Tibial Lengthening using the classic Ilizarov Technique

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Citation

R Rose. *Tibial Lengthening using the classic Ilizarov Technique*. The Internet Journal of Orthopedic Surgery. 2009 Volume 16 Number 1.

Abstract

Objective: To evaluate the results of tibial lengthening using the classic Ilizarov technique.Method: A retrospective study was performed between June 2005 and August 2009 on six patients who underwent tibial lengthening using the Ilizarov distraction technique.Results: Of the six patients, four were males and two were females. Mean age was 17 years (range 8 – 43 years). Mean tibial length gain was 4.9cm (range 3 – 9cm). Mean time in the frame was 9 months (range 7 – 11 months). The complications were: six superficial pin tract infections, four axial deviations, two residual leg length discrepancies, on delayed union, and one equinus contracture.Conclusion: Tibial lengthening can be successfully achieved by the conventional Ilizarov technique. However, this method is time-consuming, and is associated with many complications.

INTRODUCTION

The use of the Ilizarov method has markedly improved the short-term results and reduced the frequency of complications (1). However, the complication rates are still high (2, 3). The conventional Ilizarov technique for tibial lengthening is frequently time consuming, interferes with activities of daily living and is associated with many complications. The technique of tibial lengthening over an intramedullary nail has gained wide acceptance because of the improvements in patient comfort it offers and the reduction in complications (4, 5, 6, 7).

The author reviews his results of tibial lengthening using the classic Ilizarov technique.

SUBJECTS AND METHODS

This restrospective study was performed between June 2005 and August 2009. Six patients underwent a tibial lengthening procedure involving the use of the Ilizarov distraction technique. The conventional Ilizarov technique was used; no intramedullary device was inserted during the distraction phase or during the consolidation phase. The aetiologies of the leg length discrepancy (LLD) and each patient's demographics are listed in Table 1.

Figure 1

Table 1: Patient Date

Case	Age (years) Gender	Indications for Lengthening	Pre-operative LLD (cm)	Final length gained
1	43/M	Growth arrest postinfection	5	5
2	12/M	Congenital short tibia with fibula hemimelia Marked fixed equinus	9	9
3	18/M	Congenital pseudarthrosis	6	5.5
4	8/F	Blount's disease	3	3
5	8/M	Recurrent Blount's disease	6	3
6	15/F	LLD at birth	4.3	4

LLD (leg length discrepancy)

A corticotomy was performed using a gigli saw at the proximal metaphyseal-diaphyseal junction in four tibiae (Case 1, 2, 3, 6). A corticotomy was performed in the other two cases (Cases 4, 5) at the distal metaphyseal-diaphyseal junction. In Cases 4, 5, acute corrections of the angular deformities at the proximal tibiae were performed and the osteotomy sites were compressed acutely with the Ilizarov fixator. Gradual lengthening was then performed at the distal metaphyseal-diaphyseal corticotomy sites. In Case 3, the pseudarthrosis site was excised and gradually compressed.

Lengthening was achieved following corticotomy at the proximal metaphyseal-diaphyseal junction. In all cases lengthening was started in increments of 0.25mm twice per day on day 10 post-operatively. The rate of distraction was increased to 0.25mm every six hours at the second week post-operatively. Lengthening was continued at this rate until the desired correction had been achieved. The rate of distraction was adjusted to ensure that regenerate bone formation was not accompanied by premature union or delayed union. The regenerate bone was assessed weekly by plain radiographs.

Prior to lengthening of the tibia in Case 2, the congenital equinus deformity was corrected by osteotomizing the talus and lengthening of the Achilles tendon. The Ilizarov fixator was extended across the ankle joint to maintain a plantigrade position of the foot.

Angular deviations (valgus and procurvatum) developed during distractions in Cases 1, 2, 3, 5. Overlengthening on the sides of the deviations was performed in an attempt to restore the mechanical axes in Cases 1, 3, 5. In Case 2, the deformity was recognized too late.

Physical therapy to the ankles was commenced in hospital. Upon discharge, each patient was strongly encouraged to continue active and passive movement of the ankle. Following removal of the fixator, home therapy was continued until no further improvement in range of motion was noted.

RESULTS

Of the six patients, four were males and two were females with a mean age of 17 years (range 8 – 43 years). Mean tibial length gain by the six patients was 4.9 cm (range 3 – 9cm). Mean time in the Ilizarov fixator was 9 months (range 7 – 11 months). Mean lengthening index was 2.3 months/cm (range 0.8 to 4.6 months/cm). Complications were classified into minor and major complications.

Figure 2

Table 2 Patient Data

Case	Time in fixator	Lengthening index (mths/cm)	Follow-up (mths)	Complications	
				Minor	Major
1	11	2.2	12	Pin site infection Axial deviation < 5°	Equinus
2	7	0.8	24	Pin site infection Knee contracture	Axial deviation > 9° Residual LLD procurvatum
3	11	2	6	Pin site infection Equinus contracture Axial deviation < 5° Procurvatum	-
4	9	3	6	Pin site infection	-
5	9	4.6	12	Pin site infection Axial deviation < 5°	Delayed union residual LLD
6	7	1.7	6	Pin site infection equinus	-

Mths (months), LLD (leg length discrepancy)

A minor complication was defined as a complication which did not affect outcome or require extensive intervention. A major complication was a complication which affected the patient□s quality of life and required intervention. All patients developed pin site infections and these were successfully treated with oral antibiotics and local pin site care. Four patients developed axial deviations as a result of the lengthening (Cases 1, 2, 3, 5). Cases 1, 3, 5 had residual axial deviations, each < 5□. Case 2 had a valgus angulation > 9□ and procurvatum > 7□. Corrective osteotomy was performed on this patient (Case 2). Three patients developed equinus contractures during the lengthening process (Case 1, 3, 6). Following removal of the frame and physical therapy, the equinus contractures were corrected in Cases 3 and 6. The equinus contracture persisted in one patient (Case 1). This patient refused surgery and opted to wear a shoe with a heel raise. Lengthening was discontinued after 3cm in Case 5, due to poor regenerate bone formation. The regenerate bone eventually healed after nine months in the Ilizarov frame and five months in a cast. Equal leg length was achieved in Case 2. However, due to the continued normal growth in the unaffected lower limb, there was a 2cm LLD at the last follow-up visit. This patient has refused further surgery.

DISCUSSION

The conventional Ilizarov technique for tibial lengthening is frequently time-consuming, and is associated with many

complications such as pin-tract infection, angulation, post-operative scar, delayed union and stiffness of the ankle (2, 8). Moreover, if the external fixator is removed too soon, the regenerate may fracture, resulting in one or more of the following complications: deformity, shortening, and nonunion (9). The six patients in this study developed the following complications as a result of tibial lengthening: six superficial pin-tract infections, four axial deviations, one delayed union, two residual LLD and a residual equinus contracture.

Paley (8) discussed methods to prevent or minimize the complications of leg lengthening.

The primary preventive measures against equinus contractures include physical therapy, splinting, and extension of the tibial frame across the ankle joint. It has been shown that stretching exercises do not lead to prevention of contracture unless they can be maintained for at least six hours per day. Most patients would probably not exercise their muscles to that extent. The Dynasplint system which was devised by Paley (8) allows the patient to flex the ankle actively in order to relieve the discomfort which a fixed ankle-foot-orthosis would have caused. When the patient relaxes the foot, the splint take over and passively, gently extends the joint. Angin et al (10) reported good results with the use of an orthosis developed in Dokuz Eyl□l University. The device is attached to the distal ring of the Ilizarov to keep the ankle joint in a neutral position and prevent equinus during tibial lengthening. It is recommended that for tibial lengthening > 6cm, the foot should be fixed to the Ilizarov frame by wires, a foot plate and rods.

In this study, only one patient had a residual equinus contracture and the final length gained was 5cm. This patient refused lengthening of the Achilles tendon to restore a plantigrade foot.

During lengthening at the proximal tibia, there is a tendency for valgus and procurvatum deformities, and in distal tibial lengthening, there is the likelihood of a varus and procurvatum deformity. These deformities maybe caused by imbalance between muscle forces on different sides of the bone or instability due to an inadequate construct (loss of tension in the pins, or loosening of the pins) (8). Positioning of the proximal ring into varus and recurvatum can be used to prevent these axial deviations. Overlengthening on the side of the deviation or modification of the frame to include a hinge is used to correct angular deformities. In this study, four patients developed axial deviations. Overlengthening on the deviated sides reduced the angular deformities in three patients (Cases 1, 3, 5). Following removal of the fixators, the axial deviations in each patient was < 5□. No treatment was therefore necessary. The axial deviation in Case 2 was greater than 9□ of valgus and 7□ of procurvatum. Corrective osteotomy was therefore necessary.

Delayed consolidation is a troublesome complication because it may lead to prolonged time in the fixator and creates a higher risk of regenerate bone fracture or bending. Poor regenerate bone may result from too short a latency period, too rapid distraction, instability, or poor local blood supply (1). One patient (Case 5) developed a delayed union and this eventually healed after the limb was immobilized in a cast for five months. The Ilizarov frame was removed after nine months.

In this study, there were no neuro-vascular injuries, no refracture, and no osteomyelitis.

Several months of external fixation are generally required in any leg lengthening technique, and complications are very common with long-term placement of external fixators (2, 3, 11). Paley (8) first described a technique of bone lengthening over an intramedullary nail to provide a more comfortable lengthening process, shorten the external fixator time, and support regenerated bone internally. Since then, this technique has gained wider acceptance because of the improvements in patient comfort it offers (4). However, Kristiansen et al (13) abandoned this technique and returned to the classic Ilizarov method because of a high rate of serious complications in patients treated by tibial lengthening over an intramedullary nail. More recent articles on tibial lengthening have shown that a combination of intramedullary nailing and external fixation produces callus formation as good as that obtained by the standard Ilizarov method of lengthening. In addition, the combined procedure decreases the external fixation time and is associated with fewer complications (5, 6, 7).

Tibial lengthening can be successfully performed by the conventional Ilizarov technique. Good judgment, thorough appreciation of the basic principles of the Ilizarov apparatus, meticulous technique and careful follow-up are necessary to minimize the potential complications.

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