complications following femoral fractures.

Key words: Ilizarov femur, complications

In Pakistan fractures are often treated operatively in poorly equipped hospitals without facilities for adequate sterilization and asepsis. As a consequence complications of fractures such as nonunions, infected nonunions, infected nonunions with bone defects, infected and noninfected malunions, and infected open fractures are not uncommonly encountered in the outpatients departments of all the large hospitals in the major cities. Noninfected nonunions of the femur may be treated by intramedullary nailing[1], or other forms of internal fixation[2] in which the main aim is to provide mechanical stability. An atrophic or non-vital nonunion may, in addition require a biological stimulus such as a bone graft[3]. These methods are however limited in their ability to deal with infection, segmental bone loss or shortening.

The Ilizarov method relies on distraction neohistogenesis and can be used not only for the treatment of segmental defects but also to correct malalignment with minimal surgery and to overcome shortening [4,5,6].We wish to present our experience using the Ilizarov method with a circular fixator in the treatment of nonunions, malunions and open fractures of the femoral diaphysis.

Materials and Methods

From July 1996 to January 2001, 33 patients with various complications of femoral fractures involving 34 limb segments (1 bilateral) were treated at the Pakistan Society for the Rehabilitation of the disabled Orthopaedic Hospital, Sir Ganga Ram Hospital and Services Hospital Lahore.

At the time of writing 3 patients had been lost to follow-up (9.1%), and 4 had not completed treatment (12.1%) and were excluded from the study. Of the remaining 26 (78.8%) there were 20 males (76.9%) and 6 females (23.1%). The mean age was 28.1 ± 15.6 years (± 1 sd, Range 4-60 years)

In the 27 limb segments reviewed, the indications for surgery were infected nonunions of the femur 8 (29.6%), infected femoral nonunions with bone defects 7 (25.9%), infected/open femoral fractures 6(22.2%), femoral malunions with or without shortening 4(14.8%), non-infected nonunions of the femur 2 (7.4%) (Table 1.). These patients had undergone 1.23 ± 1.30 (mean ± 1sd) previous surgical procedures (including internal fixation, curettage/debridement and monolateral external fixation) with a range from 0 to 4. Only 2 (7.7%) had been treated by traditional bonesetters.

All nonunions were treated by surgical resection of the nonunion to ensure contact between bleeding bone ends. In the presence of infection all infected bone and soft tissues were radically excised and the wounds left to heal by second intention..

Table 1. Aetiology (n=27)

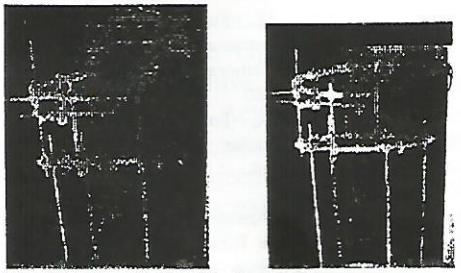
Diagnosis	No.
Infected nonunion femur	8
Infected nonunion with bone defect femur	7
Infected/open fractures	6
Malunion±shortening	4
Nonunion femur	2

Osteosynthesis was carried out with hybrid circular frames using 5mm Schanz screws for the proximal femoral fixation in order to avoid the risks associated with transfixing wires in this situation. In no case was the frame extended beyond the knee. At presentation or after radical bone debridement 17/27 limb segments had shortening or bone defects ranging from 2 to 17.5cm (Mean = 5.9 ± 4.3cm). Bone lengthening was carried out at low energy osteotomies carried out either in the proximal or distal part of the femur at a rate of 1mm/d in two 0.5mm increments.

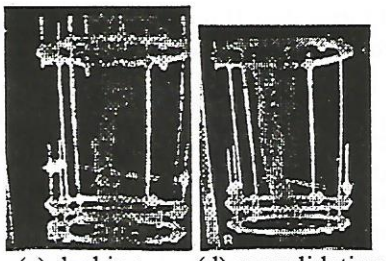
Treatment was monofocal (compression or lengthening) in 21 cases (77.8%) and bifocal in 6 (22.2%). In the bifocal cases 1 patient underwent internal bone transport using internal traction wires and 5 underwent simultaneous compression- distraction.

Patients were allowed to commence mobilization with two crutches as soon as pain allowed but weight bearing was only commenced after completion of the distraction/ transport phase. Patients were taught their own exercises because physiotherapy facilities are not integrated with the surgical services even in most teaching hospitals in Pakistan ans, as such, are not readily available. Since a large number of patients (14/26) were not residents of Lahore they were discharged from hospital only after they had learnt to manipulate the fixator and care for their pin tracks. They were then followed up at regular intervals until completion of treatment. Fixator removal was carried out by staged destabilization and progressively increasing weight bearing until radiographic confirmation of nonunion healing and/or regenerate consolidation.

Fig1 Bone transport in a case of infected nonunion with bone defect



(a)low energy osteotomy (b) during transport



(c) docking (d) consolidation

Results

Treatment was successful in 25 cases (92.6%) and failed (failure of healing) in 2 (7.4%). The mean time to fixator removal was 305.4 ± 164.4 days (mean ± 1sd, Range 59 to 637 days) or approximately 10.2 months.

Union: Union was achieved successfully in 25/27 limb segments (92.6%). One case that failed was a 40-year-old male who presented with a closed fracture of the distal third of the femoral diaphysis. He was an ideal candidate for an interlocking nail but could not afford this implant. It was decided by the senior author to use an Ilizarov construct for Osteosynthesis. He developed a stiff knee during treatment and following removal of the frame after apparent radiologic healing of the fracture, during range of motion exercises at home sustained a refracture.

The second case was that of a 55-year-old man who presented with an atrophic infected nonunion of the mid-diaphysis of the femur after two unsuccessful attempts at plate Osteosynthesis. There were multiple broken screws throughout the femur and at the time of surgery the bone ends were particularly sclerotic. During the month after fixator removal he started complaining of progressively increasing pain and gradually refractured at the nonunion site. He has a persistent infected nonunion and is currently not willing to consider any further intervention.

Infection: 15 limb segments (55.6%) had infection at presentation. Of these infection was eradicated in 12/15 (80%) and persisted in 3 (20%). One patient with an open segmental femoral fracture treated by Ilizarov external fixation developed osteomyelitis despite healing and this has so far failed to settle despite two curettages.

Alignment: At the end of treatment in no case was there a residual malalignment in excess of 7 degrees.

Length: At presentation or after radical bone debridement for infection shortening or bone defects were present in 17 limb segments (63%). After treatment only 5 (18.5%) limbs had shortening in excess of 2.5cm. The mean shortening at the end of treatment was 3.7 ± 1.0cm (mean ± 1sd, Range 3 to 5cm). In all 5 cases this was deliberate in order to reduce the complexity and duration of treatment.

According to Paley's criteria for the assessment of bone results we achieved 15 excellent (55.6%), 8 good (29.6%), and 2 fair (7.4%) with 2 failures (7.4%).

Complications:

20/27 cases had 31 Problems, Obstacles and Complications [7]. 20/27 (74.1%) cases had one or more

episodes of Grade I or II (erythema, serous discharge) pin track infections the majority of which settled with increased pin track care and short courses of oral antibiotics. There were 3 cases of saphenous nerve irritation leading to pain and paraesthesiae associated with one of the distal wires just above the knee. All three settled following removal of the offending wire. There was one case of multiple half-pin loosening, which required revision. 8 cases (29.6%) developed significant knee stiffness. One case with a distal femoral infected malunion underwent spontaneous bony ankylosis during treatment. In two cases (7.4%) there was pin track osteomyelitis, which settled following curettage. 2 cases (7.4%) refractured and were considered failures because up to the time of writing they had not agreed to further treatment. There were no cases of poor regenerate or pseudocyst formation, wire breakage, fixator component breakage, major neurovascular injury, malunion, or psychological disturbances. All patients at one time or another required oral analgesics for pain and discomfort.

Discussion

Few studies in the literature have dealt with the treatment of complications of femoral fractures using the Ilizarov method. Ilizarov limb reconstruction is a complex and demanding technique for surgeon and patient alike. The bulk of soft tissues around the femur makes this a difficult bone to treat by external fixation. Transfixation of tissues leads to more pain and discomfort during treatment and to restriction of motion at the knee. Repeated trauma to soft tissues during joint motion leads to greater pin track problems.

The results in our series (92.6% success) are equivalent to results reported in the literature despite the fact that the majority of the results reported in the literature include femoral and tibial applications[8].

Treatment time in the present series is prolonged (10.2 months) but this is remarkably similar to results reported in the literature[9]. As a direct consequence of this prolonged treatment time and the absence of support services such as specialist trainees, nurses, psychologists and physiotherapists follow-up placed great additional demands on the surgeon's time.

There have been recommendations in the literature for femoral lengthening and bone transport over intramedullary nails, which can be locked following completion of distraction or transport thereby shortening time in external fixation[10]. But we have no experience with this technique and due to the possible risk of extension of pin track infection to involve the implant we feel that in our circumstances traditional Ilizarov treatment is the safest option.

74.1% of our cases had one or more episodes of pin track infection but in only 2 cases did they lead to pin track osteomyelitis. Minor pin track infections, which do not require surgical intervention, are a part of prolonged external fixation and as long as the patient is warned about the early signs (persistent pain, redness) and is instructed in methods of dealing with them, do not seriously hamper the successful completion of treatment.

A great deal has been published in the literature about the importance of physiotherapy in order to maintain knee motion during treatment and to help in its recovery after its completion. Unfortunately in Pakistan physiotherapy services integrated with surgical services are virtually nonexistent which probably accounts for the high rate of permanent knee stiffness (29.6%) in this series. The deleterious effects of distraction on articular cartilage of the knee have been demonstrated in animals[11] and may explain the single case of spontaneous bony ankylosis of the knee in our series, though the adjoining metaphyseal osteomyelitis may have had a part to play.

In conclusion we feel that with attention to detail and patience on the part of both surgeon and patient excellent results can be obtained with this technique in patients with complications following femoral fractures. We do however suggest that surgeons trained in its use in order to keep the complication rate within internationally acceptable limits use this technique.

References

1. Frost H.M. The biology of fracture healing an overview for clinicians. Part II. Clin. Orthop. , 1989; 248:294-309.
2. Kempf I., Grosse A., Rigaut P. The treatment of noninfected pseudoarthrosis of the femur and tibia with locked intramedullary nailing. Clin. Orthop. , 1986; 212:142-154.
3. Muller M.E., Thomas R.J. Treatment of nonunion in fractures of long bones. Clin. Orthop. , 1979; 138:141-153.
4. Cattaneo R., Catagni M., Johnson E.E. The treatment of infected nonunions and segmental defects of the tibia by the methods of Ilizarov. Clin. Orthop. , 1992; 280:143-152.
5. Paley D., Chaudhray M., Pirone A.M., Lentz P., Kautz D. Treatment of malunions and malnonunions of the femur and tibia by detailed preoperative planning and the Ilizarov techniques. Orthop. Clin. North Am., 1990; 21:667-691.
6. Ilizarov G.A. Clinical applications of the tension stress effect for limb lengthening. Clin. Orthop. , 1990; 250:8-26.
7. Paley D. Problems, obstacles, and complications of limb lengthening by the Ilizarov technique. Clin Orthop 1990 Jan; 250: 81-104
8. Garcia-Cimbrelo E, Olsen B, Ruiz-Yague M, Fernandez-Baillo N, Munuera- Martinez L. Ilizarov technique. Results and difficulties. Clin Orthop 1992 Oct;(283):116-23
   Polyzois D, Papachristou G, Kotsiopoulos K, Plessas S.Treatment of tibial and femoral bone loss by distraction osteogenesis. Experience in 28 infected and 14 clean cases. Acta Orthop Scand Suppl 1997 Oct;275:84-842
9. Paley D, Herzenberg JE, Paremain G, Bhave A. Femoral lengthening over an intramedullary nail. A matched-case comparison with Ilizarov femoral lengthening. J Bone Joint Surg Am 1997 Oct;79(10):1464-80
10. Stanitski DF, Rossman K, Torosian M.The effect of femoral lengthening on knee articular cartilage: the role of apparatus extension across the joint. : J Pediatr Orthop 1996 Mar-Apr;16(2):151-4
11. Velazquez RJ, Bell DF, Armstrong PF, Babyn P, Tibshirani R. Complications of use of the Ilizarov technique in the correction of limb deformities in children. J Bone Joint Surg Am 1993 Aug;75(8):1148-56