ORIGINAL RESEARCH

Rates of Revision Surgery Using Chevron-Austin Osteotomy, Lapidus Arthrodesis, and Closing Base Wedge Osteotomy for Correction of Hallux Valgus Deformity

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To identify complications that necessitated revision surgery after the primary operation, a multicenter retrospective chart review was conducted for 646 patients who received either a modified chevron-Austin osteotomy (270 patients), modified Lapidus arthrodesis (342 patients), or closing base wedge osteotomy (34 patients) to correct hallux valgus deformity. Revision surgery for complications was calculated and compared. All surgery was performed by 1 of 5 staff foot and ankle surgeons at Kaiser Permanente medical centers. Complications included recurrent hallux valgus, iatrogenic hallux varus, painful retained hardware, nonunion, postoperative infection, and capital fragment dislocation. The rates of revision surgery after Lapidus arthrodesis, closing base wedge osteotomy and chevron-Austin osteotomy were similar with no statistical difference between them. The total rate for re-operation was 5.56% among patients who received chevron-Austin osteotomy, 8.82% among those who had a closing base wedge osteotomy, and 8.19% for patients who received modified Lapidus arthrodesis. Among patients who had the chevron-Austin osteotomy procedure, rates of re-operation were 1.85% for recurrent hallux valgus and 1.48% for hallux varus. Among patients who had the modified Lapidus arthrodesis, rates of re-operation were 2.92% for recurrent hallux valgus and 0.29% for hallux varus. Among patients who had the closing base wedge osteotomy, rates of reoperation were 2.94% for recurrent hallux valgus and 2.94% for hallux varus. The collected comparative complication rates should serve to provide adjunctive information for foot and ankle surgeons and patients regarding hallux valgus surgery. Level of Clinical Evidence: 2. (The Journal of Foot & Ankle Surgery 47(4):267–272, 2008)

Key Words: chevron-Austin, complications, hallux valgus, lapidus, osteotomy

Complications of hallux valgus surgery depend on inherent stability of the osteotomy, type of fixation, and anatomic location of the osteotomy (1, 2). The procedure for correcting hallux valgus is often dictated by the amount of correction needed. A proximal osteotomy provides greater correction for severe deformity but is also inherently less stable

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than the chevron-Austin head osteotomy and relies more heavily on fixation (3, 4). Complications associated with the chevron-Austin osteotomy include recurrent hallux valgus, overcorrection resulting in varus deformity, head dislocation, and avascular necrosis (5). Potential complications associated with a closing base wedge osteotomy include elevation, recurrence, overcorrection, and hardware failure (4, 6, 7).

Hallux valgus associated with hypermobility of the first ray can be corrected by arthrodesis of the first tarsometatarsal joint. Complications associated with this procedure include nonunion, undercorrection, and excessive shortening (8–14). Several studies have assessed outcomes and complications of these procedures (15, 16).

Hallux valgus surgery has been postoperatively assessed primarily on the basis of radiographic analysis, subjective satisfaction score algorithms, rate of deformity recurrence, and rate of hallux varus. The complication rate associated with surgical correction of hallux valgus varies with the type of osteotomy performed. The multitude of documented procedures for surgically correcting hallux valgus may suggest that surgical indications are not as well defined as some surgeons may believe. An individual surgeon's experience and training bias can dictate the procedure selected, and surgeons have their own criteria for selecting a given type of osteotomy procedure. This selection may also be influenced by previous subjective and radiographic studies of surgical outcome. Potential complications are well understood but currently cannot be reliably predicted. Moreover, not all complications are symptomatic, and asymptomatic complications may not require revision surgery. Symptomatic complications directly associated with the primary surgery (eg, recurrence of hallux valgus or of hallux varus) require surgical revision.

To date, there are no published reports on the rates of revisional surgery undertaken to correct hallux valgus. Our study compared the rates of re-operation for patients who had a chevron-Austin osteotomy, modified Lapidus arthrodesis, and closing base wedge osteotomy as the primary surgery.

Materials and Methods

We conducted a multicenter retrospective review of 646 patients who had surgical correction of hallux valgus deformity by 5 surgeons during the 5-year period extending from 2000 through 2004. For these patients, surgical correction to correct the deformity used a modified chevron-Austin osteotomy, modified Lapidus arthrodesis, or a closing base wedge osteotomy. The study included patients who had multiple concurrent procedures but excluded patients who had a double osteotomy of the first ray. Modified Lapidus arthrodesis was selected for patients with first ray instability shown either at clinical examination (ie, by direct observation of excessive dorsal/plantar excursion of the first metatarsal above the level of the lesser metatarsals) or radiographically (ie, by x-ray film showing a short first metatarsal, a metatarsocuneiform fault with plantar gapping, a navicular cuneiform fault, or hyperostosis of the second metatarsal). Modified Lapidus procedure was selected also for patients who were initially diagnosed with only metatarsus primus varus and an intermetarsal angle of more than 15 degrees between the first and second metatarsals. Modified chevron-Austin osteotomy was selected for patients with an intermetarsal angle less than 15 degrees between the first and second metatarsals, and no radiographic or clinical signs of first ray instability. A closing base wedge osteotomy was selected for patients with an intermetatarsal angle greater than 15 and no detectable first ray hypermobility. Preoperative and postoperative radiographs were not assessed or measured in this study. Patient medical records were reviewed for complications directly related to the primary surgical procedure that required additional surgery for correction. Complications included recurrent hallux valgus, hallux varus, nonunion, arthrofibrosis of the first metatarsophalangeal joint, postoperative infection, avascular necrosis, osteotomy displacement, and painful retained hardware (Figure 1). All surgical revisions that were recorded in the Kaiser Permanente patient chart were included, even if the surgeon performing the surgical correction was not the original surgeon. Overall complication rates for each procedure (chevron-Austin osteotomy, modified Lapidus arthrodesis, and closing base wedge osteotomy) were calculated and compared. Statistical significance (P value less than .05) was calculated via a chi-square analysis or Fischer's exact test depending on the number of individual complications. Patients with an aforementioned complication were separated into an individual cohort. The past medical history, age, gender, tabacco use, use of chronic steroids, and type of bunion procedure were obtained from this patient population and reported. No statistical analysis was performed from the complication cohort due the small sample size.

Operative Technique

The chevron-Austin osteotomy was done with a medial "L" or linear capsulotomy (ie, full lateral release of the conjoined adductor tendon and lateral sesamoid ligaments). The osteotomy was done at the center of the metatarsal head with an angulation of approximately 60 degrees. A longer dorsal osteotomy arm was made to facilitate easier fixation. Fixation was maintained using standard AO (Arbeitsgemeinschaft für Osteosynthese [Association for the Study of Osteosynthesis]) lag screw technique. The osteotomy was fixed with either a single or double partially threaded cor-

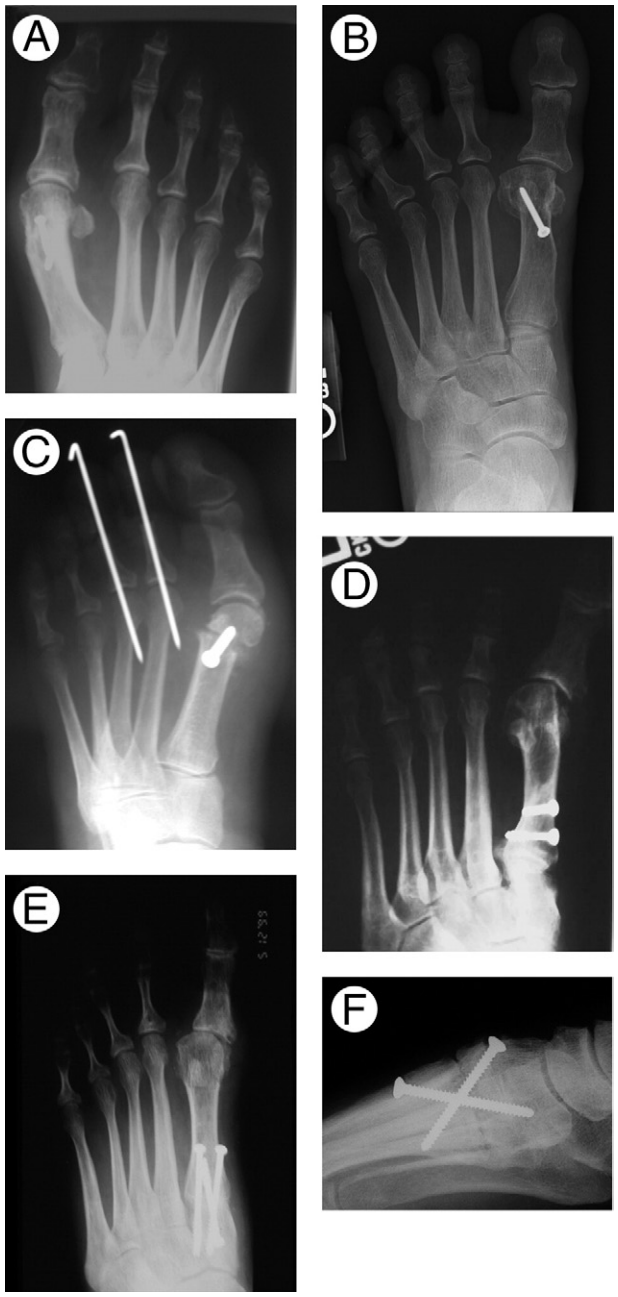

FIGURE 1 A. Anteroposterior radiograph demonstrating undercorrection after chevron-Austin osteotomy. B. Iatrogenic hallux valgus after chevron-Austin osteotomy. C. Dorsal plantar projection with capital fragment displacement after chevron-Austin osteotomy. D. Hallux valgus deformity after closing base wedge oseotomy. E. Varus overcorrection after lapidus arthrodesis. F. 7-month postoperative radiograph, showing nonunion of the first tarsometatarsal joint.

tical screw. Screw diameter varied from 2.4 mm to 3.0 mm. In most instances, medial capsulorraphy was done before closure. Postoperative bandaging maintained the hallux in a rectus position. Immediately after surgery, patients resumed weight bearing using a surgical shoe for 3 to 6 weeks and regular shoes thereafter.

Modified Lapidus arthrodesis also used a longitudinal incision to avoid the dorsomedial cutaneous nerve. The first metatarsophalangeal joint was addressed first: The hypertrophic medial eminence, if present, was resected, and the conjoined adductor tendon in the first interspace was released. The first metatarsocuneiform joint was exposed through a transverse capsulotomy. The cartilage was denuded with a sharp osteotome, leaving the subchondral plate intact. The subchondral bone was fenestrated and scalloped to promote bleeding.

Fixation was achieved with two or three 3.5-mm or 4.0-mm cortical screws (Synthes, West Chester, PA) in a stacked and crossed fashion. Postoperative management included use of a non–weight-bearing short leg cast for 4 to 6 weeks followed by protected weight bearing for an additional 2 to 4 weeks.

The closing base wedge osteotomy also used a longitudinal incision to avoid the dorsomedial cutaneous nerve. The first metatarsophalangeal joint was addressed first: The hypertrophic medial eminence, if present, was resected, and the conjoined adductor tendon in the first interspace was resected. A lateral base wedge was resected from base of first metatarsal.

Fixation was achieved with one 3.5-mm cortical screw (Synthes) or two 1.6-mm Kirschner wires. Postoperative management included use of a non–weight-bearing short leg cast for 6 weeks followed by protected weight bearing for an additional 2 to 4 weeks.

Results

A total of 270 modified chevron-Austin osteotomy procedures, 342 modified Lapidus arthrodesis procedures, and 34 closing base wedge osteotomies were performed. Total rate of reoperation was 5.56% for the chevron-Austin osteotomy, 8.19% for the modified Lapidus arthrodesis, and 8.82% for the closing base wedge osteotomy. There was no comparative statistical significance in the rate of reoperation between all three procedures (*P* value .42) (Figure 2). Of 270 patients who had a chevron-Austin osteotomy, 2 sustained postoperative capital fragment fracture dislocations, 5 developed recurrences, 4 iatrogenic varus complications, 1 painful hardware irritation, 2 painful first metatarsophalangeal joint arthofibroses, and 1 postoperative infection. All these complications required surgical management for correction. The 2 capital fragment fracture dislocations were attributed to traumatic injury sustained within the first postoperative week. None of the 5 recurrent bunions recurred a second time, and all 5 bunions were corrected with either a first metatarsal osteotomy or first metatarsal cuneiform arthrodesis. The 4 varus deformities were corrected with a first

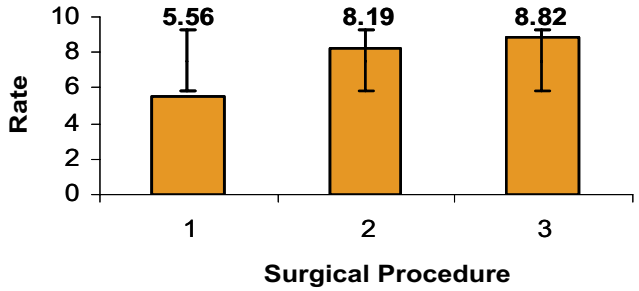

FIGURE 2 Rate of reoperation (%) for 1. chevron-Austin osteotomy, 2. lapidus arthrodesis, and 3. closing wedge base osteotomy.

metatarsophalangeal joint fusion, capsule-tendon balancing, or osteotomy. No varus deformity recurred. The 2 painful first metatarsophalangeal joint arthrofibroses were treated with surgical debridement and early return to active range of motion and did not require additional surgery. The 1 postoperative infection required an incision and drainage and healed uneventfully.

Among the 342 patients who received the modified Lapidus arthrodesis, 10 had recurrence of the deformity, 1 had a varus deformity, 7 patients had painful retained hardware, 7 had a nonunion, and 3 had painful arthrofibrosis of the first metatarsophalangeal joint. The recurrent bunions were treated with a distal metatarsal osteotomy and did not recur thereafter. The iatrogenic varus deformity was treated with a fusion of the first metatarsophalangeal joint. The 7 patients with painful retained hardware required removal of all hardware responsible for the Lapidus fusion and did not require additional surgery. The 3 patients with painful arthrofibrosis of the first metatarsophalangeal joint had surgical debridement and early return to active range of motion and did not require additional surgery.

Of the 34 patients who received a closing base wedge osteotomy, 1 had a recurrent bunion deformity, 1 had varus deformity, and 1 had irritation from retained hardware. The recurrent bunion was treated with a modified Lapidus arthrodesis and did not require additional surgery. The 1 iatrogenic varus deformity required fusion of the first metatarsophalangeal joint. The 1 patient with painful retained hardware required removalof the hardware. Table 1 shows complication rates for all 3 surgical procedures.

Of the 46 patients who developed a postoperative complication, medical records of 23 patients were retrieved. Of these 23 patients there were 14 modified Lapidus arthrdesis and 9 chevron-Austin osteotomies. The average age was 50.3. There were 18 females and 5 males. There were 3 patients who developed a recurrence; 2 had a modified Lapidus arthrodesis and 1 had a chevron-Austin osteotomy. Five patients had a nonunion, of which all had a modified Lapidus arthrodesis. Three patients had an overcorrection, of which all were chevron-Austin osteotomies. There was 1 patient who was actively smoking. This patient had a nonunion from a modified Lapidus arthrodesis. Seventeen patients had a documented past medical history and 6 patients had no past medical history noted. Two patients had a documented history of chronic steroid use, both of whom developed an overcorrection from a chevron-Austin osteotomy. Two patients had diabetes mellitus; both had a nonunion from a modified lapidus arthrodesis. Five patients had hyperlipidemia: 2 had hardware irritation from a modified lapidus arthrodesis, 2 developed a recurrence from a chevron-Austin osteotomy, and 1 had an overcorrection from a chevron-Austin osteotomy. Eight patients had documented hypertension. One had a scar release from a chevron-Austin osteotomy. One had a recurrence from a chevron-Austin osteotomy. One had painful retained hardware from a modified lapidus arthrodesis. Three had a nonunion from a modified lapidus arthrodesis. One had an overcorrection from a chevron-Austin osteotomy. One had capital fragment collapse from a chevron-Austin osteotomy.

Discussion

Various authors have reported complication rates for specific surgical procedures done to correct hallux valgus deformity. For a distal metatarsal osteotomy, complication rates between 5.7% (7 of 121 feet) and 9.52% (4 of 42 feet) have been reported (17, 18). Donnelly et al (19) reported no complications associated with a distal metatarsal osteotomy using a long plantar arm. Rossi and Ferreira (20) reported a 7.1% (12 of 168 feet) complication rate in a series of 112 patients. Peterson et al (21) reported a hallux varus rate of 1.2% (1 of 82 feet).

The rate of complications occurring after arthrodesis of the first tarsometatarsal joint has declined since Lapidus reported a 50.5% rate of disease recurrence among patients who received this procedure. Other complication rates reported for arthrodesis of the first tarsometatarsal joint include a 2.5% (3 of 119 feet) rate of hallux varus deformity (13) and 15.7% (8 of 51 feet) hallux varus (14). To date, only 1 report (22) has assessed rate of revision surgery for the Lapidus procedure. These authors (22) reported a 13% combined revision rate secondary to nonunion, hallux varus, and malunion.

Only a sparse collection of data has been collected on the closing base wedge osteotomy. Seiberg et al (3) found similar subjective results when comparing the chevron osteotomy with the closing base wedge osteotomy. Jeremin et al (23) noted that 71% of the 24 operated feet developed lesser metatarsal plantar lesions following a proximal closing base wedge osteotomy. Resch et al (24) evaluated 27 feet that had a closing base wedge osteotomy. He reported 1 recurrence and 1 transfer metatarsalgia, both of which required reoperation.

TABLE 1 Complication rates* for each of 3 surgical procedures used to correct hallux valgus deformity

	Complication rate, %			
	Chevron-Austin osteotomy	Modified Lapidus arthrodesis	Closing base wedge osteotomy	*P* value
Iatrogenic varus deformity	1.48	0.29	2.94	.10
Recurrence	1.85	2.92	2.94	.69
Hardware irritation	0.37	2.05	2.94	.09
Nonunion	0.00	0.00	2.05	.04

*Rates of postoperative infection, arthrofibrosis of the first metatarsophalangeal joint, and head collapse were statistially insignificant for all procedures.

We are not aware of any previous studies comparing rates of surgical revision for the chevron-Austin osteotomy, the modified Lapidus arthrodesis, and the closing base wedge osteotomy. Our study included complications that were defined as any that required a revisional surgery, including removal of hardware related to the primary surgery. Inclusion of hardware removal elevated the complication rate in our study. Symptomatic irritation from hardware should be considered a complication of orthopedic surgery, albeit one that is fairly easily corrected. Our results show that the chevron-Austin procedure had a lower complication rate than the Lapidus arthrodesis and closing base wedge osteotomy. The only complication that proved to be significant between procedures was the rate of nonunion, which occurred only in the Lapidus arthrodesis group. The apparent high complication rate of the closing base wedge osteotomy may be misleading due to the small cohort of 34. Rates of complications requiring surgical revision were lower in our study than in previous studies, probably because of improved internal fixation and advanced knowledge of fixation techniques as well as first ray biomechanics. Our results indicate that the Austin bunionectomy, Lapidus arthrodesis, and closing base wedge osteotomy demonstrate surgical revision rates that are not statistically significant when compared to each other. The weakness of the current study includes the small closing base wedge osteotomy population of 34 and short follow-up period of 1 to 4 years. The purpose of the current study was to supply foot and ankle surgeons and patients with the rate of reoperation of various surgical procedures for hallux valgus.

Conclusion

This study showed that the rate of surgical revision in patients who received a chevron-Austin osteotomy, Lapidus arthrodesis, or closing base wedge osteotomy was similar and did not demonstrate a statistical difference. When selecting a procedure for surgically correcting hallux valgus, surgeons should consider that we observed higher rates of nonunion and hardware-related pain in patients who had the modified Lapidus arthrodesis and that patients who received chevron-Austin osteotomy had higher rates of symptomatic hallux varus deformity. Incidence of recurrence was similar for both surgical procedures even though patient selection for the Lapidus arthrodesis was based on clinically evident first ray instability.

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