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# Retrospective Analysis of the Akin Osteotomy

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A R T I C L E I N F O

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A B S T R A C T

Hallux abductovalgus is one of the most common deformities addressed by foot and ankle surgeons. Surgically, it can be approached using a wide variety of procedures. After performing the first metatarsal osteotomy, the final step is often to realign the great toe in a rectus position. This is performed with an osteotomy of the proximal phalanx. The Akin osteotomy is a medially based closing wedge osteotomy of the proximal phalanx. When executing the osteotomy, the goal is not only to correct abduction, but also to keep the lateral cortex intact, which allows it to act as an additional point of fixation. However, the lateral cortex can be iatrogenically compromised during surgery or in the postoperative period. We investigated the frequency of disruption of the lateral cortex, osteotomy displacement, healing time, and the need for surgical revision associated with the Akin procedure. A total of 132 patients who had undergone Akin osteotomy were included in the present retrospective study. Intraoperative fluoroscopy showed the lateral cortex was compromised in 47 (35.6%) patients and remained intact for 85 (64.4%) patients. Of the 47 (35.6%) patients with lateral cortex disruption intraoperatively, 9 (19.1%) experienced displacement during the postoperative period, of whom, 3 (6.38%) required surgical revision. Although intact during surgery, the other 6 (4.55%) patients sustained lateral cortex fractures postoperatively, 2 (33.3%) of whom required surgical revision. A statistically significant difference was found between the integrity of the lateral cortical hinge and the healing time of the osteotomy. All the osteotomies with displacement postoperatively were noted to have lateral cortex failure, either during surgery or during the follow-up period.


In 1925, O. F. Akin first described an osteotomy of the proximal phalanx of the hallux (1). The osteotomy was wedge shaped, with the base oriented medially and the apex at the lateral cortex (1). The osteotomy was first fixated using a tongue depressor as a splint. Originally, the procedure included removal of the medial eminence of the first metatarsal head and the adjacent hypertrophic bone from the base of the proximal phalanx. The goal of this procedure was to place the hallux in a rectus anatomic position and prevent contact between the first and second digits. Currently, the Akin osteotomy can be used to correct the enlarged hallux abductus angle (HAA) not addressed by the first metatarsal procedure, hallux abductus interphalangeal (HAI) angle, an abnormal distal articular set angle (DASA), or to shorten a long proximal phalanx. Most often, the Akin osteotomy is performed in conjunction with first metatarsal osteotomy for the correction of a hallux valgus deformity. A normal HAA ranges from $<15^\circ$ to $20^\circ$, a normal HAI angle ranges from $0^\circ$ to $10^\circ$, and a normal DASA ranges from $0^\circ$ to $7.5^\circ$ (2–6). When used to realign the HAI angle, the osteotomy is placed distally on the diaphysis of the proximal phalanx, and, when used to correct the DASA, the Akin is placed proximally in the metaphyseal bone, with the base oriented medially in both techniques. With these 2 techniques, the goal is to retain the integrity of the lateral cortical hinge, which functions as an additional point of fixation. To correct a long proximal phalanx, a cylindrical wedge of bone is removed from the central diaphysis.

According to Frey et al (7), for correction of the DASA, the best placement of the osteotomy is in the proximal metaphyseal bone 5 to 7 mm distal to the articular surface of the base of the proximal phalanx. They also determined that removing 3 mm of bone resulted in $8^\circ$ of correction, 5 mm resulted in $16^\circ$ of correction, and 8 mm resulted in $24^\circ$ of correction (7).

Since Akin's original use of a tongue depressor for stabilization, numerous methods of internal fixation have been used. Fixation has

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progressed from monofilament wire to Kirschner wires, screws, staples, and plates. Each type of fixation has advantages and disadvantages. The method of fixation most often depends on surgeon preference; however, the goal is to establish a stable osteotomy that does not displace and heals within an appropriate period.

To the best of our knowledge, no research has been reported to date that has investigated the frequency of lateral cortical hinge fracture or complications associated with the procedure. We hypothesized that breaking the lateral cortical hinge intraoperatively would lead to prolonged healing and an increased risk of osteotomy displacement, which might result in the need for surgical revision.

#### Patients and Methods

After institutional review board approval, a retrospective medical record review was conducted of 132 consecutive patients who had undergone an Akin osteotomy performed by the same board-certified foot and ankle surgeon (L.M.F.) from July 2011 to January 2014. All patients were from the senior author's practice (L.M.F.). In the present study, an Akin osteotomy was indicated when patients presented with an abducted hallux or a hallux that overlapped or underlapped the second digit. Weightbearing radiographs of the patient's foot displayed an increase in the HAA, HAI angle, or DASA. The patient's bunion discomfort had to be significant enough for the patient to request surgical correction. Patients were excluded if they had sustained a previous fracture of the proximal phalanx of the hallux or had undergone previous hallux valgus surgery. The data collected from the individual medical records included the following: age, gender, tobacco use, foot operated on, osteotomy orientation, fixation type, lateral cortical hinge integrity, healing time in weeks, displacement of the osteotomy site, and the need for surgical revision.

*Surgical Technique*

All procedures were performed with the patient under intravenous sedation and placed in the supine position. An ankle tourniquet was used for all patients. The operative site was prepared and draped in the usual sterile manner. All patients included in the present study underwent distal first metatarsal chevron-style osteotomy before the Akin procedure. The proximal phalanx was exposed using the same incision used for the first metatarsal osteotomy. Next, the axis of the osteotomy site (proximal, central, or distal) and orientation (perpendicular or oblique to the long axis of the proximal phalanx) were determined according to the patient's presenting deformity. Without the use of an axis guide, the Akin osteotomy was performed under fluoroscopic guidance, with the intent of keeping the lateral cortex intact. The osteotomy site was feathered until it could be reduced. The osteotomy site was evaluated using fluoroscopy for lateral hinge integrity and then fixated using 1 of the following techniques: screw, staple, monofilament wire, Kirschner wire, plate, or a combination. After fixation was achieved, the osteotomy site was inspected once more using fluoroscopy to assess for the presence of hinge fracture. For each osteotomy, the senior author (L.M.F.) selected the fixation method that would provide the most stable construct. The fixation was tailored to the age of the patient, location of the osteotomy, bone quality, and the patient's ability to comply with the postoperative protocol. When the lateral cortex had been disrupted intraoperatively, adjunctive fixation was used if the osteotomy was considered unstable. The stability of the osteotomy site was analyzed by manual pressure under intraoperative fluoroscopic guidance. For the cases in which the osteotomy site was deemed unstable, adjunctive fixation using methods available to the primary surgeon at the time of operation was used (staple, Kirschner wire, screw, or cerclage wire). After the deformity was corrected, layered closure was completed. The patients were placed into a soft dressing and slipper cast postoperatively. In all patients, partial weightbearing to the heel with the aid of crutches or a walker was allowed after surgery. The patients returned to the primary surgeon's office at 2-week intervals postoperatively. Osteotomy site healing was assessed using anteroposterior, oblique, and lateral radiographs at these 2-week intervals by a board-certified radiologist and 2 of us (L.M.F., N.K.P.). Complete union of the osteotomy site was determined by complete bridging of cortical bone. The minimum patient follow-up period was 14 months postoperatively. The bone healing time was compared for patients with an intact versus compromised lateral cortex and patients with versus without a smoking history using an unpaired *t* test. Statistical significance was defined as $p \leq .05$.

## Results

A total of 132 patients (132 feet) with a mean age at surgery of 46.9 ± 15.8 (range 11 to 78) years were included in the present study. Of the 132 patients, 110 were female and 22 were male. The Akin procedure was performed on 66 left and 66 right feet. Nonsmokers comprised 75% (n = 99) of the patient population. Of the 132 osteotomies, 15 (11.4%) were oriented obliquely to the long axis of the proximal phalanx and 117 (88.6%) were perpendicular to the long axis.

A total of 47 lateral cortices (35.6%) were disrupted intraoperatively. Fixation was augmented if deemed necessary because of instability of the osteotomy site noted using intraoperative fluoroscopy. The fixation methods used are listed in Table 1. Of the 47 lateral cortices that were disrupted intraoperatively, 9 (19.1%) became displaced during the postoperative course. Three (6.38%) patients who had experienced lateral cortical hinge disruption intraoperatively required surgical revision, one of which had resulted from nonunion. An additional 6 (4.55%) patients experienced lateral cortex fracture and displacement by postoperative visit 1 (2 weeks postoperatively), 2 (33.3%) of whom required surgical revision. Thus, 5 (3.79%) patients required surgical revision, 3 (2.27%) who had sustained lateral cortex disruption intraoperatively and 2 (1.52%) who had sustained a lateral cortex fracture postoperatively. The mean healing period for the patients who retained lateral cortex integrity was 7.05 (range 4 to 14) weeks versus 8.06 (range 6 to 13) weeks for the patients with lateral cortex disruption (Table 2). The difference in healing time was statistically significant using an unpaired *t* test ($p = .002$). However, smoking was not associated with a substantial delay in healing time. Of the 33 (25%) patients who smoked, 10 (30.3%) had lateral cortices that fractured intraoperatively, 3 (9.09%) of these osteotomies became displaced postoperatively, and 1 (3.03%) required surgical revision. Osteotomy consolidation in this smoking group was noted at a mean of 7.06 (range 4 to 13) weeks versus 7.05 (range 4 to 14) weeks for the nonsmokers, a difference that was not statistically significant ($p = .23$). In total, 1 (0.76%) patient developed a superficial infection, which resolved after a course of oral antibiotics. Six (4.55%) patients complained of prolonged edema, two (1.52%) of neuritis of the proper

**Table 1**
Fixation type and lateral hinge disruption rate (N = 132 patients)

| Fixation Method | Patients (n [%]) | Cortex Fractured Intraoperatively (n [%]) | Cortex Fractured Postoperatively (n [%]) | Displaced (n [%]) | Revision Surgery (n [%]) |
|---|---|---|---|---|---|
| 1 Staple | 89 (67.42) | 21 (44.68) | 4 (66.67) | 7 (46.67) | 1 (20) |
| 2 Staples | 5 (3.79) | 4 (8.51) | 0 | 0 | 0 |
| 2 Crossing Kirschner wires | 3 (2.27) | 3 (6.38) | 0 | 2 (13.33) | 0 |
| Cerclage wire | 2 (1.51) | 1 (2.13) | 1 (16.67) | 2 (13.33) | 2 (40) |
| 3.0-mm Screw | 12 (9.09) | 1 (2.13) | 0 | 1 (6.67) | 0 |
| Plate | 5 (3.79) | 2 (4.26) | 0 | 0 | 1 (20) |
| Plate and staple | 1 (0.76) | 0 | 1 (16.67) | 1 (6.67) | 0 |
| Cerclage wire, staple, Kirschner wire | 1 (0.76) | 1 (2.13) | 0 | 0 | 0 |
| 3.0-mm Screw, staple, Kirschner wire | 1 (0.76) | 1 (2.13) | 0 | 0 | 0 |
| Staple, Kirschner wire | 6 (4.55) | 6 (12.77) | 0 | 0 | 0 |
| Staple, crossing Kirschner wires | 7 (5.30) | 7 (14.89) | 0 | 2 (13.33) | 1 (20) |
| Total | 132 (100) | 47 (100) | 6 (100) | 15 (100) | 5 (100) |