Revisonal Hallux Abducto Valgus Surgery Using Tricorrectional Bunionectomy

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We present a radiographic analysis of 91 failed hallux abducto valgus surgeries. Patients were categorized by type of postoperative complication: hallux varus, hallux limitus, or recurrent hallux abducto valgus deformities. All deformities were radiographically evaluated preoperatively and after correction using tricorrectional bunionectomy. Analysis of the surgical revisions showed improvement in radiographic parameters, including the metatarsal angle, hallux abductus angle, proximal articular set angle, and tibial sesamoid position. We conclude that tricorrectional bunionectomy is a versatile procedure that can be used when addressing a residual deformity after failed hallux abducto valgus surgery. (J Am Podiatr Med Assoc 94(4): 341-346, 2004)

Failed hallux abducto valgus (HAV) surgery may occur when the chosen procedure does not address the underlying etiology and various components of the original deformity. Previous descriptions of tricorrectional bunionectomy have shown it to be a valuable adjunct in the correction of HAV, hallux limitus, and juvenile HAV deformities. To our knowledge, to date there has not been a study of a large patient population focusing on categorizing the types and presentation of failed HAV surgery and evaluating a single treatment method to address all of the categories of failed surgery. The purpose of this article is to categorize the preoperative radiographic dimensions of 91 failed HAV surgeries into hallux varus, hallux limitus, and recurrent HAV groups, all of which underwent revisional tricorrectional bunionectomy. The preoperative and postoperative radiographic dimensions were then evaluated for correction of the previously failed HAV surgery.

In this article, we demonstrate the versatility of tricorrectional bunionectomy to attain structural correction of a variety of preoperative pathologies. For example, during hallux varus surgery, the angle must be reversed. In hallux limitus correction, emphasis on shortening and plantarflexing the metatarsal head is necessary, and deformities with all three components remaining must be addressed as well. Because the surgery is performed in metaphyseal bone, rapid healing can still be achieved. In a previous study by two of the authors (A.J.S. and M.D.S.), the average time to heal sufficiently to return to ambulation with shoes was 12.6 days based on clinical and radiographic findings. In addition, 92% of patients reported their postoperative discomfort as minimal to none, using the American Orthopaedic Foot and Ankle Society’s 100-point clinical rating system, and did not need any pain medications; however, proto-

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Reprinted from the Journal of the American Podiatric Medical Association, 97(4).  
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col included oral nonsteroidal anti-inflammatory drug therapy, thus making revisional HAV surgery more palatable after undergoing the trauma of an unsuccessful procedure as well as loss of time and a compromised result.

Preoperative Pathology

Hallux Varus Deformity

The complications were categorized into three groups: hallux varus, hallux limitus, and recurrent HAV deformities. Hallux varus, although a possible congenital deformity, is also well described as a potential complication of HAV surgery. Iatrogenic hallux varus deformity presents as a medial deviation of the great toe on the transverse plane with possible concomitant deformity, including varus rotation of the hallux and hallux interphalangeal joint contracture. As with HAV, variations may exist, from an asymptomatic, mildly deviated joint to gross subluxation, instability, and subjective complaints, including pain, inability to fit into footwear, and psychosocial issues related to poor cosmesis. Various bunionectomy procedures may predispose the patient to the development of hallux varus deformity. For example, several outcome studies have shown that the McBride procedure, which includes removal of the fibular sesamoid with complete lateral soft-tissue release, will result in hallux varus 1% to 2% of the time. Other authors have shown the incidence of hallux varus deformity to be 4.0% to 12.9% after McBride bunionectomy-type procedures. Of the 15 hallux varus deformities in this study, 3 followed traditional McBride procedures and 12 followed modified McBride procedures (fibular sesamoid left intact). Besides fibular sesamoidectomy, multiple other causes of hallux varus deformity have been described in the literature (Table 1).

A review of the literature reveals that a common denominator in the development of hallux varus deformity is iatrogenic loss of the lateral static and dynamic stabilizers of the first metatarsophalangeal joint. This imbalance favors the intact medial soft tissues and yields transverse plane deformity, with the possible concomitant development of hallux malleus or hallux exansus.

Fixed structural adaptation may develop with a long-standing deformity, negating attempts at soft-tissue correction alone. Isolated soft-tissue procedures, however, have been advocated to address an early deformity without osseous structural adaptation. These soft-tissue procedures have included abductor hallucis tenotomy or transfer, medial capsulotomy, repair of the adductor tendon complex, extensor hallucis longus or brevis transfer, plication of the lateral capsule, syndactylization of the first interspace, total joint release, and extensor hallucis brevis tenodesis. In the very early postoperative period, simple hallux splinting in the direction of valgus has been described as well.

Once osseous adaptation occurs, soft-tissue correction procedures are inadequate. The goals of structural correction include an increase in the relative intermetatarsal (IM) angle, re-creation of a normal proximal articular set angle (PASA) if it is deviated, and realignment of the sesamoid apparatus. A variety of distal osteotomies, a first metatarsophalangeal joint arthrodesis, an implant arthroplasty, reverse Akin osteotomy, crescentic base osteotomy, and modified Lapidus arthrodesis.

Although soft-tissue procedures have been documented as potential solutions, they have often been shown to be inadequate. We, therefore, propose reverse tricorrectional bunionectomy as a viable alternative for the correction of an acquired hallux varus deformity. This osteotomy has the advantage of correcting a negative PASA, if present. This procedure also corrects for the negative IM angle, addresses the negative hallux abductus (HA) angle, and allows for plantar transposition of the capital fragment if a metatarsal elevates is present.

Hallux Limitus Deformity

Patients who did not demonstrate preoperative increases in the IM or HA angles but did show radiographic changes such as flattening of the metatarsal head, dorsal osteophytes, subchondral eburnation or cysts, periarticular lipping of the proximal phalanx and metatarsal head, and narrowing of the first meta-

Table 1. Causes of Hallux Varus

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<th>Procedure</th>
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<td>Fibular sesamoidectomy</td>
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<td>Staking of the metatarsal</td>
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<td>Overcorrection of the intermetatarsal angle</td>
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<td>Overcorrection of the hallux abductus angle</td>
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<td>Simultaneous release of the adductor hallucis and flexor hallucis brevis muscles</td>
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tarsophalangeal joint space were included in the hallux limitus group. Hallux limitus creates variable amounts of pain and decreased range of motion at the first metatarsophalangeal joint depending on the grade or severity of the destruction of the joint. Some patients demonstrated a combination of very mild to slight HAV deformity with a limitus component. Revisi
tional hallux limitus surgery is often necessitated by the failure to address the metatarsus primus elevatus or decreased joint space components of the deformity, as is often seen with simple cheilecotomy procedures.

Recurrent Hallux Abducto Valgus Deformity

Most recurrent HAV deformities occur as a result of improper alignment of the first metatarsophalangeal joint. A previous study\(^2\) has shown that the sesamoids remain stationary relative to the second metatarsal throughout the development of HAV and after surgical correction of the deformity. The surgeon, therefore, must rely on structural or osseous correction for successful HAV correction rather than on soft-tissue procedures alone. In addition, failure to place the metatarsal head over the sesamoids, to correct the PASA, or to decompress and plantarflex the first metatarsal may contribute to an undesirable end result.

Often, the surgeon failing to achieve proper alignment compensates by resecting too much bone, leading to staking of the metatarsal head and loss of the tibial sesamoid groove. This approach often decreases the chances of a successful revisional surgery. Tri
correctional bunionectomy is a versatile procedure that allows the surgeon to address specific components of the remaining deformity.

Materials and Methods

Ninety-one feet that had previously undergone HAV or hallux limitus surgery were included in this study. Patients were categorized into one of three groups representing their preoperative diagnosis: 1) recurrent HAV, 2) hallux varus, or 3) hallux limitus. A total of 80 patients (91 feet) who presented for treatment to the senior authors (A.J.S. and M.D.S.) from January 1, 1997, to June 30, 2001, were classified on the basis of a retrospective radiographic analysis. The following preoperative and postoperative data were recorded and analyzed for each case: IM angle, HA angle, PASA, tibial sesamoid position (TSP), and the presence or absence of a fibular sesamoid.

To determine the types of surgical procedures previously performed, the preoperative radiographic appearance of the metatarsal head and base was evaluated. Preoperative radiographic analysis revealed that 87 cases had previously undergone a distal procedure: 15 cases (17.2%) resulted in a hallux varus deformity, 67 (77.0%) in a recurrent HAV deformity, and 5 (5.7%) in a hallux limitus deformity. Three patients had undergone a distal and a base procedure, with two developing a recurrent HAV deformity and one a hallux limitus deformity. One patient had undergone a base procedure that later resulted in a recurrent HAV deformity. The exact distal and base procedures performed cannot be ascertained because previous operative reports were unobtainable.

Procedure for Hallux Varus

A standard medial approach is used, with appropriate soft-tissue releases performed as needed. An L

shaped osteotomy is performed distally within cancellous bone, with the long arm plantar and parallel to the plantar aspect of the foot (Fig. 1). The dorsal osteotomy is then performed at an approximately 80° angle to the plantar one and perpendicular to the long axis of the first metatarsal. The second dorsal osteotomy is performed parallel to the negative intraoperative PASA, with the apex medial and the base on the lateral aspect of the metatarsal. This small wedge of bone is removed to correct for the negative PASA, and the capital fragment is then transposed medially and impacted until the varus deformity is no longer present.

Using standard AO techniques, a 4.0-mm cannulated cancellous screw is placed from proximal dorsal

Figure 1. An L-shaped osteotomy, with the plantar osteotomy twice as long as the dorsal osteotomy. The osteotomy is temporarily fixed with a 0.062 Kirschner wire while the 4.0-mm cannulated screw is inserted across the osteotomy.
to plantar distal and directed into the crista. If a secondary point of fixation is needed in cases in which osteopenic or cystic bone is encountered, an Orthosorb pin (Johnson & Johnson, New Brunswick, New Jersey) can be used to supplement the screw fixation. The sesamoid apparatus is carefully examined to ensure proper position. The soft tissues are closed according to the surgeon’s preference. Patients can walk immediately after surgery in a postoperative shoe and can begin wearing athletic shoes in 10 to 14 days.

Procedure for Revisional Hallux Limitus

Surgical correction of hallux limitus was accomplished by removing a trapezoid-shaped portion of bone at the first metatarsal head as previously described by Selner et al.\textsuperscript{2} The procedure not only corrected any abnormal IM angles and PASAs but also decompressed the metatarsophalangeal joint and plantarflexed the metatarsal head to restore range of motion and function. The osteotomy was fixated using standard AO techniques in a manner similar to the procedure for the hallux varus deformity.

Procedure for Revisional Hallux Abducto Valgus

A standard approach to performing tricorrectional bunionectomy as previously described by Selner et al\textsuperscript{1} was used for patients with recurrent HAV deformity. Care was taken not to remove an excessive amount of the medial eminence.

Results

Hallux Varus Group

Fifteen feet (14 patients) were identified clinically and radiographically as having hallux varus deformity. All 15 had previously undergone a distal procedure, with only 3 having undergone removal of the fibular sesamoid. Average preoperative IM angle, HA angle, TSP, and PASA values for feet with intact fibular sesamoids were 5.5°, -4.8°, 1.7°, and -4.1°, respectively, and average postoperative values were 7.3°, 9.8°, 2.4°, and 8.4°, respectively. Average preoperative IM angle, HA angle, TSP, and PASA values for feet with previous fibular sesamoid excision were 7.0°, -8.7°, 1.3°, and -7.3°, respectively, and average postoperative values were 7.3°, 4.3°, 2.3°, and 2.3°, respectively. Average preoperative IM angle, HA angle, TSP, and PASA values for the entire hallux varus group (15 cases) were 5.8°, -5.5°, 1.6°, and -4.7°, respectively, and average postoperative values were 7.3°, 8.7°, 2.4, and 7.2°, respectively. Average changes in IM angle, HA angle, TSP, and PASA values were 1.5° (25.8%), 14.3° (260.0%), 0.80 (50.0%), and 11.9° (253.2%), respectively.

According to these data, the greatest improvements in the hallux varus group occurred in cases that had previously undergone fibular sesamoid excision. This subgroup had an average postoperative increase in the HA angle of 149.4° and an average postoperative increase in the PASA of 131.5°.

Interestingly, all of the cases in the entire study population that had undergone a fibular sesamoid excision presented with a hallux varus deformity. These data are consistent with previous observations in the literature of the increased risk of iatrogenic hallux varus with fibular sesamoid excision.

Hallux Limitus Group

A total of six feet (four patients) were evaluated as having hallux limitus with associated radiographic changes. All six cases had intact fibular sesamoids. Five feet had previously undergone a distal procedure alone. Average preoperative IM angle, HA angle, TSP, and PASA values for these five feet were 11.2°, 11.2°, 3.2°, and 12.8°, respectively, and average postoperative values were 6.4°, 9.2°, 2.0°, and 6.0°, respectively. One foot had undergone a combination distal and base procedure, and average preoperative IM angle, HA angle, TSP, and PASA values were 7.0°, 14.0°, 5.0°, and 17.0°, respectively, while average postoperative values were 5.0°, 7.0°, 4.0°, and 9.0°, respectively. Average preoperative IM angle, HA angle, TSP, and PASA values for the entire group (six cases) were 10.5°, 11.7°, 3.5°, and 13.5°, respectively, and average postoperative values were 6.2°, 8.8°, 2.3°, and 6.5°, respectively. Average changes in IM angle, HA angle, TSP, and PASA values were -4.3° (-40.9%), -2.8° (-23.3%), -1.2° (-34.3%), and -7.0° (-51.8%), respectively.

In the hallux limitus group, the greatest postoperative improvements occurred in the subgroup that had undergone a previous distal procedure alone. These cases had average postoperative decreases in IM angle, HA angle, TSP, and PASA values of 42.9%, 17.9%, 37.5%, and 53.1%, respectively. The reduction in radiographic measurements represents improved alignment and position of the joint in patients who presented with combined HAV and hallux limitus deformities. In patients who presented with hallux limitus deformity alone, the main emphasis of the procedure is achieving decompression of the joint by means of shortening and plantarflexion of the metatarsal.
Recurrent Hallux Abducto Valgus Group

In the recurrent HAV group, all 70 feet (62 patients) evaluated had intact fibular sesamoids. Sixty-seven cases (95.7%) had previously undergone a distal procedure alone and had average preoperative IM angle, HA angle, TSP, and PASA values of 14.3°, 30.6°, 5.6°, and 25.0°, respectively, and average postoperative values of 6.3°, 14.6°, 3.1, and 7.0°, respectively (Fig. 2). Two feet had previously undergone a combination distal and base procedure and had average preoperative IM angle, HA angle, TSP, and PASA values of 11.5°, 26.0°, 6.0, and 26.0°, respectively, and average postoperative values of 8.5°, 14.0°, 3.5, and 13.0°, respectively. Only one case had previously undergone a base procedure alone, and average preoperative IM angle, HA angle, TSP, and PASA values were 14.0°, 22.0°, 6.0, and 24.0°, respectively, while average postoperative values were 6.0°, 9.0°, 2.0, and 10.0°, respectively. The entire recurrent HAV group (70 cases), however, presented with average preoperative IM angle, HA angle, TSP, and PASA values of 14.2°, 29.9°, 5.6°, and 25.0°, respectively, and average postoperative values of 6.3°, 14.5°, 3.1, and 7.8°, respectively. Average changes in IM angle, HA angle, TSP, and PASA values were −7.9° (−55.7%), −15.3° (−51.5%), −2.5 (−44.6%), and −17.2° (−68.8%), respectively. The recurrent HAV group did not have a more impressive postoperative result for all measurements in any particular subgroup.

Discussion

The present study evaluated and categorized the various types of deformities found in patients who present for revisional HAV surgery. Although no correlation has been demonstrated between clinical symptoms and the various kinds of pathology presented, other conclusions may be inferred from our extensive radiographic analysis. The largest subgroup of patients with recurrent HAV, 95.7%, had undergone a previous distal procedure alone. In addition, 15 feet presented with a hallux varus deformity. Because previous operative reports were unobtainable, the exact distal procedures performed cannot be ascertained; nevertheless, judging by the structure of the metatarsal head on preoperative radiographs, it can be concluded that most cases had previously undergone only a modified McBride procedure. These data once again support the contention that if the etiologic factors of HAV are not correctly addressed, attempts at correction are likely to fail. For example, soft-tissue procedures as a substitute for structural repair are associated with an increased failure rate.

This study demonstrates that tricorrectional bunionectomy can be used and adapted to address many of the complications associated with bunion surgery. Multiple components such as PASA, IM angle, TSP, and shortening and plantarflexion of the first metatarsal may be addressed at the same time using this procedure without disrupting the lateral capsule. Tri-correctional bunionectomy is clearly an extremely versatile procedure that allows the podiatric surgeon significant flexibility in addressing the wide range of first-ray pathologies found during revisional bunion surgery.

We believe that this study is the first of its kind to attempt to categorize the different groups of complications associated with failed HAV surgeries and to determine the frequency of occurrence of each group.

Figure 2. A, Preoperative bilateral weightbearing anteroposterior radiograph of a patient with recurrent hallux abducto valgus deformity who had undergone previous hallux abducto valgus surgery using a distal procedure. B, Postoperative bilateral anteroposterior radiograph of the same patient after correction of the recurrent hallux abducto valgus deformity using the tricorrectional bunionectomy procedure.
in a large sample of patients presenting for revisional surgery. To our knowledge, this study is the first of its kind to attempt to evaluate a single surgical procedure, tricorrectional bunionectomy, to treat all three groups of complications associated with failed HAV surgeries. We hope that this study will stimulate discussion and that future investigations will include even larger sample sizes or a multicenter design.

Acknowledgment. Glenn Weinraub, DPM, Jay Riley, DPM, Raymond Tsukuda, DPM, and Catherine Cheung, DPM, for editorial assistance.

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