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Overview of Distal First Metatarsal Osteotomies

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Distal first metatarsal osteotomies have played a prominent role in the surgical management of the hallux abducto valgus deformity. This chapter is a brief overview of distal first metatarsal osteotomies. Distal metatarsal osteotomies are usually performed with concurrent remodeling of the medial exostosis or eminance and some form of soft tissue balancing technique.

REVERDIN OSTEOTOMY AND MODIFICATIONS

In 1881, Reverdin described a closing wedge osteotomy of the first metatarsal head with the apex laterally that also included excision of the medial eminence (Fig. 11-1A). His purpose was to realign the abducted hallux and remove the prominent bump. The procedure effectively reduces an abnormal proximal articular set angle but does not directly address the intermetatarsal angle.¹

Since the time when Reverdin first described his osteotomy, there have been a number of modifications. Roux, in 1920, described an osteotomy of the first metatarsal in which the capital fragment has a long lateral beak (see Fig. 11-1B). There are three cuts to this osteotomy. The first or distal cut is dorsal to plantar, through and through, made in the metaphyseal region of the first metatarsal head. The second or proximal cut transects the entire first metatarsal, thereby mobilizing the capital fragment. After the capital fragment is mobilized, the third osteotomy is made

perpendicular to the first cut and completes a trapezoidal section of bone, which is resected. The distal capital fragment is then transposed laterally and tilted medially, closing the trapezoidal space.^{2,3} Similar in design to the Mitchell osteotomy, the Roux osteotomy addressed both transverse plane deformity of the metatarsal head and the intermetatarsal angle.

Peabody, in 1931, reported an operation almost identical in location and purpose to that of Reverdin. Peabody performed this osteotomy more proximal than did Reverdin in the anatomic neck (see Fig. 11-1C). The osteotomy does not quite transverse the entire width of the bone, but leaves the articular or capital fragment attached by a thin segment from the lateral side of the neck and shaft area; at this site, there is undisturbed continuity of capsule and periosteum.⁴

Another modification of the Reverdin is the distal L osteotomy, referred to at times as the Reverdin-Green procedure⁵ (see Fig. 11-1D). The first cut constructed is transverse, proximal, and parallel to the joint surface. The second dorsal cut is then perpendicular to the shaft of the metatarsal, in the frontal body plane. This creates a wedge that will enable the joint surface to be realigned, properly adjusting the proximal articular set angle. The plantar osteotomy is then made parallel as a shelf protecting the sesamoid articulation surface of the first metatarsal. Transposition of the capital fragment is achieved by completion of the osteotomy laterally.⁶

The Reverdin corrects for abnormality of the proximal articular set angle, but the modifications also address the intermetatarsal angle.

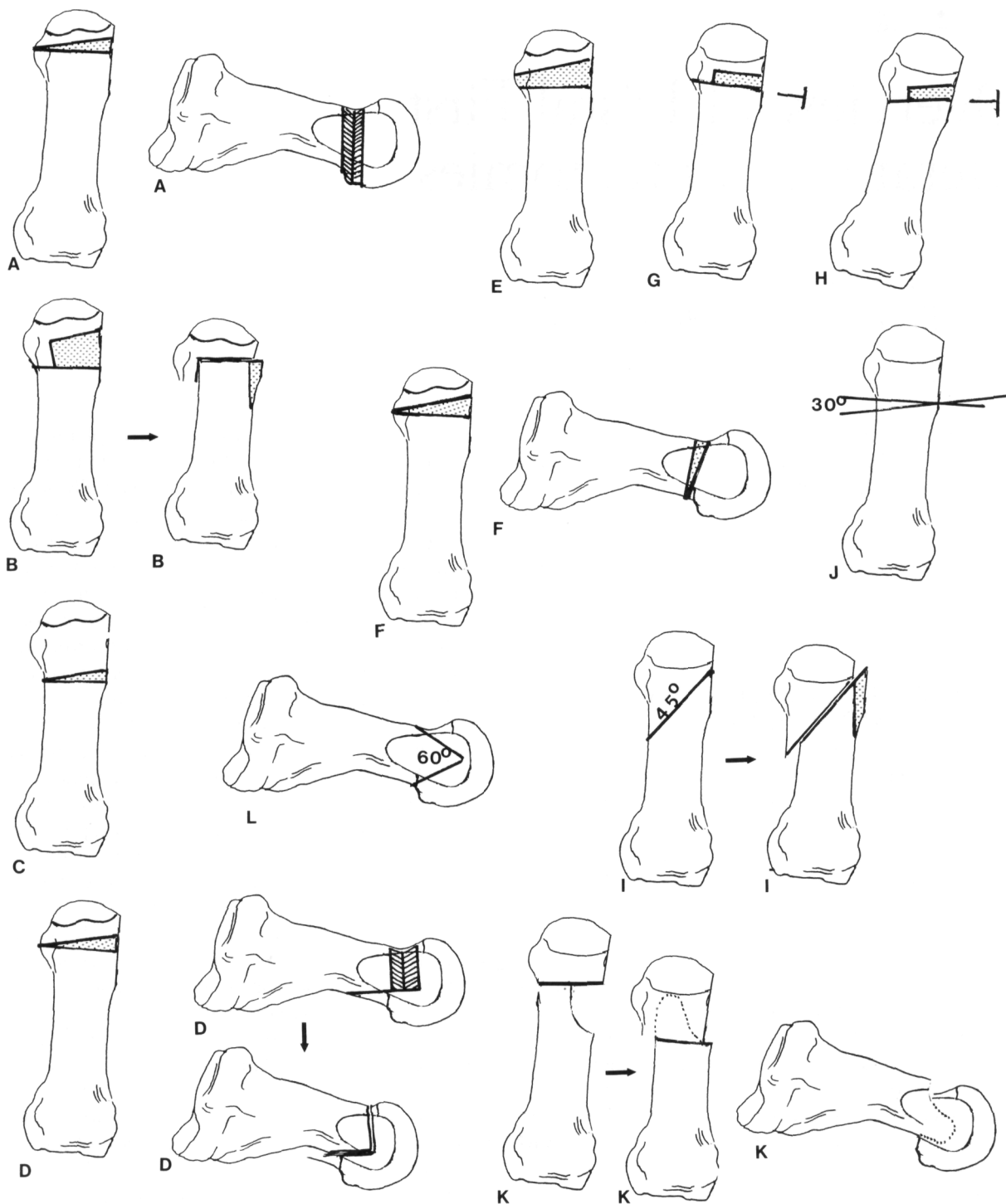


Fig. 11-1. (A) Reverdin osteotomy. (B) Roux osteotomy. (C) Peabody osteotomy. (D) Distal L osteotomy. (E) Hohmann osteotomy. (F) DRATO osteotomy. (G) Mitchell osteotomy. (H) Miller osteotomy. (I) Wilson osteotomy. (J) Lindbren and Turan osteotomy. (K) Mygind osteotomy. (L) Austin osteotomy.

HOHMANN OSTEOTOMY

Hohmann, in 1923, proposed an operation that would not only correct the valgus deformity of the great toe but also splaying of the forefoot as a whole. The procedure included dissection of the abductor hallucis from the medial head of the flexor brevis, detachment from its insertion into the base of the proximal phalanx, and reflection proximally. The head of the first metatarsal was disconnected from the shaft by a trapezoid or cuneiform osteotomy (see Fig. 11-1E). The trapezoid piece removed was wider on the medial aspect. The capital fragment was then pushed closer to the second metatarsal and the osteotomy closed. The severed end of the abductor hallucis was reattached to a more dorsal point on the medial side of the base of the phalanx.^{3,7}

CAPP OSTETOMY

Suppan, in 1974, proposed the cartilaginous articulation preservation principle or CAPP procedure. At all times, the major part of the articulating cartilage is to be preserved. This technique as a general rule corrects the intermetatarsal angle and proximal articular set angle, and allows repositioning of the cartilaginous articulation by rotation of the base of the proximal phalanx to address the valgus component of the hallux. Two cuts approximately 1/4 in. apart are made through the metatarsal head, and the section of bone is removed. The medial exostosis is also resected, thus leaving the cartilage and subchondral bone of the head of the metatarsal to be positioned freely and correctly within the surrounding capsule. The osteotomy cuts are performed at a right angle to the metatarsal.⁸

DRATO OSTEOTOMY

The viability of the articular cartilage of the first metatarsophalangeal joint, considered with the congruity or incongruity of the joint surfaces, is important in the assessment of hallux abducto valgus deformity that was stated by Johnson and Smith. They proposed the derotational, angulational, transpositional osteotomy, or DRATO procedure, in 1974 (see Fig. 11-1F). The osteotomy consists of resection of the medial exostosis; a transverse osteotomy is then performed at the neck of the metatarsal perpendicular to its shaft. The

capital fragment is either inverted or everted depending on the amount of rotation of the hallux present. A second osteotomy is then performed distal to the first osteotomy, parallel to a line that traverses the metatarsal head, intersecting at the articular margins of that head. The second osteotomy connects with the first at the lateral cortex. The resultant medial wedge is removed to adduct the capital fragment. A third osteotomy may be used to remove a dorsally based wedge to dorsiflex the capital fragment. The metatarsal head is displaced laterally by one-third the width of the bone, and fixated.⁹

MITCHELL OSTEOTOMY AND MODIFICATIONS

In 1945 and again in 1958, Mitchell described an osteotomy procedure that was used to correct metatarsus primus varus and hallux valgus. The osteotomy is performed by making an incomplete osteotomy perpendicular to the long axis of the first metatarsal. The distal osteotomy is made about 3/4 in. from the articular surface of the metatarsal head (see Fig. 11-1G). The thickness of the bone formed between the bone cuts depends on the amount of shortening of metatarsal necessary to relax the contracted soft tissue structures. The proximal osteotomy is then completed. The size of the lateral spur depends on the amount of intermetatarsal angle to be corrected with lateral displacement of the capital fragment. The osteotomy is displaced plantarly to accommodate for shortening of the metatarsal and to prevent metatarsalgia. Angulation of the distal bone cut will provide correction for abnormalities of the proximal articular set angle.^{3,10,11}

In 1974, Miller described another modification to the Mitchell type of osteotomy (see Fig. 11-1H). He regarded the axis of the foot as more important than the axis of the first metatarsal bone; therefore, the osteotomy was performed perpendicular to the axis of the foot. He obtained lateral displacement in the frontal plane to achieve better correction.^{3,12}

WILSON OSTEOTOMY AND MODIFICATIONS

Wilson, in 1963, described an oblique osteotomy for the advantages of simplicity, stability with displacement of the metatarsal head without need for internal

fixation, broad osteotomy surfaces that reduce the risks of nonunion, and a large metatarsal head fragment that minimizes the chances of avascular necrosis (see Fig. 11-1I). This technique consists of an oblique osteotomy of the distal third of the first metatarsal, combined with remodeling of the medial exostosis. The line of the osteotomy is on the medial side at the proximal end of the exostosis, extending laterally at an angle of 45°. The osteotomy is cut to displace the distal fragment by angulation of the saw at 45°; the remaining prominent shaft is removed after the osteotomy is in its correct alignment.^{13,14}

There have been a number of other modifications to the Wilson osteotomy. One of the first modifications was made by Helal et al; in 1974, they changed the direction of the osteotomy by tilting it from a dorsal-distal position to plantar-proximal. Because this double oblique osteotomy modification is oblique in two planes, dorsal tilting of the capital fragment is prevented while the area of contact at the osteotomy site is also increased.¹⁵ In 1976, Davis and Litman used Wilson's technique with one exception, that the medial exostosis was not removed, which allowed the first metatarsophalangeal joint to remain undisturbed. Davis and Litman considered that the less interference with the joint, the better.¹⁶

Allen et al., in 1981, then modified the osteotomy in two ways. First, they used a cancellous screw for rigid internal fixation, and second, they fashioned a medially based wedge that after removal allowed for correction of a laterally deviated cartilage.¹⁷ In another modification, Pittman and Burns, in 1984, altered the direction of the osteotomy from a proximal-medial to a distal-lateral direction to address hallux limitus by plantarly displacing the capital fragment.¹⁸

The Telfer osteotomy for hallux valgus was introduced in 1985. The procedure was developed with modifications to the original simple oblique Wilson osteotomy at the neck of the first metatarsal head that produce a maximum lateral displacement of the distal fragment and retain the ideal position by means of rigid internal fixation. The prominent metatarsal shaft that is created after the osteotomy is transposed is now removed. The author also states that fear of nonunion is now virtually nonexistent, and that greater correction of the hallux valgus is possible by increasing the lateral displacement of the distal fragment because of the internal fixation.¹⁹

In 1988, Klareskov et al. modified Wilson's osteotomy by plantar-flexing the first metatarsal head as it is shifted laterally. The plantar displacement of the distal fragment allows the first metatarsal to bear more of the weight-bearing forces, thus reducing excessive pressure on the lateral metatarsal heads.²⁰

TRANSVERSE OSTEOTOMY

A transverse osteotomy described by Lindgren and Turan is performed at approximately 30° to a line that transverses the metatarsal head. The osteotomy is displaced laterally and fixated²¹ (see Fig. 11-1J).

PEG-IN-HOLE OSTEOTOMY

Perhaps the most interesting and uncommon modification of dual-plane, lateral and plantar, displacement osteotomy of the distal end of the first metatarsal is that described by Mygind and credited to Thomasen in 1952 and 1953. The peg-in-hole osteotomy is described as primarily indicated in adolescents and young adults with hallux valgus and metatarsus primus. Thomasen's osteotomy modified the oblique osteotomy of the distal end of the first metatarsal. The osteotomy was performed, and a bone spike or peg was made in the proximal portion of the metatarsal with the hole being fashioned in the capital fragment (see Fig. 11-1K). The osteotomy was then laterally displaced so that the osteotomy could interlock, and is then fixated.³²²

AUSTIN OSTEOTOMY

In 1981, Austin published his osteotomy, which is a horizontally directed, V displacement osteotomy of the metatarsal head for the management of hallux valgus and an increase of the intermetatarsal angle²³ (see Fig. 11-1L). In preparation for the osteotomy, the medial exostosis is remodeled, and a drill hole is centered on the medial surface of the metatarsal head. The hole is the apex of the osteotomy cuts. The V osteotomy is horizontally directed, and the cuts are made at a 60° angle that allows the cuts to remain in cancellous bone areas of the head, providing a broad

surface for healing. Also, this osteotomy provided excellent stability. The capital fragment is displaced laterally and impacted by hand pressure in the corrected position. The protruding portions of the proximal metatarsal area are now remodeled.

SUMMARY

Distal metatarsal osteotomies perform four basic functions. They can decrease the intermetatarsal angle; realign structural abnormalities in the transverse plane such as abnormal proximal articular set angles; and shorten or maintain the length of the metatarsal. The Reverdin-type osteotomy is used in correction of an abnormally high proximal articular set angle. This may also be accomplished by biplane osteotomies of the Wilson, Mitchell, or Austin types. Reduction of the intermetatarsal can be accomplished by lateral displacement of those osteotomies. The degree of reduction will be less than that obtained with proximal osteotomies, and therefore lateral displacement osteotomy is used with intermetatarsal angles ranging from 12° to 16°. Distal osteotomies may cause a significant decrease in metatarsal length and therefore should not be used with excessively short metatarsals. Plantar flexion of the capital fragment aids in compensating for metatarsal shortening by retaining the weight-bearing function of the metatarsal. Distal osteotomies may be used to advantage in patients with long first metatarsals.

The osteotomies described by Reverdin, Hohmann, Mitchell, and Austin are described in detail in Chapters 15, 13, 14, and 12, respectively.

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