SHORT ARTICLE

Femoral Lengthening by Ilizarov Technique: Results and Complications

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Abstract

Femoral lengthening using Ilizarov technique was performed in ten patients comprising of 6 females and 4 males in an age group of 10-19 years with an average shortening of 6.8 cms. The etiology of shortening was post-infective in 8 patients and post-traumatic in two patients. The desired length was achieved in six patients and in four patients the final limb length discrepancy ranged between 1 to 3 cms. The total duration of external fixation ranged from 24 weeks to 90 weeks with an average healing index of 6.23 weeks/cm. There were 10 problems and 2 true complications. Temporary decrease in knee range of motion was a common difficulty encountered during lengthening. Results were rated as excellent in five, good in two, fair in two and poor in one patient.

Key words

Ilizarov Technique, Femoral lengthening

Introduction

The earliest limb lengthening technique dates back to 1905 when Codivila1 of Bologna published his experience of lower limb lengthening by acute distraction through calcaneal nail after an osteotomy of femur (1). Since then the technique saw many modifications with regard to the apparatuses used for distraction (2-5), the types of osteotomies (6) and the methods used for maintenance of bony alignment during lengthening (7, 8). The importance of preservation of periosteum (9, 10) and a period of latency (2) before distraction, was soon recognized. Despite many modifications in the apparatuses and the techniques of lengthening, the rate of complications remained high (11). In 1970's Wagner's technique became the method of choice for limb lengthening in the western world. The technique however has the problems of a long hospital stay, multiple surgical interventions and a higher complication rate (12, 13). At the same time when modifications in the techniques of limb lengthening were going on in the West, Ilizarov had been working on the principle of distraction osteogenesis using ring fixator, in the remote area of Kurgan, Siberia. The introduction of tension stress effect by Ilizarov provided a major breakthrough in limb lengthening (14). In 1972, he published his remarkable experience with femoral lengthening at a significantly lower complication rate (15). For the last two decades Ilizarov technique has been widely used all over the world for limb lengthening. While tibial lengthening with this technique has yielded excellent results (16-18), the complication rate is relatively higher in the femoral lengthening (19, 20), owing to the peculiarity of femur with regard to the disparity between anatomical and mechanical axis and the influence of large muscle groups on the adjacent joints during lengthening. The purpose of this study was to assess results and complications of femoral lengthening by Ilizarov technique in our patients.

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Material and Methods

Ten patients operated for femoral lengthening by Ilizarov technique at the hospital for Bone and Joint Surgery, Srinagar, between 1997 and 2001 were included in the study (Table 1). The study group included 6 females and 4 males in an age group of 10 to 19 years (mean 15 Years). The patients were followed up for a period ranging from 2 to 6 years (mean 3.8 years). Shortening was due to infection in 8 patients and as a result of trauma in two patients. The average shortening was 6.8 cms (range 4-13 cms). Five patients in addition to shortening had abnormal ipsilateral knee or hip joint due to septic arthritis. Two patients had undergone pelvic support osteotomy for septic arthritis of the hip and in one patient the pelvic support osteotomy was performed simultaneously with lengthening, by Ilizarov technique.

Table 1: Shows displaced extension type supracondylar fracture of the humerus.

S.No.	Age	Sex	Etiology	Previous Surgery
1	17	M	Tom Smith Hip	Previous surgery
2	10	M	*COM femur, healed path fracture	Incision drainage & Spica
3	12	F	*COM femur, healed path fracture	Incision drainage & Spica
4	14	F	*COM femur	Sequestrectomy
5	19	F	Post septic hip	Pelvic support osteotomy
6	17	F	Epiphyseal arrest distal femur	Nil
7	13	F	Post osteomyelitic shortening with dislocation hip	Incision drainage
8	14	F	Septic hip	Arthrotomy
9	19	M	Multifocal osteomyelitis, shortening tibia, femur	Tibial lengthening
10	19	M	Open# femur with bone loss	External fixation

*COM = Chronic Osteomyelitis

The ring fixator was constructed one day prior to surgery to decrease the operation time. We used the Italian modification of the technique to avoid transfixing wires in the proximal femur (21). The pre-construct consisted of a distal block consisting of a 5/8th ring and a full ring of appropriate size. An Italian arch was used for the proximal femur and connected by oblique posts to an intermediate full ring. This full ring was in turn connected to the distal block by hinged rods.

Surgery was performed under general/epidural anesthesia. The fixation of the ring fixator was started form the distal 5/8th ring. The ring was fixed to the distal femur at least 2 cms away form the joint line and perpendicular to the mechanical axis. The pre-assembled frame was then constructed over this distal wire. The distal block was connected to the intermediate ring by hinges to place the proximal assembly in anatomical axis. Next the proximal arch was fixed at the sub-trochantric level by two half pins, one from anterior to posterior direction and the other from medial to lateral in such a way as to place the pins, one superior and other inferior to the arch. A third half pin was used at a distance from the arch using fixation clamp. No wires were used in the intermediate ring. Corticotomy was performed at the distal metaphysis using 10 mm osteotome through an anterio-lateral incision. Corticotomy was completed by externally rotating the distal block. In one patient, corticotomy was performed at the sub-trochantric level. The hinges were replaced by graduated telescopic rods so that lengthening would start in slight varus. Modification was made for simultaneous pelvic support osteotomy in one patient. In this patient, osteotomy around hip was performed at the same time as lengthening. Distraction was started at an average on 7th day of surgery at the rate of 0.25 mm four times a day. The rate of distraction was adjusted according to the quality of the regenerate and was continued till the desired length was achieved. The patients were encouraged to do active physiotherapy and bear weight as per tolerance. Patients were initially followed every week till the lengthening was completed and thereafter every three weeks till the consolidation of the regenerate. After the lengthening was completed, the fixator was left in place till the consolidation of the regenerate. Fixator was removed when at least three cortices were visible on the x ray. The fixator was removed as an OPD procedure and a protective toe to groin cast was applied for a period of two weeks. The results of the technique were evaluated by a scoring system modified from Dror Paley *et al* (17, 22) as shown in Table 2. The score was modified as many patients in the study group had abnormal hip or knee joint.

Table 2: Assessment of Results

Additions	20 Points	15 Points	10 Points	0 Points
Length achieved	Within 1 cm. of goal	Within 3 cm. of goal	Within 5 cm. of goal	Discrepancy >5 cm.
Range of motion Hip	Same as pre-op	75% of Pre-op	50% of Pre-op	<50% of Pre-op
Range of motion Knee	Same as pre-op	75% of Pre-op	50% of Pre-op	<50% of Pre-op
Change in gait	0,1 to 0	1, 2 to 1	0 to 1 or 1, 2 to 2	0 to 2
Healing index	4-5 Wks/cm	5-6 Wks/cm	6-7 Wks/cm	> 7 Wks/cm
Subtractions				
Any major complication			-20	
Any minor complication			-10	
Any additional surgical intervention performed			-5	
Final Score				
90-100	Excellent			
75-89	Good			
50-74	Fair			
<50	Poor			

Legends: 0 - No limp, 1 - Mild limp, 2 - Moderate limp

Results

Desired length was achieved in 6 patients. In rest of the patients the final limb length discrepancy ranged between 1 to 3 cms. The length achieved ranged between 4 and 11 cms (mean 6.1 cms) and the total duration of fixation ranged between 24 wks to 90 weeks with an average of 38.9 wks. The healing index ranged between 3.27 wks/cm to 9 wks/cm (mean 6.23wks/cm). Results were rated as excellent in five, good in two, fair in two and poor in one patient (Table 3).

Complications

One patient developed regenerate fracture after the removal of fixator, with two cm loss of length, which was managed by skeletal traction and spica cast. This patient however developed stiff knee at the end of treatment. Derangement in the knee range of motion was the commonest complication. In six patients the knee range of motion decreased from the pre-operative level. In five of these patients, this however improved after fixator removal but in one patient the loss of range of motion persisted even after the fixator removal. Pin tract infection was seen in two patients, which needed only antibiotics and dressings. One patient had a delayed consolidation. This patient achieved a length of 10 cms and needed 2 years of fixation by the ring fixator. There were no non-unions, no dislocations and no neuro-vascular complications. According to Paley's classification (23) there were10 problems, and two true complications.

Table 3: Results of lengthening.

S.N.	LLD (Cm) Pre-op	LLD (Cm) Post-op	Length Achieved (Cm)	Gait Pre-op	Gait Post op	Fixation Time Wks.	Healing Index Wks./cm	Score 100	Result	Follow-up Years
1	7	2	5	2	2	30	6	30	Poor	6
2	12	1	11	2	0	36	3.27	95	Good	5
3	5.5	0	5.5	2	0	33	6	95	Excellent	5
4	6	0	6	2	0	38	6.3	95	Excellent	5
5	7	1.5	6	2	1	36	6.5	50	Fair	4
6	4	0	4	1	0	34	5.23	95	Excellent	4
7	13	3	10	2	1	90	9	65	Fair	3
8	6	0	6	2	0	36	6	90	Excellent	2
9	4	0	4	2	0	24	6	100	Excellent	2
10	4	0	4	2	1	32	8	80	Good	2

LLD - Limb length discrepancy

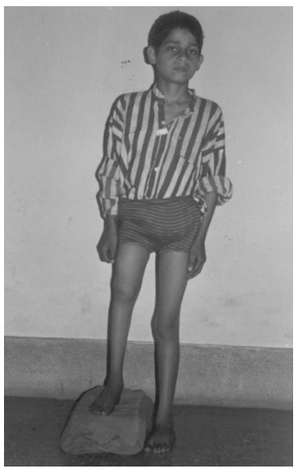

Fig. 1. Photograph showing shortening of right lower limb.

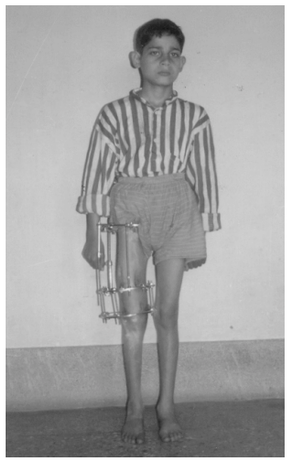

Fig. 2. Length equalized by Ilizarov technique

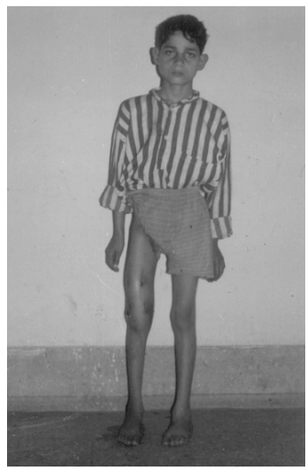

Fig. 3. Photograph showing the final result

Fig. 4. Pre-operative X-Ray showing shortening of right femur

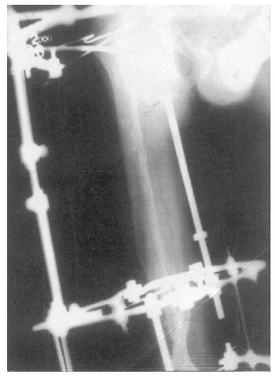

Fig. 5. X-Ray showing femoral lengthening

Discussion

The average length of 6.1 cm at a healing index of 6.23wks/cm is consistent with other studies (24, 25). Though the results were satisfactory in our studies yet the difficulties encountered during lengthening were also frequent. Temporary loss of knee range of motion during lengthening was a constant feature in our patients. This was seen more in patients who had a lengthening greater than 5 cms. However, only two patients persisted with a significant loss of knee range of motion at the end of treatment, while in the rest, the pre-operative range of motion was regained. Numerous studies have reported similar experience. Herzenberg *et al* (24) reported a decrease in flexion of the knee during lengthening to an average minimum of 37^0+15^0, which improved to 69^0+28^0 towards the end of consolidation phase and a mean final flexion of 122^0+23^0 was recorded against the mean pre-operative value of 127^0+16^0. The authors concluded that there was no correlation between the worst flexion during lengthening and the final range of motion. Maffulli *et al* drew similar conclusions in their series of 46 patients undergoing tibial or femoral lengthening (19). Barker *et al* observed the pattern of recovery of knee range of motion in 35 patients undergoing lengthening and found that 88% of knee flexion was regained by 6 months, 92 % in 12 months and 97% by 18 months (26). Modification of technique for pin placement has been shown to decrease the knee flexion loss during femoral lengthening (27).

There was one regenerate fracture in our series. Danziger *et al* reported 9 fractures in their series of 18 femoral lengthening (28). They recommended concomitant tibial and femoral lengthening in cases of substantial lengthening. Two patients in our series achieved lengthening greater than 10 cm. One of these patients had delayed consolidation at a healing index of 2.1 months/cm. Long periods of consolidation and increased complications have been reported with substantial lengthening (29). In order to avoid the long period of external fixation during consolidation phase, Paley *et al* performed femoral lengthening over an intramedullary nail with better results (22). Early reports of lengthening over self-lengthening nails have shown promising results (30, 31). However, most of the patients in our series resulted from infective pathology with abnormal hip or knee joint. Ilizarov technique in these patients presented satisfactory results. The correction of multi-planer deformities in addition to lengthening is a definite advantage of Ilizarov technique in such patients.

Satisfactory results can be achieved by relentless postoperative care and dedicated physiotherapy to avoid the problems of knee range of motion, the common difficulty in femoral lengthening. Early results with self-lengthening nails reveal definite advantages in terms of better patient compliance, avoidance of cumbersome external fixator, and protection against regenerate fractures. Ilizarov technique however will still hold the place in management of shortenings as a result of infections with multiple deformities.

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