

Tricorrectional Bunionectomy for Surgical Repair of Juvenile Hallux Valgus

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The authors propose the use of the tricorrectional bunionectomy as an alternate correction of severe deformity in juvenile hallux valgus. In the past, hallux valgus surgery in juveniles has been avoided. A follow-up study of the tricorrectional bunionectomy as the surgical treatment for juvenile bunion deformity in seven patients is presented.

There is controversy in the literature about the etiology and treatment of juvenile hallux valgus deformity. Merely defining and classifying juvenile hallux valgus has been the subject of much disagreement. Some authors say that the condition is acquired during the formative years,^{1,2} while other authors state that it is a deformity resulting from the plastic nature of the bone and its associated components in individuals under 20 years of age.³ McGlamry⁴ states that it is not merely a precursor to the adult condition, but a progressive entity that can lead to a deformity in the first metatarsophalangeal joint and the related metatarsophalangeal joint apparatus. Anatomical differences from the adult bunion deformity include less valgus rotation of the hallux without arthritic changes in the first metatarsophalangeal joint. There is also a lower incidence of chronic inflammatory bursal reaction and less hyperostosis at the metatarsophalangeal joint.^{1,3}

A new procedure has been developed for juvenile bunion deformities. This procedure, the tricorrectional bunionectomy, corrects the bunion deformity in all three planes. It is a distal metatarsal osteotomy that involves a transverse V-osteotomy with a long plantar hinge that reduces an elevated proximal articular set angle and the intermetatarsal angle and also plantarflexes the metatarsal head. Fixation is achieved with a cannulated bone screw.

Incidence

The age of the typical patient with juvenile bunions usually ranges between 11 and 14 years. Some authors have speculated that patients in this age group have an increased awareness of their bodies and that any deformity is perceived as different by their peers. Pain, cosmesis, or the desire to wear certain types of shoes also generates concern. Patients less than 10 years of age are rarely symptomatic.^{1,5,6}

In a study of 100 patients, 57 patients had noted the deformity in their teens or before, while only five patients noted it after the age of 20 years.⁷ Another study of patients with hallux valgus revealed that 46% had lateral shifting of the hallux before the age of 20 years.⁸ In a study by Cole,⁹ it was reported that 36% of school children between the ages of 8 and 18 years displayed a mild to severe

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hallux valgus. Of those children, 75% were female. McGlamry⁴ cites a study in which 92% of all patients between the ages of 9 and 19 years with hallux valgus were female, and 75% of those individuals had bilateral deformities.

Etiology

Many causative factors that may contribute to the progression of the juvenile deformity have been reported in the literature. According to Root et al.¹⁰ "The causative factor for all hallux abducto valgus deformity is mechanical malfunction of the first metatarsophalangeal joint." Most authors agree that any factor that causes abnormal subtalar joint pronation and instability of the first ray will enhance the progression of juvenile bunions. Heredity, congenital deformity, metatarsus primus adductus, metatarsus adductus, pes valgus, ankle equinus, intrinsic muscle imbalance, obesity, and other causes of excessive pronation have been cited as causing juvenile bunion deformity.^{1-3, 5, 6, 10} Regardless of the causative etiology, some authors argue that the hallux valgus deformity increases prior to an increase in the intermetatarsal angle.^{7, 8, 11} In a study by Hardy and Clapham,⁸ the hallux abductus angle was greatest in children under 14 years of age. As the deformity progressed, after children reached the age of 15 years, the intermetatarsal angle showed an increase in size. In a study of 3,642 feet of school age children, subluxation and displacement of the hallux was the primary deformity, and the widening of the intermetatarsal angle was secondary.⁸ Other authors believe that metatarsus primus adductus or metatarsus primus varus is the primary deforming force in juvenile hallux valgus.^{11, 12} Some authors believe that an intermetatarsal angle of greater than 9° to 10° is abnormal and is the primary deforming force in the development of hallux valgus.¹²⁻¹⁴

Background

The authors of this study propose that the tricorrectional bunionectomy can be used for correcting juvenile hallux valgus with intermetatarsal angles of greater than 15° to 16°. Base osteotomies are considered the surgical treatment of choice for intermetatarsal angles of greater than 14°.

According to Youngswick,¹⁵ a preoperative intermetatarsal angle of greater than 13° is the criterion for a base wedge osteotomy. The surgeon must take into consideration the proximally located epiphyseal plate in juveniles when considering base wedge osteotomies.

McGlamry⁴ states that the maximum intermet-

atarsal angle for an Austin head osteotomy is 16°. Various head and neck osteotomies, such as the Mitchell, Wilson, and Austin procedures, have been described in the literature for correction of moderate deformities with varied success.^{2, 3, 5} Jahss¹⁶ and Tachdjian¹⁴ advocate base osteotomies as their treatment of choice for correction of abnormal intermetatarsal angles. Epiphysiodesis by stapling the lateral aspect of the epiphyseal plate has been described, but the predictability of the procedure is limited.⁴ In their report on the derotational, angulational, transpositional osteotomy (DRATO procedure), Johnson and Smith¹⁷ advocated the multipane correction of hallux valgus with a distal metatarsal osteotomy.¹⁸

The tricorrectional bunionectomy has been performed on adults with intermetatarsal angles of up to 21° with excellent results. It is the contention of the authors that correction of juvenile hallux valgus with the tricorrectional bunionectomy can achieve the same or better results without disruption of the epiphyseal plate and that these results can be maintained postoperatively. A study of the postoperative results of the tricorrectional bunionectomy was presented by Boggs et al.¹⁸

Procedure

A dorsomedial, curvilinear, J-shaped skin incision is made. A dorsomedial approach to the first metatarsophalangeal joint is achieved with a horizontal elliptical capsulotomy. The head of the first metatarsal is exposed, with care taken to release the medial and lateral sesamoid ligaments. A transverse V-osteotomy is performed through the head of the first metatarsal, with the plantar arm being twice the length of the dorsal arm. The proximal articular set angle can be corrected by excising a pie-shaped wedge from the dorsal arm. The capital fragment is transposed laterally and plantarly to the corrected position and then temporarily fixated with an 0.062 Kirschner wire through the medial eminence.

Using a 2.0 bone drill, a drill hole is made approximately 1½ cm proximal to the osteotomy from proximal dorsal to distal plantar. Although most drill holes with cannulated bone screws are made over a wire, because of the varied angles involved in this procedure, it is not possible to do so with present equipment. The proximal portion of the drill hole is countersunk, and a 0.035 Kirschner wire is placed as a guide wire in the drill hole. The length of the screw is then measured. A 4.0 Johnson and Johnson^(®) cannulated, self-tapping bone screw

^(®) Johnson and Johnson, Brunswick, NJ.

is placed over the guide wire. The osteotomy is fixated with a cannulated screwdriver. The temporary Kirschner wire is removed.

The medial exostosis is excised, and the head is remodeled. Care is taken to ensure that the sesamoids are in the anatomically correct position, and the capsule is then sutured with a 2=0 Vicryl^{®2}. The skin is reapproximated with 3=0 Prolene^{®2} in a running subcuticular suture. Patients walk on the day of surgery and are generally back in shoes within 18 to 28 days. Physical therapy, consisting of ultrasound, whirlpool, and range-of-motion exercises, is started approximately 3 weeks postoperatively. Functional orthotic devices are prescribed. All screws are removed approximately 6 months after surgery.

Materials and Methods

X-rays involving 13 feet were evaluated from seven patients. Preoperative and postoperative anteroposterior and lateral weightbearing radiographs were taken with the patients in their normal angle and base of gait. The x-rays were taken at various time intervals, and the intermetatarsal angles, hallux abductus angles, and sesamoid position were evaluated. The tibial sesamoid position was evaluated by using the #3 position as midline to the first metatarsal. The postoperative time period varied for each patient, ranging from 8 to 53 months, with an average of 28.5 months.

Results

Six patients had bilateral procedures performed. One procedure was unilateral. Subjectively, the patients all stated that they had no pain. They report good range of motion in the great toe joint, and they have no limitations for sport activities. All patients are happy with the cosmetic appearance of their toes.

Table 1 presents the preoperative and postoperative radiographic measurements for each patient. Preoperative intermetatarsal angles ranged from 12° and 21°, while postoperative intermetatarsal angles ranged from 3° to 11°. The average preoperative intermetatarsal angle was 15.1°; the average postoperative intermetatarsal angle was 6.5° (Table 2). Preoperative hallux abductus angles ranged from 18° to 34°, while postoperative hallux abductus angles ranged from 8° to 22°. The preoperative average was 27.7°; the postoperative average was

Table 1. Preoperative and Postoperative Radiographic Evaluation

	Patient		Preoperative Angle (°)	Postoperative Angle (°)
1	IM ^a	R	17	7 at 35 months
		L	18	8
	HA ^b	R	28	16
		L	29	20
	SP ^c	R	4	4
		L	5	4
2	IM	R	17	9 at 31 months
		L	21	11
	HA	R	23	15
		L	29	18
	SP	R	6	4
		L	6	4
3	IM	R	14	7 at 8 months
		L	12	6
	HA	R	26	18
		L	20	22
	SP	R	4	0
		L	3	2
4	IM	R	15	8 at 8.5 months
		L	16	8
	HA	R	27	10
		L	26	20
	SP	R	4	3
		L	3	3
5	IM	R	12	6 at 24 months
		L	14	5
	HA	R	30	14
		L	34	16
	SP	R	5	0
		L	3	0
6	IM	R	13	4 at 40 months
	HA	R	30	14
	SP	R	5	0
7	IM	R	14	3 at 53 months
		L	14	3
	HA	R	30	8
		L	18	8
	SP	R	4	0
		L	4	2

^a Intermetatarsal.

^b Hallux abductus.

^c Sesamoid position.

15.5°. The sesamoid position preoperative range was from 3° to 6°, while the sesamoid position postoperative range was from 0° to 4°. The preoperative average position of the sesamoid was 4.3°; the postoperative average was 2.0°.

The average reduction per patient was 7.1° for the intermetatarsal angle, 11.5° for the hallux abductus angle, and 2.3° for the tibial sesamoid position. The patients walked on the day of surgery and were wearing tennis shoes approximately 18 to 28 days postoperatively.

^{®2} Ethicon Inc, Somerville, NJ.

Table 2. Preoperative and Postoperative Averages of Radiographic Angles

	Preoperative (°)	Postoperative (°)	Average Reduction (°)
IM ^a	15.1	6.5	7.1
HA ^b	27.7	15.5	11.5
SP ^c	4.3	2.0	2.3

^a Intermetatarsal.

^b Hallux abductus.

^c Sesamoid position.

Discussion

The results indicate that the tricorrectional bunionectomy can be used for the correction of juvenile hallux valgus, with good results maintained postoperatively. Preoperative intermetatarsal angle size or length of postoperative time period did not have a negative bearing on the overall success of each procedure.

Conservative therapy should be the primary treatment for all juvenile patients, but progression of the disease should be the criterion for surgical intervention. Not all patients are surgical candidates, especially when a base wedge osteotomy procedure is being considered. The tricorrectional bunionectomy can be used for correction of juvenile hallux valgus as a treatment option for progressive disease because it does not interfere with the epiphyseal growth center of the first metatarsal.

Conclusions

The authors believe that the tricorrectional bunionectomy offers several advantages: 1) The tricorrectional procedure may be considered for intermetatarsal angles between 16° and 21°; 2) Patients can walk immediately, as opposed to the 6 to 8 weeks postoperative nonweightbearing condition usually required after a base wedge osteotomy. This allows bilateral procedures to be performed; 3) The patient can usually return to wearing shoes within 3 weeks and can begin early rehabilitation; and 4)

The tricorrectional procedure offers greater flexibility in the reduction of the multiplane deformity; reduces the intermetatarsal, hallux abductus, and proximal articular set angles; plantarflexes the capital fragment; and elongates the first metatarsal.

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