Lateral Ankle Stabilization Using Acellular Human Dermal Allograft Augmentation

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Background: We describe a retrospective study that uses the Brostrom-type surgical procedure with modifications that augment deficient and torn ligaments with acellular human dermal grafts. At the onset of this study, the most prevalent dermal graft available to us was GraftJacket (Wright Medical Technology, Arlington, Tennessee). Greater than 50% of the study participants were grafted with this product, but more recently other equally effective human dermal grafts have been used with no apparent difference.

Methods: Thirty-five lateral ankle stabilization procedures were performed in the past 6 years on 33 patients. Eight patients were considered athletes (mean age, 23 years). The balance of the study group consisted of sedentary patients (mean age, 41 years). The mean patient body mass index (calculated as the weight in kilograms divided by the square of the height in meters) was 31.

Results: All of the patients were satisfied with their results, with no recurrent instability. Two patients in this group went on to have contralateral ankle stabilization in a similar manner owing to their satisfaction. Complications included two soft-tissue infections.

Conclusions: Lateral ankle stabilization using acellular human dermal graft augmentation is a useful tool in the surgical treatment of ankle instability. This procedure offers distinct advantages over traditional methods of ankle repair and can be performed with relatively limited surgical exposure. Ease of operation, consistent results, and limited patient morbidity should allow surgeons to use this procedure independently or adjunctively to improve surgical outcomes. (J Am Podiatr Med Assoc 105(3): 209-217, 2015)

Surgical approaches in treating the unstable ankle have steadily evolved over the past several decades. Early ankle stabilization procedures, such as the Chrisman-Snook, Watson-Jones, Evans, and others, became the standard of care, with favorable long-term outcome studies supporting their use. These procedures, termed nonanatomical, use host tendons to stabilize the deficient lateral ankle ligaments. Such procedures require lengthy incisions, involve the sacrificing of host tendons to be used as grafts, and can potentially lead to restricted range of motion of the ankle and subtalar joints. The long-term morbidity with nonanatomical host tendonesis procedures was such that surgeons were reluctant to repair all but the most symptomatic and unstable ankles.

In 1966, Brostrom first reported on a less invasive anatomical repair of the anterior talofibular and calcaneofibular ligaments. He reported that in acute and chronic cases of ligamentous injury, the damaged ligaments could be repaired to regain functional stability. The other historical milestone in lateral ligament repair of the ankle occurred with the Gould modification. This procedure improved overall stability by augmenting the direct ligament repair with the adjacent extensor retinaculum, recognizing the limitations of supporting the ankle with potentially damaged or attenuated ligaments and proving to increase frontal plane stability to the ankle.

Long-term studies have demonstrated a high degree of success with Brostrom-type procedures. These surgical procedures are now considered first for most patients with recalcitrant instability of the ankle unless clinical and radiographic findings suggest severe instability where
host ligamentous anatomy is felt to be severely disrupted. Although this article deals primarily with surgical considerations related to ankle instability, it should be noted that most of the patients, even those with frank tears of the anterior talofibular and calcaneofibular ligaments, respond favorably to a well-orchestrated rehabilitation program, thus avoiding surgery.

As suggested, there are notable limitations to true anatomical repairs in the surgical treatment of ankle instability. Anatomical repairs may sometimes prove insufficient in high-demand ankles or in cases where inversion stress radiography is sufficiently high to suggest near complete loss of soft-tissue restraint. Other examples of patients who might fail when using anatomical repairs include obese patients, serious athletes with multidirectional physical demands on their ankles, and patients who may possess modest biomechanical pathologic abnormalities causing repetitive inversion torque to the lateral ankle.

In recent years, some surgeons have attempted to bridge the gap between anatomical and non-anatomical ankle stabilization repairs by further modifying the Broström repair. Present-day access to allograft, xenograft, and other synthetic materials for purposes of ligamentous augmentation has resulted in the introduction of new approaches to ankle stabilization procedures. The reported use of these graft substances for ankle stabilizations is, however, limited as success rates with accepted approaches have been admittedly good, therefore not driving the need to devise new techniques. The authors contend, however, that for the increasing number of obese patients with chronic ankle instability and patients in whom lifestyle and demand may exceed the limits of the Broström-type stabilization, graft augmentation may be considered. The potential for improved stability with graft augmentation increases the scope of cases that can be considered with this more anatomically confined procedure and avoids the need for tendon harvest. This retrospective study seeks to demonstrate the efficacy of using acellular human dermal (AHD) allograft for tissue augmentation in lateral ankle stabilization repairs.

**Materials and Methods**

This retrospective report includes 33 patients in whom 35 ankle stabilizations using AHD graft augmentation were performed in the past 6 years in an outpatient setting at Lovelace Women’s Hospital, Albuquerque, New Mexico. The mean number of postoperative months for all of the patients at study termination was 37 months. There were 23 females and 10 males. The mean body mass index (calculated as the weight in kilograms divided by the square of the height in meters) for the female study group was 31. The male study group had a mean body mass index of 30 kg/m². Eight patients were considered athletes whose main reason for considering ankle stabilization was to continue sports participation. The mean age of this group was 23 years. The balance of the study group could be considered sedentary and unfit, with a mean age of 41 years. Their mean body mass index was 31 kg/m². All of the patients were assigned a subjective activity level designation from 1 (lowest activity level) to 5 (highest activity level). The value of 1 reflects a patient who is so impaired by obesity or other infirmaries that even activities of daily living are cumbersome. The value of 3 is considered an average individual who enjoys a robust life but does not engage in physical activities on a regular basis. The value of 5 represents a conditioned athlete who participates in competitive sports and exercises almost daily. The average subjective activity score for our total patient study group was 2.6. This value reflects a study population that is, on average, sedentary and physically inactive. Three ankle arthroscopies were performed immediately before ankle stabilization. All of the patients had failed conservative measures of treatment, including, but not limited to, immobilization, splinting, physical therapy, and moderation of activity as necessary.

All of the patients in this study underwent investigational studies, including standard and inversion stress radiographs, magnetic resonance imaging (MRI), and musculoskeletal ultrasound evaluations, as deemed necessary by their presenting concern. Orthometric evaluation with gait analysis was performed on each patient.

Realizing that all of the medical and surgical care was performed in a large multidisciplinary medical center and hospital, patient records, including historical data and subsequent care by other physicians, were more easily accessed. All of the patients in this study expressed satisfaction with their outcome at the time of patient discharge from our care. Although this represents a very small postoperative window, many of the patients were either contractually bound to our group for insurance reasons or had long-standing relationships with other providers in the group. All of the patient records in the study group were investigated for the potential of ongoing concerns pertaining to their
ankle, and none were found. In addition, all of the patients in this study group who engaged in regular fitness or competitive sports before their injury were able to return to those activities as far as our records could determine.

**Surgical Technique**

It is the senior author’s (R.M.P.) preference to place the patient in a lateral position using a bean bag or similar bolster for patient support. General anesthesia is, therefore, required. Proper intraoperative tensioning of the implanted AHD graft is mandatory to ensure a good functional outcome (as would be the case with other tenodesis stabilizations). Graft tensioning has been found to be difficult with patients in other than the lateral position. If the patient requires ankle arthroscopy before stabilization, he or she will need to be repositioned.

A 4-cm curvilinear incision is made approximately 1 cm anterior to the joint margin of the fibular malleolus following its anatomical curvature. If the incision is too close to the fibula, exposure of the anterior talofibular ligament attachment into the talus will be difficult. The length of the incision should allow for adequate exposure to the talar insertion of the anterior talofibular ligament on the lateral shoulder of the talus and extending such that it allows access to the peroneal tendons, the calcaneofibular ligament, and the lateral wall of the calcaneus. Note that the senior author typically evaluates prospective patients preoperatively as to whether the calcaneofibular ligament is deficient. The MRI findings are not consistently accurate in assessing calcaneofibular ligament integrity. Clinical instability as evidenced by ankle inversion stress radiography is found to be valuable in this assessment. The strength and stability of the AHD graft–augmented repair, however, negates the need for direct attention to calcaneofibular ligament repair in most patients with sprain-induced instability of the ankle. If direct repair is presumed necessary for the calcaneofibular ligament, the incision placement may need to be directed more posteriorly as it approaches the calcaneus.

Subcutaneous exposure is accomplished after ligating and cauterizing the exposed veins, which can be numerous in this area. The sural nerve should not be visualized with this exposure. A similar curvilinear incision through the deep fascia and the anterior talofibular ligament is then accomplished. This incision should be estimated at the midpoint of the anterior talofibular ligament if it can be visualized, which is usually closer to the fibula than the overlying skin incision. The integrity and thickness of the underlying anterior talofibular and calcaneofibular ligaments are then assessed. Again, preoperative patient assessment should give the surgeon a good feel for patients requiring additional strength and stability with their ankle repair.

At this time, it should be determined whether graft supplementation is indicated. The senior author’s preference, based on patient outcomes, is to graft enhance most anterior talofibular ligament tears, and with high-demand ankles run an additional graft strut from the fibular malleolar graft site onto the lateral wall of the calcaneus (Fig. 1). This secondary strut has been found to be very helpful in affording additional stability to the ankle, but it requires special care with implantation to avoid excessive stiffness of the hindfoot. As will be described, this calcaneofibular strut runs near perpendicular to the subtalar joint axis of motion, so it will need to be implanted with more laxity than is accomplished at the talofibular site.

When it has been determined that AHD grafting is desirable, the graft implant is transferred from its freeze-dried state onto the back table for hydration in sterile saline. This process takes approximately 20 min and is critical to achieve maximal pliability. It has been determined to be beneficial to maximally prestretch the graft before use, allowing the surgeon to accurately tension the graft during implantation (Fig. 2). The senior author’s graft preference is the GraftJacket MaxStrip, 1 × 12 cm (Wright Medical Technology, Arlington, Tennessee). This graft is approximately 1.5 to 2.0 mm thick and when folded over longitudinally onto itself is approximately the diameter of the nearby peroneal tendons.

**Figure 1.** Anatomical orientation of acellular human dermal graft sites. A, Fibular anchor site. B, Talar anchor site. C, Calcaneal anchor site.
Graft site preparation is accomplished by carefully reflecting the incised fascia, ligaments, and periosteum proximally onto the fibula and distally onto the talus, exposing the ligament’s points of origin and insertion. If a calcaneal graft is desired, elevators are used to expose the lateral wall of the calcaneus. The authors’ preferred site is anterior to the posterior facet of the subtalar joint, which can be visualized posteriorly. Limited exposure on the calcaneus is required for implantation. The senior author prefers to implant suture anchors approximately 5 to 8 mm below the dorsolateral border of the calcaneus so that the implanted AHD graft can firmly adhere to the lateral calcaneal wall. The foot and ankle should then be held in neutral alignment, with proposed suture anchor landmarks marked to ensure that graft positioning will be optimal. With the foot at 90° to the leg, orientation of the calcaneal graft should be perpendicular to the sole of the foot or slightly anterior to that orientation.

The graft anchor sites on the distal fibula, talus, and calcaneus are then rasped to remove all of the overlying soft tissue to optimize graft-to-bone adherence. Suture anchors of choice are then fixated to the anchor sites (Fig. 3). Surgeons should consider the use of resorbable anchor materials as opposed to the use of metallic anchors to avoid the potential for metallic artifact in the event that studies such as MRI or computed tomography are necessary in the more distant future. The senior author prefers to use the 3.7-mm Arthrex Bio-Corkscrew anchor with attached #0 FiberWire (Arthrex Inc, Naples, Florida). In smaller patients, the 2.4-mm Arthrex Mini Bio-SutureTak anchor with #2.0 FiberWire suture has also worked well.

Selecting the larger screw anchor for the anchor site on the fibula is preferable because the direction of tension on the anchor is near parallel to its direction of implantation. Anchor orientation at the talar and calcaneal sites should be such that the direction of pull runs oblique to the anchor insertion.

The talofibular (anterior talofibular ligament) graft implantation should proceed from the talus to the fibula while holding the foot in a near fully everted position. Locating the desired suture position on the graft before actually suturing it to the fibular anchor is of paramount importance in achieving predictable outcomes. Simply using a Freer elevator held over the graft and gently indenting it while the graft is positioned under tension works well for this process. It is preferable to have an assistant hold the desired position of the ankle while measuring and anchoring the graft. With the graft properly anchored, the foot can be relaxed, and tensioning on the graft can be observed when the hindfoot and ankle approach neutral. Do not cut the suture anchor sutures as these will be used later during closure to suture the overlying fascia and ligamentous tissue to the anchor sites. If a calcaneal strut is desired, appropriate graft suture sites for the calcaneal strut are then measured and sutured in a similar manner (Fig. 4). When suturing the calcaneal strut, the foot and heel should be held in a neutral as opposed to an everted position. Observed tensioning of this graft after implantation with inversion of the hindfoot occurs only modestly after the hindfoot passes neutral and concomitant tensioning is seen with the talofibular strut. For patients...
weighing more than approximately 250 lb, the graft can then be sutured back onto itself to the fibula and then talus if additional strength is desired.

With the hindfoot again held in an everted position, the retracted overlying tissue from the fibula and talus are then sutured under physiologic tension to the graft anchor sites with the intact anchor suture using a horizontal mattress suture technique. The remaining anchor suture is cut and then used to reapproximate the retinaculum in typical pants over vest fashion. Subcutaneous skin is approximated and closed in the usual manner.

**Postoperative Management**

Postoperative patients are typically immobilized in a posterior splint and, thereafter, a removable cast for a total of 4 weeks. They are instructed to stay nonweightbearing for the first 2 weeks. Gentle range of motion on the sagittal plane only with resistance band assistance can begin 1 week after surgery. Four weeks postoperatively, patients are placed in an oxford-type street shoe or a sneaker with a stirrup-type ankle-foot orthosis brace to avoid inversion-eversion stress for an additional 3 to 4 weeks. Most patients can be discharged from further care 6 weeks after surgery but are cautioned not to engage in any strenuous sports for 3 months. Additional physical rehabilitation of the ankle above and beyond activities of daily living or sports activities is instituted thereafter only if deemed necessary.

**Results**

The patients in this study showed a very high rate of satisfaction. All of the study patients were found to be clinically stable postoperatively compared with normal parameters. The postoperative course in the study group of 35 ankles was unremarkable except for two postoperative infections, the most serious of which required an operative incision and drainage. The pathogen was cultured to reveal *Staphylococcus aureus*, which responded to oral antibiotic drug therapy. This patient was a high school football player, and his postoperative infection proved to have no negative effect on stability. Another patient outcome that could be considered a complication affected the only female who had both of her ankles stabilized. After she recovered from the second ankle stabilization, she found that the second side was more to her liking as it seemed more stable. Her comment was that the first side seemed loose, although she had no gross instability. Subsequent to voicing this concern, she underwent ankle stress inversion testing, which proved somewhat consistent with her concern. Findings demonstrated less than 5° on the more recently performed ankle and 12° on the perceived looser side. Although this finding is considered high normal, she elected to have her ankle restabilized. The intraoperative findings were of interest. The previously placed graft had incorporated nicely into host tissue and still maintained its integrity visually and functionally when stressing the ankle. To tighten the ankle, the talar and calcaneal graft sights were left intact and the graft was sectioned approximately 5 to 7 mm from the original anchor points. The new graft was simply sewn into the old graft using #2 FiberWire. A new anchor was placed in the fibula, and the new graft was sewn under increased tension. The patient’s level of satisfaction has been high during her postoperative course.

Postoperative pain and its management varied greatly in the study population. Generally, it was found that advanced age and obesity resulted in increased postoperative pain levels and perceived slower healing. There were no patients who during their postoperative course demonstrated excessive swelling or inflammation that exceeded the normal parameters of healing as would be consistent with a standard Brostrom-type stabilization. Approximately one-third of all of the patients have been followed for unrelated concerns. All of the patients were satisfied with their results, with no recurrent instability. Two patients in this group went on to
have a contralateral ankle stabilized in a similar manner owing to their satisfaction.

Patients in this study were never released from our care before having reached a level of personal satisfaction about their outcome and before being able to demonstrate an ambulatory status that would allow them to accomplish activities of daily living. For patients who had previously engaged in sports activities, they were typically followed until they were at least able to begin participation and were additionally given an algorithm guiding them eventually to full and unrestricted participation. All of the study patients who were actively employed before surgery were not discharged until they could resume work or felt comfortable about their resumption of employment.

Discussion

When considering the results of this study, the first question that should come to mind is whether the patient sample was representative of the population in general. After looking at this study population’s demographic characteristics, we believe that the answer would be no. The sample represented in this study, however, does support the contention that athletes are not the only ones who are prone to ankle injuries and that the inactive, deconditioned obese population and patients with a high degree of calcaneal varus are also at high risk. It should not be surprising, therefore, that the introduction of an ankle-stabilizing procedure to meet the demands of not only the athlete but also the inactive obese population has merit. As one would assume, the patient population in this study reflects and coincides with the medical decision making to offer an augmented and enhanced manner by which to repair their ankle.

The choice to use graft substances other than host tissue for any type of surgical repair should be made only after thorough research and investigation of the product and its intended use. The senior author’s selection of AHD grafts for lateral ankle repair was made as a result of personal experience with AHD grafts in the surgical repair of ruptured Achilles tendons. In selected cases in which substantial loss of tendon substance had occurred, AHD grafts have proved to work well with intratendinous repair as well as its use as an external circumferential tendon wrap. Studies demonstrating AHD graft use in other parts of the body, particularly in rotator cuff repairs and Achilles tendons, have demonstrated excellent host compatibility, strength of repair, and subsequent histocompatibility.13 These studies demonstrated that AHD grafts would undergo histologic transformation whereby the graft-host interface was difficult to distinguish microscopically.14 Reported cadaveric studies comparing Achilles repairs with and without AHD graft augmentation demonstrated a twofold increase in strength of repair using AHD grafts.15

The senior author’s goal in using AHD graft augmentation for lateral ankle stabilization surgery is to increase the options of tissue strength enhancement available intraoperatively when performing anatomical repairs of the anterior talofibular and calcaneofibular ligaments. This technique, although still using the Broström-type incisional approach, expands the range of such repairs to patients who previously would be considered for more invasive tenodesis-type procedures.

Appropriate patient selection for ankle stabilization repair is paramount to ensure optimal outcome. Indications for surgical intervention include failure to respond to a formalized rehabilitation and physical therapy program, persistent ankle instability, pain confined to an area anterior to the distal fibular malleolus, gross instability as demonstrated radiographically by forced inversion stress views of the ankle, and MRI findings that support the diagnosis of attenuation or tears of the anterior talofibular ligament and possibly the calcaneofibular ligament. Contraindications to lateral ankle stabilization without adjunctive procedures include MRI findings showing intra-articular pathologic abnormalities, such as osteochondritis dissecans lesions requiring repair; anatomical variants of the foot, such as hindfoot varus, cavovarus, or neuromuscular conditions such as Charcot-Marie-Tooth disease; and other injuries around the ankle that may be masquerading as lateral ankle pain, such as tarsal coalition.

DiGiovanni and Brodsky16 previously described anterior talofibular ligament and calcaneofibular ligament enhancement/augmentation for lateral ankle stabilizations superficial to or at the level of host ligaments (underlying repairs). An example of an overlying repair is the Broström-Gould modification using host extensor retinaculum. Underlying repairs include all nonanatomical repairs in which host tendons are anchored directly into bone. We prefer the latter, whereby overlying host ligament and fascia are subsequently reanastomosed and sutured over the AHD graft, providing additional strength to the underlying repair.

This retrospective review lacks some objectivity in postoperative patient assessment. Numerous studies, however, have objectively documented
outcomes using standardized testing methods for anatomical and nonanatomical ankle-stabilizing repairs. In a 1980 article by Gould et al\textsuperscript{7} on the Broström-Gould repair, the authors claimed that all 50 patients in their case study were found after 1 or more years to be improved, with a satisfaction rating of 8 or better (on a scale from 1 to 10, with 10 being the most favorable outcome). Karlsson et al\textsuperscript{9} after 2 to 12 years of follow-up, found that 89% of 148 ankles achieved a good to excellent result by performing a Broström stabilization with one or two ligament repairs. When comparing Broström repair outcomes with nonanatomical repairs, such as the Chrisman-Snook repair, the later repair reported by Snook et al\textsuperscript{5} claimed a 94% good to excellent outcome after 10 years.

Case Reports

Although most cases in this study represent fairly typical preoperative findings and surgical treatment, the following cases within our study group represent two more atypical cases in which ankle stabilization with augmentation was found useful as an adjunctive procedure to enhance ankle stability.

Case 1

A 52-year-old man presented to Albuquerque Health Partners, Albuquerque, New Mexico, with a 5-year history of progressive pain in both ankles. He denied a history of overt trauma to either ankle. He did not engage in sports activities. His vocation was that of a police investigator, requiring extended periods of standing and walking. This patient’s ankle pain was interfering with activities of daily living. He would traditionally wear high-top duty-type boots for stability. Physical examination revealed this patient to be 6 foot 2 inches and 325 pounds; his fitness level was deemed poor. Physical examination also revealed periarticular swelling of both ankles without erythema. Mild tenderness on palpation was elicited to the medial and lateral gutters as well as anteriorly in both ankles. Foot morphology was normal, although he seemed to possess a hindfoot varus; this was later found to be a semirigid ankle varus. He did not display a varus deformity to the calcaneus. Ankle range of motion was intact on the sagittal plane. Excessive mobility was noted, with inversion stress demonstrating frontal plane instability.

Radiographic evaluation revealed an incongruent ankle joint bilaterally, demonstrating an approximately 15° ankle varus. The medial talar dome had yet to show substantial damage to the tibial plafond. The medial and lateral ankle gutters demonstrated longstanding osseous debris. Stress anteroposterior ankle testing revealed that both ankles were semireducible with forced valgus stress. The MRI studies revealed findings consistent with his standard radiographic examination as well as loss of the anterior talofibular and calcaneofibular ligaments.

It was determined that owing to his ankle varus, arthroscopic debridement alone would be of little help. Conversely, this patient’s pain and functional levels did not justify ankle fusions. He was offered arthroscopic debridement of the ankle with open debridement of the medial and lateral gutters to allow for reduction of the joint and an ankle stabilization with augmentation to help maintain the correction. He understood clearly that a more ablative procedure could be necessary in his more distant future.

The operative procedure was uneventful except for finding considerable debris to the distal medial gutter. After this debris was removed, the ankle was still resistant to reduction under fluoroscopy, so it was deemed necessary to release the deltoid ligament, after which the joint reduced by approximately 75%. Thereafter, the lateral gutter was debrided completely through the exposure necessary for the ankle stabilization. Owing to this patient’s body weight, the standard method of graft augmentation was doubled back on itself. The graft was, therefore, fixated from the lateral talar body to the fibula and onto the lateral calcaneal wall and then reversed back onto itself, thereby doubling the graft thickness.

This patient recovered from surgery uneventfully and was transitioned at 4 weeks to an articulated ankle-foot orthosis, which he wore for an additional month. Postoperative radiographs revealed a good, but not complete, reduction of his deformity, which was compatible with intraoperative radiographs. This patient rated his reduction in pain postoperatively at 75%, and he returned to normal work activities 8 weeks postoperatively. This patient’s satisfaction with his first procedure was such that he had his contralateral ankle repaired in a similar manner 11 months later.

Case 2

A 62-year-old woman presented with concerns about ankle instability and walking too heavily on the lateral aspect of her foot. She also presented with a recalcitrant diabetic ulcer to the plantar and
lateral aspects of this foot. She had seen three other podiatric physicians for local wound care, but the wound would not heal completely without recurrence. This patient was retired and enjoyed traveling, which she could not do in her present state. Physical examination revealed this patient to be 5 foot 4 inches and 216 pounds. Her fitness level was poor. Further examination revealed loss of protective and vibratory sense consistent with diabetic neuropathy. She displayed a grade 2, noninfected diabetic ulcer on the plantar lateral forefoot. Biomechanical examination revealed a cavovarus hindfoot with $15^\circ$ of ankle dorsiflexion with the knee extended. She demonstrated gross instability of the ankle on the frontal plane that was confirmed with stress anteroposterior ankle testing. Ankle radiographs demonstrated a congruent ankle joint without significant arthritis.

This patient was placed in an articulated ankle-foot orthosis and a postoperative shoe. Her ulcer noticeably improved with her ankle supported upright with an ankle-foot orthosis. Although she was at high risk, this patient elected for surgical repair of her varus hindfoot deformity and instability, realizing that not seeking definitive correction would likely pose a greater risk of loss of limb in the future.

She underwent a calcaneal slide osteotomy to reduce her heel deformity in conjunction with an ankle stabilization using AHD augmentation. Postoperative recovery was uneventful, and her foot ulcer resolved. Appropriate diabetic shoes were subsequently dispensed.

**Conclusions**

This retrospective study revealed the demographic characteristics and outcomes of 35 lateral ankle stabilizations using AHD graft augmentation. Note that although most patients in this study were stabilized with GraftJacket human dermal graft, a variety of similar human dermal graft products have arrived on the market since the beginning of this study. Patient outcomes using other dermal grafts (assuming the mechanical characteristics are the same) have produced similar outcomes without exception.

This study spans 6 years, with a mean of 37 months among all of the study participants. Since the beginning of this review, there has been an approximately even distribution of cases performed yearly until the present date. The results of this study have, in fact, been so favorable and consistent that the senior author has used this modification of the Broström ankle stabilization in lieu of the traditional Broström approach, unless a specific patient profile and intraoperative findings do not justify the need. It is well accepted that this procedure requires a bit more dissection to prepare anchor points for graft placement and the careful tensioning of the graft itself to ensure that it will, indeed, be under sufficient tension to restrain subluxatory forces. There is, indeed, a learning curve to achieve consistent results with this procedure, as would be the case with nonanatomical repairs using host tendons.

This procedure offers distinct advantages over traditional methods of ankle repair and can be performed with relatively limited surgical exposure.

Without having to harvest host tendon and subjecting the patient to possible complications, such as tendon loss or weakness, surgeons can achieve a repair that offers superior strength to the traditional Broström repair. Using a variety of options discussed herein, surgeons may modify the procedure intraoperatively to fit each patient's needs.

This study offers an alternative to traditional approaches when contemplating ankle stabilization procedures for the high-demand or obese patient. Its use as an adjunctive procedure for the senior author's patients has proved most useful and beneficial.

**Financial Disclosure:** None reported.

**Conflict of Interest:** None reported.

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