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ORIGINAL STUDY

Medial malleolar screw hemiepiphysiodesis for ankle valgus in children with spina bifida

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Medial malleolar screw hemiepiphysiodesis has been shown to be an effective procedure for the treatment of ankle valgus in children with spina bifida. The purpose of this study was to highlight the guided growth technique and discuss its efficacy. We retrospectively reviewed 10 spina bifida patients with 18 ankle valgus deformities treated with medial malleolar screw hemiepiphysiodesis. Medical reports were obtained to document age at surgery, gender, concurrent operative procedures and postoperative early and late complications. Anteroposterior and lateral weight bearing radiographs of both ankles were evaluated using the tibiotalar angle, pre and postoperatively. The average age at operation was 10,05 years. Average follow up was 15,33 months (11-21 months). During follow-up, the average preoperative distal tibiotalar angle of 16.27 degrees improved to an average of 2,88 degrees with statistical significance ($p < 0,05$). No major complications were detected. In conclusion, hemiepiphysiodesis is a safe and sufficient method to correct ankle valgus deformity in children with spina bifida, with a low incidence of complications and satisfactory results.

Keywords : spina bifida ; myelomeningocele ; ankle valgus ; hemiepiphysiodesis.

INTRODUCTION

Health problems in patients with spina bifida include many organ systems and need multidisciplinary management. Orthopedists, participating in the care of children with spina bifida are members of the health care team seeking to maximize function and minimize disability for ambulation (*8*). Neurological level of involvement, hip deformity, scoliosis, foot and ankle deformity, age and obesity are factors affecting the ambulation potential of spina bifida patients (*1,13*).

Both congenital and developmental foot deformities are common in spina bifida including vertical talus, equinus, clubfoot, calcaneal and valgus deformities (*7,8*). Being one the most common lower limb deformity in spina bifida patients, valgus deformity of the ankle may arise from the distal tibia, the subtalar joint or both and may cause skin irritation or breakdown over the medial malleolus or talar head (*9,12*). In a patient with L5 or higher level of

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involvement, the significant soleus weakness can lead to a decrease in the downward pull of the fibula during stance phase of the gait cycle, which may alter the distribution of the forces around the distal tibial physis to cause the ankle valgus deformity (*4*).

The goal of the treatment is to achieve a plantigrade, mobile and functional foot that is efficient for ambulation with or without bracing.

Two common surgical options for the management of the distal tibial valgus deformity are distal tibial and fibular osteotomy and medial malleolar hemiepiphysiodesis (*8*). For various conditions medial malleolar screw epiphysiodesis has been shown to be an effective procedure for the treatment of ankle valgus in children (*5,14,15*). The purpose of this study is to highlight the technique of using guided growth with screw hemiepiphysiodesis and discuss its efficacy especially in patients with spina bifida.

MATERIALS AND METHODS

A retrospective review of operative logs from January 1, 2008 to November 1 2011 was undertaken to identify all spina bifida patients who underwent distal tibial medial hemiepiphysiodesis for ankle valgus deformity. The general indication of distal tibial medial hemiepiphysiodesis for low lumbar or sacral spina bifida cases was ankle valgus deformity over 10 degrees, having difficulty to wear a brace and at least 1 year of growth remaining (*2,14*). Medical records were reviewed to document the following : patient age at surgery, gender, underlying diagnosis, date at surgery, concurrent operative procedures, and postoperative early and late complications.

During the study period, a total of 38 ankles were treated with medial malleolar hemiepiphysiodesis with various underlying diagnoses. Out of this group, 18 ankles in 10 patients were included to this study with ankle valgus deformity according to spina bifida.

Operative Technique

Surgery was applied as described in previous studies (*13,14*). Under general anesthesia,the child placed in supine position, a 2 to 3 mm incision was made at the tip of medial malleolus. Under image intensification, a guide wire was sent across the physis. Care was taken to send the wire close and parallel to the medial cortex on the AP view and in the middle of the physis on the lateral view. The guide pin was then overdrilled beyond the physis for 10 mm and a 4.5 mm fully threaded cannulated screw (TST, Pendik, ISTANBUL) was placed.

Patients were allowed to bear weight immediately after surgery but brace wearing was not allowed until wound healing was observed to avoid skin irritation.

Radiographic Analysis

Anteroposterior and lateral weight bearing radiographs of both ankles were obtained before surgery and during follow-ups. The tibiotalar angle was identified as the 90° angle between the diaphyseal tibial axis and the tangential line to the talar dome and measured to evaluate the distal tibial valgus improvement (*11*).

Statistical Analysis

Statistical analysis was performed using Microsoft Excel 2010 (Redmond, WA) and SPSS version 20 (Armonk, NY). Continuous variables were compared using the Student t test. Statistical significance was set at $p < 0.05$.

RESULTS

In this study, retrospectively, we evaluated 10 children (18 ankles), with ankle valgus deformity due to low lumbar or sacral spina bifida, treated with medial malleolar screw epiphysiodesis (Table I). There were 6 female and 4 male patients. 8 patients were bilateral. Average age at the time of surgery was 10.05 years (8-14 years). One patient had bilateral anterior knee hemiepiphysiodesis , 2 patients had hip containment surgery, one anterior tibial tendon to calcaneus transfer, one calcaneal lengthening and one patient had Achilles tenodesis as concurrent surgeries. There were no intraoperative complications. Neither early nor late postoperative complication related to infection was noted. Average follow- up time was 15.33 months (11-21 months). During follow-up, the average preoperative distal tibiotalar angle of 16.27 degrees (10-28 degrees), improved to an average of 2.88 degrees (0-7 degrees) which was statistically significant ($p < 0.05$, Table II). The average rate of correction was 0.87 degrees per month. No overcorrection into varus was detected in any of the patients (Fig. 1).

Table I. — Patient Demographics

Patients	Age at Surgery	Gender	Side	Preoperative Tibiotalar Angulation	Final Tibiotalar Angulation	Follow-up (month)	Concurrent Surgery
1	10	Female	R	25	5	16	Ant. Knee Hemiepiph.
			L	19	7	16	Ant. Knee Hemiepiph.
2	8	Female	R	13	5	13	
			L	10	3	13	
3	13	Male	R	15	0	11	Calcaneal Lengthening
4	8	Female	R	12	0	14	
			L	11	7	14	ATT Transfer
5	14	Male	L	18	7	21	
6	10	Male	R	18	5	16	Tenodesis of Achilles Tendon
			L	15	3	16	Hip Surgery
7	11	Female	R	14	0	17	Hip Surgery
			L	14	0	17	
8	12	Male	R	28	0	16	
			L	22	0	16	
9	10	Female	R	16	0	13	
			L	14	2	13	
10	8	Female	R	14	3	17	
			L	15	5	17	

DISCUSSION

Valgus deformity of the distal tibia can be related to the hindfoot, the ankle or to both. Care must be taken to determine the precise anatomical location of the deformity to prevent unsuccessful results (*13*).

For the flexible deformities, orthoses can be used to provide correction. With progression of the deformity, orthoses can cause pressure wounds and skin breakdown. Surgical correction is indicated in that situation for severe and rigid deformities (*13*).

There are two common surgical techniques described for the treatment of ankle valgus deformities, distal tibial osteotomies and hemiepiphysiodesis. Distal tibial osteotomies have a significant amount of complication risks (delayed healing, malunion, hardware problems and neurovascular compromise) that makes medial malleolar screw

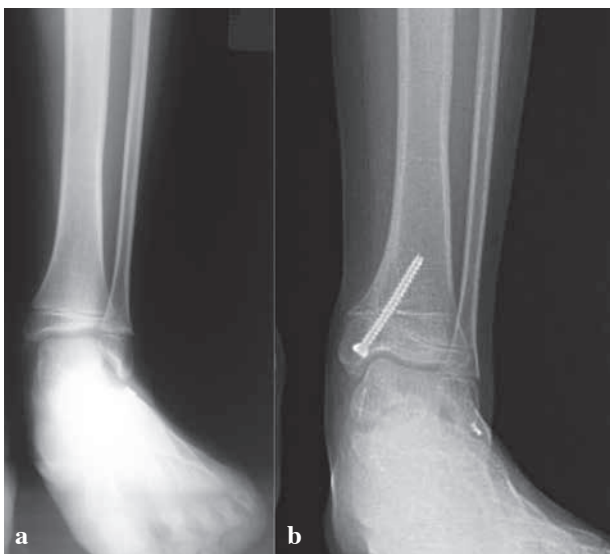

Fig. 1. — 8 year old girl (a) preoperatively (b) after 12 months follow-up.

Table II. — Descriptive Stastistics

	N	Mean	Minimum	Maximum	P value
Preoperative tibiotalar angulation	18	16,28 ± 4,74	10	28	< 0.001*
Postoperative tibiotalar angulation	18	2,89 ± 2,74	0	7	

*Paired-Sample t test.

epiphysiodesis an attractive alternative treatment option (*2,3,5,14*). To our knowledge this is the only study that presents the results of medial malleolar screw hemiepiphysiodesis in the ankle valgus deformity for patients with spina bifida.

Correct screw placement is mandatory to achieve adequate correction. In the study of Davids *et al*, screw placement anywhere in the medial 25% of the tibial physis was shown to be effective. Also it was noted that on the sagittal plane, screw placement within the middle third of the physis would not alter the sagittal tibial tilt (*3*). In our study, also, sagittal alignment deterioration was not noted.

Infection is one of the major complications. For transmalleolar screws, in the literature,an overall of 2% to 3.4% infection rate was reported (*3,14,15*). To reduce the infection rate, Stevens *et al* proposed to apply a weight-bearing cast for 2-3 weeks after surgery (*15*). No infections were seen in our series which could possibly hinder the use of orthoses before adequate wound healing.

In previous reports the overall correction of the tibiotalar angle was between 9.7 and 12.4 degrees, which was similar to our study with 13.4 degrees of overall correction or 0.87 degrees per month (*3,14,15*).

The degree of correction is directly dependent upon the growth potential of the distal tibia. There is a risk of undercorrection if epiphysiodesis is performed in a patient with a low growth potential and vice versa. In the series of Davids *et al* screws were removed in 5 ankles of three children, due to achievement of adequate correction, which led to recurrence in all cases and two ankles required a placement of a second screw. They concluded that this technique might be applied to younger children and when correction of malalignment has been achieved before skeletal maturity, screw removal should be delayed until some degree of overcorrection is present (*3*). In our series, screw removal related to overcorrection was not reported.

With transphyseal screws hardware removal can be challenging. The other implant that can be used for hemiepiphysiodesis are tension band plates (*5,15*). In the study of Stevens *et al* the extra periosteal tension band provided a similar rate of correction as tranphyseal screws (*15*). Driscoll *et al* compared medial malleolar transphyseal screws with tension band plates and showed a faster rate of correction in the screw group however they could not find statistical significance (*5*).

The results of this study indicate that the medial malleolar hemiepiphysiodesis is a safe and sufficient method to correct ankle valgus deformity in children with spina bifida, with a low incidence of complications and satisfactory results.

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