METATARSUS ADDUCTUS/SOFT TISSUE RELEASE PROCEDURES

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INTRODUCTION

If caught early enough, a large majority of pediatric metatarsus adductus deformities are amenable to conservative treatment measures. The more resistant cases or those where treatment has been delayed may require more sophisticated and aggressive surgical treatment to restore normal alignment. Several variables exist that can be used as a guide in choosing the appropriate procedure. These include the patient's age, stage of osseous development, severity of the primary deformity, as well as the presence or absence of other deformities. Each of these considerations will be discussed as they apply to surgical correction by soft tissue release procedures. Osseous procedures, including metatarsal osteotomies, are presented in a separate chapter within this text.

Literature Review

Reviewing the literature reveals a variety of soft tissue procedures that have been described to treat the resistant metatarsus adductus deformity. The diversity and inconsistency that exist can be linked back to the unsettled issue as to the true etiology of the deformity.

Extrinsic Tendon Anomalies

Peabody and Muro first described an abnormal insertion of the tibialis anterior tendon distally and plantarly on the first metatarsal creating an abnormal mechanical advantage (1). Kite agreed with this finding and added that both tibialis anterior and tibialis posterior were at an advantage and easily overpowered the peroneals producing the metatarsus varus deformity (2, 3). These thoughts were shared in a slightly different light by several subsequent authors. Sgarlato, in 1973, described an abnormal medial insertion of tibialis anterior or a dynamic muscle imbalance caused by a lack of peroneus longus power (4).

Sgarlato recommended a lateral transfer of tibialis anterior into the cuboid or third cuneiform. This procedure was also described by Davidson in 1967 for resistant cases of metatarsus adductus with reported excellent results (5). Reimann and Weiner felt that a primary subluxation of the tarsometatarsal articulation occurred, resulting in secondary soft tissue contracture of tibialis anterior (6).

While performing an anterior medial release of the first metatarsocuneiform and naviculocuneiform joints, Ghali and associates noted an abnormally thickened band of tibialis anterior tendon that ran plantarly and proximally to insert into the plantar and medial surfaces of the first cuneiform (7). They recommended resection of this portion of tendon allowing it to slide dorsally releasing its pathological pull on the medial cuneiform.

Browne and Paton described an abnormal insertion of tibialis posterior extending past the navicular and primarily attaching to the medial cuneiform (8). They recommended selective release and transfer when indicated for these resistant cases.

When reviewing the above literature, several points must be kept in mind. First, these studies were not isolated to the metatarsus adductus deformity as we know it. In current podiatric literature metatarsus adductus is defined as a congenital transverse plane deformity in which all five metatarsals are medially deviated at LisFranc's joint. These earlier studies often included forefoot adducto varus deformities that were a component of more complex pedal anomalies. Second, many of the theoretical points were not substantially or consistently supported by clinical findings. Finally, several of the anatomic observations reflect known normal secondary insertions of the respective tendons.

Intrinsic Tendon Anomalies

A dynamic imbalance or malinsertion of the abductor hallucis muscle has been proposed by several authors to be a contributing factor in the etiology of metatarsus adductus (9-11). Thompson felt that congenital metadductus was in part caused by abnormal insertion of abductor hallucis and its accessories (12). He recommended resection of the entire abductor hallucis muscle with selective sectioning of fibers from the medial head of flexor hallucis brevis. In a five year study, he reported 90 percent good results with minimal complications. His

most frequent complication was postoperative hallux valgus which he treated with adductor tenotomies. Sgarlato advised against resection for the abductor hallucis for the above reasons. He felt that there was an anomalous insertion of the abductor hallucis into the first metatarsal head and recommended sectioning the tendon, lengthening, and reattaching it to the base of the proximal phalanx (4).

Though the above theories do present some evidence of a dynamic component to metatarsus adductus, there is no real data supporting isolated primary soft tissue contracture as the etiology. At the Podiatry Institute, tendon resections or transfers are rarely performed as the primary procedure of choice for metadductus. However, these tendons are evaluated preoperatively and inspected intraoperatively for anomalies or malinsertions and treated accordingly. Effective results have been obtained when combining the above procedures, especially release of a tight abductor hallucis tendon, with more aggressive soft tissue release or osteotomies at the tarsometatarsal articulation.

Structural Correction

The most popular and commonly performed soft tissue procedure for this deformity is probably that described by Heyman, Herndon, and Strong in 1958 (12). They originally described this conservative operative procedure for correction of resistant cases of metatarsus varus or adductus as well as for residual clubfoot deformities. The surgery was indicated for pediatric patients younger than age 7 and usually older than 3.

The upper age limit of 7 was based on the assumption that this was about the time the metatarsal bases began taking on their adult contour. The lower age limit in their original study was 3 years, though they did not reject using the procedure in younger patients. They believed the procedure, termed anterior capsulotomies, was comparatively simple and did not result in injury to the bones themselves. They also advocated that the operation gave structural correction to a resistant deformity that could not be afforded by tendon transposition or transfer.

The original publication described the procedure as being performed under pneumatic tourniquet through one dorsal transverse incision. It began at the first cuneometatarsal articulation and continued laterally to the base of the fifth metatarsal. Using sharp dissection techniques, each metatarsal base was encircled severing the dorsal, plantar, interosseous, and intermetatarsal ligaments as well as joint capsule. The forefoot was then swung laterally at the tarsometatarsal joint and held in as much abduction as possible. The foot was casted in this position with the heel not everted. An initial cast change was performed two weeks after surgery, at which time further abduction was attained. Casting therapy was maintained for approximately 3 months postoperatively.

In their initial study, the authors performed their procedure 29 times on 20 patients. Only nine cases were performed for isolated metatarsus adductus deformities. The remaining 20 were done to correct residual forefoot adductus as a component of clubfeet. Out of the former group of nine, all yielded good or excellent results. There were also no reports of wound healing complications nor any circulatory or sensory embarrassment.

Since their original description, several modifications have been applied to the tarsometatarsal and intermetatarsal release. In 1970, Kendrick et al reported 92 percent good results with the above procedure (13). They were able to follow a majority of the patients on a long term basis and noted excellent maintenance of correction. They also preferred a dorsal transverse approach, but did mention the option of using two dorsal linear incisions.

When performing their soft tissue release, they recommended leaving the plantar lateral two-thirds of the cuneometatarsal capsule intact to prevent dorsal bunion formation. Similarly, they maintained the lateral fifth metatarsocuboid articulation to prevent over correction. They did report several potential complications including skin slough, avascular necrosis of metatarsals and cuneiforms, dorsal prominence of base of first metatarsal, and late degenerative joint disease.

In a recent study, Stark et al retrospectively reviewed 48 feet that had undergone Heyman, Herndon and Strong (HHS) procedures. Their results conflicted with those of previous studies (14). Their patients were divided into one of four groups based on etiology. Group I is the most relevant to our discussion and included patients with simple metatarsus adductus treated only with the HHS release. The remaining groups were comprised of those cases who had additional deformities and required other major surgical procedures in addition to the tarsometatarsal release. Of the 48 feet studied, 19 were considered to have poor results, and seven had fair results after an average 9 year follow up. A poor result was one where a moderate amount of at least two of the following three complications existed: 1) residual adductus 2) clinical pain 3) difficulty with shoe gear. When comparing the overall results with those of the individual groups, the figures were similar.

Of the 15 feet from the simple metatarsus adductus group, only eight were reported as good, while six had poor results. They felt that the likelihood of success failed to justify the known risks and complications that may result from the described surgery. This is probably the most comprehensive report published on the HHS procedure and the reader is referred to the complete reference for the study.

When the HHS procedure is performed at the Podiatry Institute several modifications are used. Two, or preferably three, longitudinal incisions are used instead of the dorsal transverse approach described previously (Fig. 1). It is felt that the dorsal longitudinal incisions decrease the possibility of accidental transection of vital neurovascular and tendinous structures. This approach also facilitates anatomic dissection through tissue planes.

The most medial incision is placed over the first metatarsocuneiform joint, the other two are centered over the second and fourth metatarsal spaces. Care is taken to preserve the lateral capsular and ligamentous structures of the fifth metatarsocuboid articulation as well as the insertion of the peroneus brevis tendon. This will create a functional hinge at the lateral aspect of the foot and prevent inadvertent overcorrection.

Following division of the intermetatarsal, dorsal, and medial capsule and ligaments, the metatarsals can be plantarflexed to visualize the plantar ligaments. Again, it is recommended that only the medial two-thirds of the plantar ligaments be resected in order to prevent displacement laterally or dorsally. Because this procedure essentially creates a LisFranc's dislocation, instability can easily result. If additional stability is needed, Kirschner wires (K-wires) can be used to help maintain alignment. They are usually placed through the first metatarsocuneiform joint and the fifth metatarsocuboid joint. A pin placed transversely across the metatarsus can also be used and serves to facilitate manipulation and casting both intraoperatively and postoperatively (Fig. 2). In either instance, intraoperative radiographs are suggested to assure accurate alignment.

The indications used for the surgery are similar to those described by the original authors. If the deformity is flexible, the procedure can be performed in children up to the age of 8 years. As an aid to determining the degree of flexibility, Yu et al described an abductory stress test that can be performed both clinically as well as radiographically (Figs. 3 A, B). As the metatarsal bones mature toward their adult configuration, the deformity becomes more rigid often times requiring osteotomies.

When discussing the indications for the procedure, it is often suggested that the metatarsal bones in the young

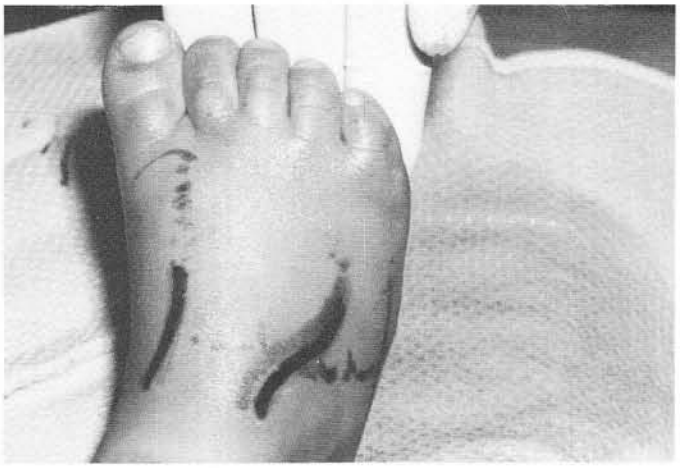


Fig. 1. Use of longitudinal incisions is preferred. This lessens chance of accidentally transecting vital neurovascular and tendonous structures.

Fig. 2. Use of Kirschner wires can lend increased stability and facilitate manipulation and casting techniques.

child (usually less than 8 years old) are rounded in configuration and therefore amenable to soft tissue correction. However, this has not been a consistent intraoperative finding by surgeons at the Podiatry Institute. Often times a rounded metatarsal base seen on preoperative radiograph will be squared when viewed during surgery (Figs. 4 A, B).

As reported in Kendrick's study, the procedure carries with it a significant number of potential complications including wound complications, avascular necrosis of metatarsals and cuneiforms, and late degenerative joint disease. The latter of these, tarsometatarsal arthritis is easy enough to appreciate when performing the soft tissue release. Great care must be taken to avoid damaging the cartilaginous metatarsals and cuneiforms particularly when releasing the first metatarsocuneiform joint. The epiphyseal growth plate of the first metatarsal can easily be mistaken for the joint space resulting in significant deformity in the segment as the child matures.

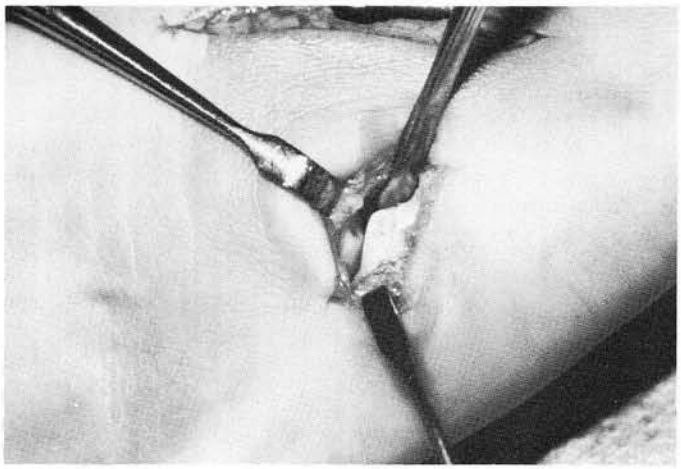
Fig. 3. A, B. An abductory stress test can be used as an aid in determining degree of flexibility present in deformity. Care is taken to stabilize heel and cuboid as an abductory force is applied to forefoot.

In a certain percentage of metatarsus adductus cases, a co-existing hallux varus condition is present and should be considered a separate deformity. Often this adduction deformity at the first metatarsophalangeal joint will not be apparent until the tarsometatarsal release has been performed. In that situation, a tight or malpositioned abductor hallucis tendon can play a significant role in the etiology. The hyperactivity of the abductor muscle can be clinically simulated by stroking the inner border of the foot resulting in medial deviation of the hallux on the first metatarsal head. In other instances, the hallux may maintain a normal alignment on the metatarsal head but a prominent abductor tendon is still present medially. In either case sectioning, lengthening,

or transfer of the tendon can provide a quick and effective release. Most frequently, the tendon is tenotomized through a small incision at the medial aspect of the first metatarsophalangeal joint (Fig. 5).

Postoperative management following the HHS procedure is as important as the procedure itself. If maintenance of correction is to be expected, an extensive casting regimen is required for several months after surgery. This demands a combined cooperative effort on the part of the physician, patient, and parents.

Fig. 4. A, B. Classic rounded metatarsal base seen on pediatric radiographs are oftentimes squared when viewed intraoperatively.



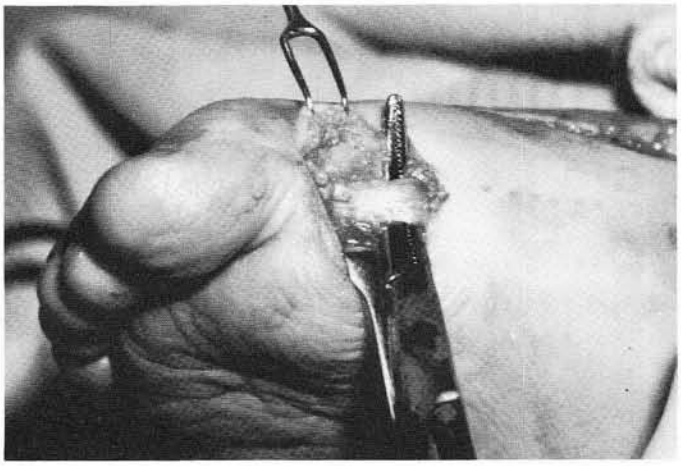


Fig. 5. Tight abductor hallucis tendon is sectioned through small incision at medial aspect of first metatarsophalangeal joint.

CONCLUSION

The extensive soft tissue release described by Heyman et al is a controversial procedure at best. The procedure has its indications and can be effective in the right circumstances. However, the degree of difficulty in executing the procedure combined with the prolonged postoperative management make the procedure unattractive in most cases.

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