Ilizarov treatment of severe type I fixed flexion deformities of the knee joint

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Received 7 May 2018
Accepted 20 May 2018

The Egyptian Orthopaedic Journal
2018, 53:21–25

Background
Two types of flexion contracture of the knee can be distinguished: the one associated with joint destruction and ankylosis, and the other in which joint anatomy and mobility are preserved.
In the first type, the aim of treatment is to obtain an ankylosed knee in a functional position, and in the second is the correction of deformity and preservation of movements.
Treatment of severe deformities is associated with serious complications such as insufficient correction, skin necrosis, neurovascular problems, leg-length discrepancy, posterior subluxation of the tibia, fractures of the femur and the tibia, and recurrence of the deformity.
The Ilizarov method offers a minimally invasive procedure that allows gradual correction of the deformity with relatively few complications.
Aim
This study was carried out to assess the results of gradual correction of severe type I fixed flexion deformities of the knee joint using Ilizarov external fixator.
Patients and methods
This study included eight patients having severe type I fixed flexion deformity of the knee joint. The preoperative fixed flexion deformity ranged from 50 to 80° (mean: 67.5±8.3°). All knees were stiff preoperatively. The cause of the deformity was juvenile rheumatoid arthritis in four (50%) patients, infection following open reduction and internal fixation of a tibial plateau fracture in three (37.5%) patients, and repeated hemarthrosis of the knee in one (12.5%) patient.
Results
Full correction was achieved in all patients following removal of the fixator. The follow-up period ranged from 12 to 36 months (mean: 24±4.3 months) following removal of the brace. Two (25%) patients had no recurrence of the deformity, whereas the remaining six (75%) cases had partial recurrence of the deformity that ranged from 5 to 25° (mean: 11.25±9.5°) during the follow-up period.
Conclusion
Ilizarov gradual distraction is an option to improve the quality of life of patients having severe type I fixed flexion deformities of the knee joint despite the high rate of partial recurrence.

Keywords:
fixed flexion deformity, Ilizarov external fixator, knee, type I

Egypt Orthop J 53:21–25
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1110-1148

Introduction

Knee flexion deformities can cause marked physical disability [1]. Severe deformities represent one of the most challenging deformities to treat [2]. Two types of flexion contracture of the knee can be distinguished: the one associated with joint destruction and fibrous ankylosis (type I), and the other in which joint anatomy, and mobility are preserved (type II). Type I deformities are even more challenging to treat [2]. The aim of treatment of such cases is to obtain an ankylosed knee in a functional position [2].

Acute correction whether nonoperative or operative may lead to serious complications [1].

This study was carried out to assess the results of gradual correction of severe type I fixed flexion deformities of the knee joint using Ilizarov external fixator.

Patients

This study included eight patients having severe type I fixed flexion deformity of the knee joint. The study included four (50%) male and four (50%) female

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patients. The right knee was affected in six (75%) cases, and the left knee in two (25%) cases.

The preoperative fixed deformity ranged from 50 to 80° (mean: 67.5±8.3°). All knees were stiff preoperatively. All patients were not able to bear weight on the affected limb preoperatively because of the severe degree of fixed flexion contracture.

The cause of the deformity was juvenile rheumatoid arthritis in four (50%) patients, infection following open reduction and internal fixation of a tibial plateau fracture in three (37.5%) patients, and repeated hemarthrosis of the knee in one (12.5%) patient. This patient had rheumatic heart disease and was on anticoagulant therapy for 12 years.

Three of the four patients who had rheumatoid arthritis were previously treated by synovectomy. Three patients were treated by open reduction and internal fixation of tibial plateau fractures and ended up with infection and the implants were removed.

Methods

All cases were treated by gradual correction of the deformity using Ilizarov frame using the bloodless technique. The study was approved by the local ethical committee and all patients were consented.

The frame consisted of a femoral block and a tibial block connected together using two uniplane anterior hinges (anterior to the center of rotation of the knee joint), one medial and one lateral. One posterior distraction mechanism was used to gradually correct the deformity. Distraction was started as soon as the postoperative pain subsided at an average of 2–3 full turns/day to produce a distraction rate of 1 mm/day at the posterior aspect of the knee joint where the neurovascular bundle (the structure at risk) lies.

The duration of correction ranged from 6 to 10 weeks (mean: 8±1.3 weeks). All patients were kept in the frame for 6 weeks after achieving full correction. Then, the frames were removed and above-the-knee plaster cast was applied for 4 weeks. Then, a brace was used to guard against recurrence for 3 months following removal of the cast.

Results

Full correction was achieved in all patients following removal of the fixator. This was maintained also in the cast applied after removal of the fixator. The follow-up period ranged from 12 to 36 months (mean: 24±4.3 months) following removal of the brace. Two (25%) patients had no recurrence of the deformity, whereas the remaining six (75%) cases had partial recurrence of the deformity that ranged from 5 to 25° (mean: 11.25±9.5°).

Three (37.5%) patients were able to walk without any walking aids or shoe modification, one (12.5%) patient used crutches because of associated hip osteoarthritis, three (37.5%) patients used a high heel to compensate for 10–20° of residual flexion deformity, and one (12.5%) patient used a wheel chair because of recurrence of 25° of flexion deformity following removal of the cast. This patient was on anticoagulation therapy (Warfarin) after valve replacement surgery for the treatment of rheumatic valve disease. She also developed ipsilateral equinus deformity in the ipsilateral ankle, fixed flexion deformity in the contralateral knee, and flexion deformity in both hips.

None of the patients included in this study had fractures during frame application or during the period of follow-up. In addition, none of them had vascular or neural injuries during frame application or during distraction.

All knees were stiff after frame removal and during the follow-up period (Figs 1 and 2).

Discussion

Major knee flexion deformity is disabling [1]. Many surgical procedures have been proposed to treat fixed knee flexion deformities including casting [3], posterior soft tissue release [4,5], osteotomies [6], and femoral shortening [7,8].

Treatment of the more severe deformities is associated with serious complications such as insufficient correction, skin necrosis, neurovascular problems, leg-length discrepancy, posterior subluxation, and recurrence of the deformity [2].

In addition, some treatment options have some limitations for use, for example, guided growth can work only in children and adolescents having enough remaining growth potential to allow for correction of the deformity. In addition, this method leads to slow correction [9].

The Ilizarov technique allows for gradual correction of the most complex deformities of the knee. In this method, the rate of correction can be modified according to the severity of the deformity, and

Figure 1

(a) Preoperative clinical appearance and radiographies for a patient having juvenile rheumatoid arthritis. (b) Postoperative photograph after frame application. (c) Photographs after achieving full correction in the frame. (d) Final clinical appearance and radiographies.

degree of contracture. Gradual distraction of the soft tissues by the Ilizarov technique prevents the hazards of rapid extension of the chronically contracted and flexed knee joint that can result in ischemia, gangrene, and amputation [10].

Damsin and Ghanem [2] used Ilizarov frames to treat 13 knees with fixed flexion deformities. The age of their patients ranged from 1.7 to 18.8 years. They had fractures in four patients, common peroneal nerve palsy in one patient, and recurrence of the deformity in four patients. The fractures occurred in children with congenital webbing treated at the ages of 1.7 and 4.8 years of age. The fractures occurred during the correction of posterior subluxation of the tibia and were considered to be owing to shearing forces. They considered flexion deformity of the knee secondary to congenital webbing as the most difficult type to treat [2].

Hosny and Fadel [1] treated 50 patients with 29 unilateral, and 21 bilateral knee flexion deformities using Ilizarov frames. The mean angle of maximum extension to maximum flexion improved from a preoperative average of 68° (25–140°), to an average of 3.5° (0–20°) after removal of the fixator. At the last follow-up, the average angle was 13.5° (0–70°). They reported fractures in seven patients and knee subluxation in three cases. They concluded that a circular frame is an effective method that also allows a possibility to correct other deformities, to reduce the joint, and to lengthen the bone concomitantly. In addition, they believe that recurrence of the deformity appears to depend on the etiology and not the type of treatment and that the relatively high rate of recurrence is still unsolved [1]. Gaurav [11] used Ilizarov frame to treat 39 knees in 26 patients with fixed flexion deformities. All of his patients achieved complete correction without significant complications [11].

El Gafary [10] used Ilizarov frames to correct flexion deformities in 20 knees of 12 patients. All patients were affected by anterior poliomyelitis. Their mean age was 13.5 years. The mean deformity was 55° (35–100°). He achieved almost full correction without any skin or neurovascular complications. He had two posterior subluxations that were corrected during treatment [10].

Two types of flexion deformities of the knee can be distinguished: the one associated with joint destruction and ankylosis (type I) and the other one in which joint anatomy and mobility are preserved. In the first type, the aim of treatment is to obtain an ankylosed knee in a

Figure 2

(a) Preoperative flexion deformity of the knee under anesthesia. (b) Medial aspect skin scar. (c) Lateral aspect skin scar. (d) Full correction in the frame. (e) Radiographies following removal of the scar. (f) Recurrence of 5° deformity after 3-month follow-up. (g) Recurrence of 20° deformity after 36-month follow-up.

functional position, and in the second, correction of the deformity and preservation of movements [2].

Treatment of severe type I deformity using osteotomy or arthrodesis requires excision of a significant amount of bone to be able to correct the deformity without skin and neurovascular compromise. This will lead to significant limb-length discrepancy in unilateral cases. Guided growth is not an option in adults and might not be suitable in severe cases. In addition, it will result in significant limb-length discrepancy in unilateral cases. Soft tissue procedures might not be effective in cases with knee joint destruction and ankylosis (type I deformity). Therefore, Ilizarov gradual distraction of such cases might be the most accepted method of treatment in such cases.

This study included eight patients with severe flexion deformity of one of their knees together with knee joint destruction and loss of movements. This method allowed for correction of the flexion deformity in all cases using the bloodless technique without any open surgery despite the fact that all knees showed marked destruction, intra-articular adhesions, and articular

cartilage destruction before frame application. However, the recurrence after frame removal remains a problem in spite of the fact that the deformity recurred in our cases only partially in six of our eight patients. Four patients with partial recurrence of the deformity could manage their daily life activities using shoe modification (heel raise). One needed crutches because he had rheumatoid arthritis of both hips, and one needed a wheel chair because of recurrence of the knee deformity, and in addition, she developed flexion deformity in the contralateral knee and both hips because of difficult control of her anticoagulation therapy with resultant recurrent episodes of bleeding and hemarthrosis. This recurrence rate might raise the question whether we need to fuse those knees after achieving full correction. However, all of our patients who had significant recurrence refused to go for arthrodesis and they preferred to keep their knees flexed to some extent.

None of our patients had fractures during frame application and during the period of distraction. This can be explained by the fact that the patients included in this study were adults and none of them had congenital webbing, which is known to be associated with high fracture rates.

Conclusion

Ilizarov gradual distraction is an option to improve the quality of life of patients having severe type I fixed flexion deformities of the knee joint despite the high rate of partial recurrence.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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