

Calcaneus lengthening osteotomy for correction of symptomatic flexible flat foot in children using fibular autograft

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Abstract

Background

Currently lateral column lengthening procedure is the one of choice to restore the medial arch and to correct forefoot abduction. This procedure requires a bone graft to expand the osteotomy site either autograft or allograft

Objectives

This study aims to evaluate the results of the use of a segment of the fibular diaphysis as an autograft to expand the osteotomy site

Patients and methods

28 feet (22 patients) of idiopathic flexible flat foot in children with a mean age of 9.2 years old (average 7.4 – 13.5 years old) were operated by calcaneal lengthening osteotomy using a segment of the ipsilateral fibular diaphysis as an autograft. The mean follow-up period was 11.2 months (average 9 – 13 months).

Results

Patients were evaluated according to clinical and radiological parameters. Clinically 20 cases were classified as very good, seven cases as good while one case was classified as poor. Radiologically one case had a failure of graft incorporation with the breaking of the graft.

Conclusion

The fibular autograft is an effective and simple method without significant donor site morbidity when used to expand the osteotomy site in cases of calcaneal lengthening osteotomy to correct cases of flexible flat feet

Keywords

Flat foot – Fibula – Bone graft – Calcaneal lengthening.

Introduction

Since 1975 Lateral column lengthening described by Evans became the procedure of choice for correction of the symptomatic flexible flat foot [1]. Calcaneal lengthening corrects the main deformities present in pes planovalgus as forefoot abduction, dorsiflexion of navicular over talus, and hindfoot valgus [2]. Calcaneal lengthening osteotomy involves the insertion of a structural bone graft to distract the osteotomy site. Many types of grafts were used as tricortical iliac crest auto graft, proximal tibial autograft, and tricortical allograft [3]. Each type is not without complications. The drawbacks of the currently used types lead to thinking of the use of the fibula as a more acceptable alternative that can avoid the other drawbacks.

Aim of the work

This work aims to evaluate the fibular diaphysis to be used as an autograft to expand the osteotomy site for calcaneal lengthening osteotomy for the flexible flat foot in children.

Patients and methods

In the period from January 2017 till January 2020, 28 feet in 22 patients of symptomatic flexible flat foot were operated using lateral column lengthening by calcaneal lengthening osteotomy. This study was conducted in Zagazig university Hospital. The mean age was 9.2 years old (average 7.4 – 13.5 years old), 15 patients were males while 7 cases were females. Sixteen patients were unilateral while six patients were bilateral. All cases complained of persistent medial foot pain and pain in the sole with prolonged walking with difficulty in running and practicing other sports activities in spite of a trial of conservative treatment tried at least 3 – 6 months for all cases. Clinical examination revealed presence of multiple deformities in all cases as loss of medial longitudinal arch, fore foot abduction, supination, hind foot valgus and equinus deformity. Operative procedures, calcaneal lengthening osteotomy and gastrocnemius recession were done for all cases. The mean follow up period was 11.2 months (average 9 – 13 months).

Under general anesthesia with a tourniquet applied to the upper thigh, the patient was positioned in the lateral decubitus. A longitudinal incision extends from 1 cm proximal to the calcaneocuboid joint proximally to the sinus tarsi. Take care to avoid injury of peroneal tendons or branches of the sural nerve.

Elevate extensor digitorum brevis muscle subperiosteally in dorsal direction and retract peroneal tendons planter. Transverse osteotomy was done 1cm to 1.5cm proximal to the calcaneocuboid joint which is kept intact. The osteotomy passed between the anterior and middle calcaneal facets through the calcaneal neck but not reaching the medial cortex.

A retrograde k-wire was inserted across the calcaneocuboid joint then through the distal segment of the osteotomy. This wire is used to stabilize the calcaneocuboid and to handle the distal segment to distract the osteotomy site. Another 3mm k-wire is inserted in the proximal segment, distract the osteotomy site with the two wires and place the fibular segment in the lateral part of the osteotomy vertically. Intraoperative, radiological confirmation of talonavicular joint reduction after insertion of the fibular graft was done using an image intensifier as guided by proper talonavicular coverage. In cases of insufficient talonavicular coverage, the graft was pushed medially a little. Advance the wire previously inserted across the calcaneocuboid joint proximally to fix the graft in the osteotomy site (Figure 1).



Figure 1: Preoperative and postoperative x-rays after osteotomy and graft fixation

The wound was closed in layers and a non-weight-bearing below-knee cast was applied for six to eight weeks till healing of the osteotomy was radiologically confirmed (Figure 2)

After eight weeks the cast and the k-wires were removed, the patient was allowed partial weight-bearing using arch support for about two to three months according to patient comfort.



Figure 2: Postoperative X-ray after progressive graft incorporation and k-wire removal

Results

Twenty-eight cases of idiopathic flexible flat foot in children below the age of fourteen (average 7.4 – 13.5 years old) were operated by calcaneal lengthening osteotomy using a segment of fibular diaphysis as an autograft to expand the osteotomy site. The mean follow-up period was 11.2 months (average 9 – 13 months). The results of all cases were recorded with no cases lost during the follow-up period.

Evaluation of study cases depends on clinical results and radiological results. Clinical results were evaluated according to the score proposed by Philips [4].

Table 1: Clinical results evaluation according to Philips

	Clinical correction in standing position	Need to orthosis	Pain/pressure sores	Gait/painful walking
Very good	Complete	No	No	Improvement
Good	Slight hindfoot valgus (10°)	No	No	Improvement
Fair	Slight hindfoot valgus (10°) & slight forefoot abduction	Foot orthosis	No	The same as preoperative
Poor	Overcorrection or relapse	Ankle & foot orthosis	Present	More pain with walking

Among 28 cases 20 cases were classified as very good, seven cases as good while one case was classified as poor. Twenty-seven cases had arch restoration

with full correction of forefoot abduction. Hindfoot valgus was a correction to neutral in most cases while eight cases still had residual hindfoot valgus. One

case had a recurrence of deformity due to fracture of the fibular graft and collapse of the osteotomy.

Radiological evaluation: The mean time of graft healing was 87 days (average 98 – 77days). Complete healing of the graft was confirmed by the inability to identify the boundary between the fibular graft and native bone and the presence of crossing bony trabeculae across the fibula with a minimal amount of fibular graft can be seen at the osteotomy site

Significant improvement of lateral talus first metatarsal angle (Meary's angle) from a mean of – 17 degrees (from 9 to 28 degrees) preoperative to a mean of + 1.1 degrees (from 0 to 3 degrees) postoperative.

Complications

One case had a failure because of fracture of the graft and recurrence of the deformity; this was noted one and half months after surgery. No other complications were reported.

Discussion

Flexible flat foot is a common deformity in children and usually asymptomatic and requires no treatment [5], symptomatic cases of the flexible flat foot are usually presented by pain along the medial border of the foot due to prominent talar head medially and recurrent foot sprain with prolonged standing and walking, gait disturbance and pain over the sinus tarsi.

The deformity commonly involves collapsing medial longitudinal arch, short lateral foot column, hindfoot valgus, forefoot supination, and short gastrosoleus complex. Some or all of these deformities can be present but a short lateral column commonly combines the essential deformity, the collapsing medial arch.

Evans described his technique in lateral column lengthening [1] and later modified by Mosca [6], since that it became the most prevalent technique for correction of lateral column shortening deformity.

Lateral column lengthening involves the insertion of a bone graft to expand the osteotomy site. Different types of bone grafts have been used which are either autografts or allografts. For the bone graft to be ideal it should have several criteria, it should provide good structural support to the osteotomy to avoid osteotomy collapse, it should have good healing potential with the recipient site, it should be immune-compatible with the recipient and have a low donor site morbidity.

Much debate has been grown about the superiority of each type. As regards the healing potential one study

stated that allograft bone was at least as effective in terms of healing as autograft but without donor site complications and morbidity associated with iliac crest grafting[3].

Numerous iliac crest donor site complications were reported as prolonged pain, infection, hematoma, and nerve injury on the other side the availability of allograft is still unaffordable in many centers besides lower mechanical stability and compromised osteoinduction activity [7].

Problems related to donor site morbidity and allograft availability and immune tolerance led researchers to find out a more suitable structural graft.

In the current study, we used ipsilateral fibular autograft from the middle segment of the fibular diaphysis. This technique has many advantages. Graft harvesting is easy and done under a tourniquet with no blood loss. The fibula can reform again within the intact periosteal sleeve [8]. The fibula provides good structural support being cortical all around so there is a low risk of graft yielding and osteotomy collapse. No prolonged postoperative pain was reported after autogenous iliac graft harvesting [9].

The main disadvantage of fibular autograft is relative delayed graft healing time compared with autogenous tricortical iliac crest graft which takes about 2 months on average in many series [10]. The delay in graft healing can be explained by the cortical nature of the fibular autograft. However, this relative increase in graft healing time did not affect the outcome of study cases.

Conclusion

The fibular graft is a reliable alternative to the iliac crest graft for lateral column lengthening by calcaneal osteotomy. It has comparable results with less morbidity.

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