Lateral Shifting of the First Metatarsal Head in Hallux Valgus Surgery: Effect on Sesamoid Reduction

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Lateral Shifting of the First Metatarsal Head in Hallux Valgus Surgery: Effect on Sesamoid Reduction

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ABSTRACT

Thirty feet with hallux valgus (HV) having grade 2 and 3 sesamoid stations on AP radiographs were examined after Lindgren–Turan oblique distal metatarsal osteotomy with a minimum follow-up of 12 months. Adductor tendon release from the lateral sesamoid was not performed to determine the isolated effect of distal metatarsal osteotomy on metatarsosesamoidal reduction. Of the 30 feet, 20 (67%) had reduced and 10 (33%) unreduced sesamoids at the follow-up. Ultimately, distal metatarsal osteotomy (DMO) with lateral shifting of the first metatarsal head more than 7.2 mm was found to reduce the sesamoids in the great majority of the cases (95% CI 7.243–9.757). Sesamoid release is redundant for metatarsosesamoidal reduction if sufficient lateral shift of the first metatarsal head over the sesamoids is accomplished.

Key Words: Hallux Valgus; Sesamoid Reduction; Distal Metatarsal Osteotomy; Sesamoid Release

INTRODUCTION

The reduction of the sesamoids is an important issue in the treatment of hallux valgus (HV).[6,9,10] The literature indicates that in HV it is the metatarsal head which moves medially. The sesamoids retain their anatomic relationship to the second metatarsal.[3,14,20,22] The adductor tendon inserts into the base of the proximal phalanx and the lateral sesamoid, anchoring the sesamoids.[14] During the progression of hallux valgus, the metatarsal head drifts medially off the sesamoids. The sesamoid complex is held stable by the adductor tendon.[20] Since the metatarsosesamoid dislocation is due to the medial shifting of the metatarsal head, the shifted metatarsal head should be brought laterally over the sesamoids for metatarsosesamoid reduction.

This study investigated whether lateral displacement of the metatarsal head over the sesamoids is sufficient for metatarsosesamoid reduction without adductor tendon release from the lateral sesamoid.

MATERIALS AND METHODS

Patients operated on for hallux valgus were retrospectively reviewed. The dates of the study were from February 1989 to November 1997 and the surgical procedure was a Lindgren–Turan[13] oblique distal metatarsal osteotomy. The operation consists of a distal oblique metatarsal osteotomy through a dorsomedial incision. The distal fragment is shifted laterally as much as possible and then fixed with a screw vertical to the osteotomy plane in the desired position. The spike on the medial side of the proximal fragment is excised (Fig. 1). A bunionectomy is performed only if there is still a medial prominence after maximum displacement.

Forty-three patients with 60 toes with a minimum follow-up of 12 months were evaluated. On the preoperative weightbearing AP views, measurements were obtained of HV, intermetatarsal (IM) angles, and the sesamoid station (position of the medial sesamoid relative to the axis of the first metatarsal). The first metatarsal axes and thus the HV and IM angles were measured with a line drawn from the center of the first metatarsal head through the center of the base of the first metatarsal by the technique described by Miller.[17]

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Fig. 1: A case of hallux valgus corrected with the Lindgren–Turan oblique distal metatarsal osteotomy.

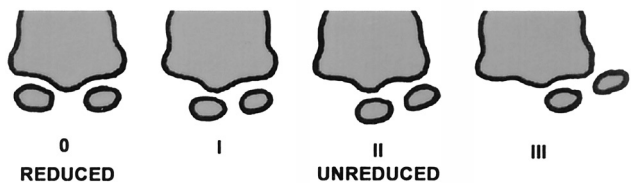

Fig. 2: Definition of sesamoid reduction relative to the intersesamoid ridge (cristae).

An ordinal system was used to grade the preoperative sesamoid station.[21] Grade 0 indicated that the medial sesamoid was completely medial to the midaxial line; grade 1, that the medial sesamoid was overlapping the line less than 50%; grade 2, that the medial sesamoid was overlapping the line more than 50%; and grade 3, that the medial sesamoid was completely lateral to the line (Fig. 2).

After excluding the patients who had a bunionectomy and a sesamoid station less than 2, a total of 30 feet of 23 patients (22 female, 1 male) were included in the study. The average age was 51.3 years (range, 18–72 years).

On the preoperative and the last control AP radiographs, the distance from the center of the first metatarsal head to the midline of the second metatarsal shaft on a line vertical to the latter was measured. The difference of the measurements between the preoperative and the last control radiographs gave the lateral shifting of the first metatarsal head in millimeters (Fig. 3).

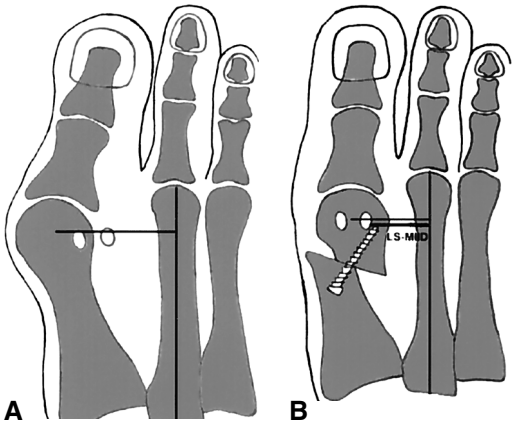

Fig. 3: Measurement of the lateral shifting of the first metatarsal head. The difference of the preoperative (**a**) and the postoperative (**b**) measurements from the center of the first metatarsal head to the midline of the second metatarsal shaft. **LS-MIID** represents the distance between the lateral border of the lateral sesamoid and a longitudinal line bisecting the second metatarsal shaft.

The distance between the lateral border of the lateral sesamoid and a longitudinal line bisecting the second metatarsal shaft (LS-MIID) was measured on the AP views using the technique by Saragas and Becker[20] to determine the relative position of the lateral sesamoid to the second metatarsal shaft. The preoperative and postoperative results were noted (Table 1). First metatarsal shortening was expressed as a percentage from the pre- and postoperative AP radiographs.[7]

The stationary reduction of the sesamoids was determined at the last control tangential views using the technique described by Talbot and Saltzman.[22] Sesamoids reduced and unreduced groups were formed according to the sesamoid position at the last control tangential views. Location of the medial sesamoid entirely medial to the midcristal line was defined as reduced and any other position as unreduced (Fig. 2). Preoperative and postoperative radiological features of the groups were compared to find the main factor on sesamoid reduction. Group comparisons were done at the .05 level of significance using the Student unpaired *t* test.

RESULTS

The average postoperative follow-up was 32 months. At the last tangential sesamoid views, of the 30 feet, 20 had reduced and 10 had unreduced sesamoids (Figs. 4 and 5). The average preoperative sesamoid station on the AP radiographs was 2.9 in the reduced and 2.6 in the unreduced group; the difference was statistically not significant.

The sesamoid reduced and unreduced groups were not significantly different with respect to their preoperative HV angles (average 36.4° in the reduced and 36.6°

Fig. 4: Sesamoids reduced.

Fig. 5: Sesamoids unreduced.

in the unreduced group). The average postoperative HV angle was 14.4° in the sesamoid reduced group and 23.6° in the sesamoid unreduced group ($p < .0001$). There was no hallux varus due to overcorrection.

The comparison between sesamoid reduced and unreduced groups with respect to the preoperative IM angles showed no statistically significant difference (average 16.2° in the reduced and 15.8° in the unreduced group). The amount of lateral displacement of the first metatarsal head after the operation was found to be greater in the reduced group as compared to the unreduced group and this was statistically significant ($p < .0005$; 8.5 mm and 4.1 mm, respectively; 95% CI 7.243–9.757) (Table 1).

The percentage shortening of the first metatarsal averaged 5.1% in the reduced and 5.2% in the unreduced group. The difference was not statistically significant.

In the reduced group, the distance between the fibular sesamoid and the LS-MIID was 8.7 mm preoperatively and 8 mm postoperatively. The difference was statistically significant ($p < .0005$). In the unreduced group, it was 8.3 mm preoperatively and 7.2 mm in the follow-up. The difference was also statistically significant ($p < .05$) (Table 2).

Table 1: Clinical and radiological characteristics of the patients

	All Feet	Sesamoids		*p*
		Reduced	Unreduced	
Sex (M/F)	2/28	1/19	1/9	
Follow-up (MO)	32	31.4 (SD 18.6)	32.8 (SD 26.2)	NS
Preop HV angle	36.5°	36.4 (SD 1.5°)	36.6 (SD 2.6°)	NS
Preop IM angle	16°	16.2° (SD 3.3°)	15.8° (SD 2.9°)	NS
Postop HV angle	19°	14.4° (SD 5.1°)	23.6° (SD 5.8°)	<.001
Preop sesamoid Station	2.8	2.9	2.6	NS
1st Met–2nd Met distance (lateral shifting)	7 mm	8.5 mm (SD 2.7)	4.1 mm (SD 2.6)	<.0005

M, male; F, female; MO, month; HV, hallux valgus; IM, intermetatarsal; Met, metatarsal; SD, standard deviation; NS, not significant.

Table 2: Comparision of reduced and unreduced groups with respect to lateral sesamoid–second metatarsal shaft distance (LS-MIID)

	Pre-op LS-MIID	Post-op LS-MIID	*p*
Sesamoids reduced	8.7 mm	8 mm	<.0005
Sesamoids undreduced	8.3 mm	7.2 mm	<.05

DISCUSSION

The sesamoids are an integral part of the function of the first metatarsophalangeal (MTP) joint.[9,11,22] The restoration of a normal metatarsosesamoid articulation has been considered essential for achieving a biomechanically sound operative result in HV surgery.[22] In his review of the hallux valgus, Coughlin emphasized his belief that ''the lack of reducing the sesamoidal subluxation to a normal articulation creates a risk for recurrent deformity''.[6]

Lateral sesamoid release is one of the causes of diminished motion of the first MTP joint in HV surgery.[3,8,19] Although adductor release can be made from a single incision, it generally requires a separate incision between the first and second metatarsals[1,4,5,8,18] and includes adductor tendon and intermetatarsal ligament release from the lateral sesamoid and freeing the former from its attachment to the proximal phalanx.[4,6,14,16,18]

The purpose of adductor tendon release from the lateral sesamoid is to bring the sesamoids medially. However, in HV the sesamoid mechanism basically retains its anatomic relationship to the second metatarsal.[3,14,20,22] The first metatarsal head dislocates but not the sesamoids. Corrective surgery for HV should aim at bringing the first metatarsal to the sesamoids.[20]

The present study has shown that sufficient lateral displacement of the metatarsal head alone by a distal metatarsal osteotomy is capable of reducing the sesamoids in 67% of the cases with hallux valgus. Among the parameters investigated, only the amount of the lateral shifting was found to have a statistically significant role in reducing the sesamoids into their grooves (8.5 mm in the reduced, 4.1 mm in the unreduced group; $p < .0005$; (95% CI 7.243–9.757). Parameters reflecting the severity of the deformity (preoperative HV and IM angles and the sesamoid station on the AP radiographs) were found to have no role in the reduction.

In popular osteotomies like chevron, only 2–5 mm of lateral displacement is possible.[2,6,12] As indicated in the present study, this amount of shifting appears to be inadequate to reduce the sesamoids. Although sesamoids might be reduced with lower amounts of lateral shifting, in this study 7.2 mm was found to be the minimum for lateral displacement of the metatarsal head to reduce the sesamoids in most cases. The figure presented is considerable since the patient population of this study was randomly selected and reflects the common properties of HV patients. Mann and Donatto[15] could not find a significant change in the sesamoid position using the chevron procedure without adductor tendon release, indicating that the metatarsal head still remains medial to where it should be.

The postoperative HV angles of the reduced group was found to be significantly decreased as compared to the unreduced group. This is not surprising, as it was formerly reported that the main difference between the reduced and unreduced groups was the amount of lateral displacement of the metatarsal head which is significantly higher in the reduced group. Prominent lateral displacement of the metatarsal head indirectly causes higher correction of the intermetatarsal angle overall, resulting in decreased HV angle. Leaving the medial exostosis is a major advantage of the Lindgren–Turan operation over other distal metatarsal osteotomies. In the presence of a medial exostosis on the distal fragment, greater lateral displacement is possible with better contact between the fragments, thus eliminating the need of bringing the anatomically located sesamoids medially. Our view is that, inadequate lateral displacement of the metatarsal head constitutes the need for adductor tendon release from the sesamoid, not the contracture of the lateral soft tissues attached to the fibular sesamoid.

In this study, AP standing radiographs determined the preoperative positions of the sesamoids. Talbot and Salzman[22] have shown that there is a poor relationship between the sesamoid station on the standing AP x-rays and the true position on the tangential one. However, in 90% of their cases, the station on the AP view was either equal to or deviated only one stage from those on the tangential ones. In our series, 24 feet had stage 3 and six feet had stage 2 sesamoids preoperatively. Therefore it can be stated that most of the sesamoids were either subluxed or dislocated preoperatively in our cases.

In comparision of the pre- and postoperative LS-MIID measurements which show the position of the lateral sesamoid relative to the second metatarsal, a decrease in both groups which is statistically more

pronounced in the reduced group, is seen. This minimal decrease is probably due to the lateral shifting of the first metatarsal head and shortening of the first metatarsal, which relaxes the tight lateral soft tissues and brings the lateral sesamoid nearer to the second metatarsal shaft. Although the lateral sesamoids slide minimally laterally from their preoperative positions, even in that situation, two thirds of the cases were found to have sesamoids reduced. Although statistically this was the case, alteration of the lateral sesamoid position was about 1 mm for the both groups (0.7 mm for reduced and 1.1 mm for the unreduced group) which might even be the result of measurement errors. The importance of this finding is that lateral sesamoid position was not markedly changed postoperatively. This demonstrates that reduction of the sesamoids was due to lateral shifting of the metatarsal head and not related to the medialization of the sesamoids. In other words, the lateral sesamoids preserved their preoperative stationary positions after the operation.

CONCLUSION

Sectioning the adductor tendon to reduce the sesamoids beneath the metatarsal head brings the sesamoids into a nonanatomic position. Adequate lateral shifting of the first metatarsal head over the sesamoids can both correct the hallux valgus angle and obtain a well balanced metatarsosesamoidal articulation without any additional soft-tissue release.

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