CHAPTER **24**

SOFT TISSUE REBALANCING PROCEDURES FOR THE TREATMENT OF GERIATRIC HALLUX VALGUS DEFORMITIES

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HISTORY

Today, a soft tissue approach for the correction of painful hallux abducto valgus (HAV) deformity, is not widely accepted among podiatrists for severe deformities. With improvements in power instrumentation, and AO fixation techniques becoming a very familiar part of most physician's operating skills, these more aggressive techniques, involving various configurations of osteotomies, have largely taken the place of soft tissue procedures. These newer techniques involving more bone work, however, presenting a challenging task in an ever-aging population, who may present with factors that would make an osteotomy an increased risk for potential postoperative complications.

In 1928, Earl D. McBride originally described his procedure for correction of hallux abducto valgus deformity in his article entitled "A Conservative Operation For Bunions." In this article, he outlined the etiology and surgical approach for correction of this "multi-vectorial" deformity.[1] McBride was the first to recognize the deforming force of the conjoined tendon of the adductor hallucis muscle as a major contributing factor in the development of HAV. He believed that a short shoe would evert the great toe, and that the adductor conjoined tendon would gain mechanical advantage over the abductors of the toe. This would lead to a gradual pulling of the fibular sesamoid into the interspace. As the sesamoid became more fixed in place, the sesamoid would push the head of the 1st metatarsal inward at each step.[1]

The theory of the McBride bunionectomy was to decrease the pathomechanical forces surrounding the first metatarsophalangeal joint, and to restore normal anatomic alignment to the joint. The original procedure was performed through a single two-inch incision placed just lateral to the lateral border of the extensor hallucis longus tendon, with its center over the first metatarsophalangeal joint. Dissection was then carried directly into the interspace where the conjoined adductor tendon and lateral head of the flexor hallucis brevis were released, and the fibular sesamoid excised. The conjoined tendon and extensor hallucis brevis lateral head were then transplanted into the dorsum of the head of the first metatarsal bone. The incision was retracted medially to expose the medial eminence and overlying bursa. Next, the bursa was excised, the hypertrophic prominence resected, and a medial capsulorrhaphy was performed.[1]

There have been many modifications of the original McBride bunionectomy. McBride himself altered the technique as he gained more experience with the procedure.[2-6] His incisional approach changed, as did the fact that he warned against transferring the lateral head of the flexor hallucis brevis with the conjoined tendon of the adductor hallucis. He later stated this would give rise to a cock-up hallux. Between 1954 and 1967, McBride advocated either a fascial-periosteal suture placed between the medial aspect of the neck of the second metatarsal and the lateral aspect of the neck of the first metatarsal, or a circumferential suture around the necks of both of the metatarsals. He believed this would reapproximate the normal anatomical distance between the first and second metatarsals.

In 1950, Joplin described a modification of the McBride bunionectomy to reapproximate the first and second metatarsals. He advocated running the

conjoined tendon through a drill hole in the first metatarsal, and fixing it under tension. He also used the extensor tendon of the fifth digit to reduce the spread of the first and second metatarsals.[7]

The Duvries modification of the McBride bunionectomy differs from the original in the following ways. First, Duvries did not "reef" the capsule of the medial aspect of the first metatarsophalangeal joint. Instead, a wedge section was removed and the cut edges reapposed. This prevents a soft tissue ridge which can become an irritant from shoes. The Duvries method does not suture the conjoined adductor tendon to the dorsum of the first metatarsophalangeal joint, and does not use circumferential retention sutures to hold the first and second metatarsal together. In the Duvries method, the conjoined adductor tendon is incorporated into sutures that hold the capsules of the first and second metatarsal in close approximation.[8]

Kempe and Singer, in 1985, described a modification to the McBride procedure utilizing the adductor conjoined tendon transfer. The modification included transportation of the adductor hallucis tendon into the medial capsular flap via a pulley suture, and derotation of the sesamoid apparatus. This was accomplished by placing torque on the medial capsular flap. It is transferred to the tibial sesamoid through the tibial sesamoid ligament, and then to the fibular sesamoid by the intersesamoid ligament. The contracted fibular sesamoid ligament was sacrificed. This procedure was devised to maintain the sesamoids in a corrected position while not necessitating removal of the fibular sesamoid. The tension of the adductor tendon transfer also helps to maintain reduction in the intermetatarsal angle. Kempe and Singer advocate this procedure for deformities in which the fibular sesamoid is at least one half in the interspace, and the tibial sesamoid is four or greater. Mild to moderate hallux abductus of 20 to 40 degrees, and mild valgus rotation of the hallux is acceptable. The articular surface of the first metatarsophalangeal joint should be good viable cartilage.[9]

Dobbs wrote, in reference to soft tissue balancing procedures, "the procedure should be limited to the most simple of deformities and that the strength of the procedure is in its positional correction and should not be used for structural pathology."[10] The indications and criteria that Dobbs set forth for soft tissue procedures were:

1) Mild to moderate deformity; deviated joint
2) PASA and DASA = normal
3) IMA = rectus foot type: 12 degrees or less, adductus foot type: 10 degrees or less
4) ROM = pain free; no crepitus; at least 45-50 degrees of dorsiflexion
5) Tibial sesamoid position #4 or greater
6) Mild axial rotation of hallux acceptable

Dobbs stated that a plantarflexed first ray or forefoot valgus would increase the possibility of recurrence.[10]

Regardless of the modifications made to the original McBride procedure, one consensus has remained constant: the McBride bunionectomy has traditionally been abandoned when the deformity presents as anything other than the simplest entity. This presents the surgeon with a dilemma when confronted with a moderate or severe deformity, but an osteotomy is directly contraindicated. For example, in the geriatric population, osteoporotic bone stock is a common concern, and may allow inadequate internal fixation, thus compromising the osteotomy correction. Painful malalignment leading to delayed or non-union may result. Another problem may arise when one considers the amount of time and energy it takes for an osteotomy to adequately heal. The postoperative course is more difficult when an osteotomy is involved, and early injury to the surgical site can compromise the desired end result.

MATERIALS AND METHODS

A total of 21 patients, with a total of 25 procedures were retrospectively evaluated by means of preoperative and postoperative radiographic analysis, as well as subjective and objective chart review. The criteria used for inclusion in this review were: an intermetatarsal angle equal to or greater than 14 degrees, normal PASA, and DASA, age 55 or older, or patients with obvious radiographic evidence of cystic areas in the metatarsal head, which led to the selection of the procedure described rather than a more traditional osteotomy. Patients with obvious radiographic cystic areas were included without consideration of age.

The radiographic angles were determined by two evaluators who separately measured the angles from the preoperative radiographs and compared them to the final postoperative radiographs, using

standard accepted technique. The examiners then had to reach agreement as to the angle measured. Of the 21 patients considered, all but one was operated on by the same clinician, the other patient was included because of the outlined criteria as well as the fact that the surgical approach was the same as advocated by the authors.

Each patient included in the study had the same surgical approach for their HAV deformity, that being the sequential soft tissue rebalancing procedure described, without an associated osseous procedure. The anatomical structures used to restore normal joint anatomy and function were determined by use of the stepwise approach that is presented here. As all patients are different in their initial presentation, anatomy, and degree of adaptation, there is no singular approach to these complicated clinical entities. Therefore, the careful stepwise approach is vital. Methodical intra-operative evaluation following each step during the procedure is the key to the success of the surgery.

PROCEDURE

When discussing the authors' sequential soft tissue rebalancing procedure for hallux abducto valgus deformity, it is essential to emphasize the need for careful, step-wise, intraoperative evaluation. This helps to maximize the effects of the soft tissue anatomy used to reconstruct the first metatarsophalangeal joint. The authors have chosen not to refer to the procedure simply as a modified McBride bunionectomy with an adductor tendon transfer, because there are significant differences in both philosophy and surgical technique between the two approaches.

As noted in the procedure profile table, all of the patients had what was considered to be a modified McBride technique as part of the rebalancing procedure. When using the term modified McBride, the authors are referring to that portion of the procedure that includes excision of the medial exostosis on the distal-medial aspect of the metatarsal head, release of the deep transverse intermetatarsal ligament, mobilization of the fibular sesamoid, and release of the adductor tendon from its insertion along the lateral base of the proximal phalanx. As noted in the table, other components of the soft tissue rebalancing procedure include: adductor tendon transfer, excision of the fibular sesamoid, extensor hallucis brevis transfer, and extensor hallucis longus lengthening. Other components not specifically tabulated as part of this study, but considered contributory adjuncts frequently used, are a lateral capsulotomy, release of the flexor plate with the McGlamry Elevator, and medial capsulorrhaphy.

A sequential approach was used in those patients previously identified as having an IM angle equal to or greater than 14 degrees, and being at least 55 years of age unless there were significant cystic changes in the metatarsal head, such that the authors believed an osteotomy would be contraindicated. A dorsal curvilinear 5 cm to 6 cm skin incision was made just medial to the extensor hallucis longus tendon overlying the first metatarsophalangeal joint. Layered anatomic dissection with hemostasis applied as necessary was strictly adhered to in order to remain as atraumatic as possible.

An inverted "L" type capsulotomy was then performed, and the dorso-medial first metatarsal exostosis was resected in the sagittal plane with care taken to keep the tibial sesamoidal groove completely intact. Attention was then directed to the first intermetatarsal space, where the deep transverse intermetatarsal ligament was identified and transected. The conjoined tendon of the adductor hallucis brevis (oblique and transverse heads) was identified and freed from its insertion on the lateral aspect of the base of the proximal phalanx, and from its attachments to the fibular sesamoid. This tendon was carefully dissected, in a proximal direction, to the level of the myotendonous junction, with care taken to preserve the underlying neuro-vascular structures. At this point the tendon was tagged with a non-absorbable suture for later transfer.

Attention was then directed to the fibular sesamoid, which was evaluated to determine whether to release the sesamoid or remove it. The authors will generally prefer to excise the sesamoid rather than just release the soft tissue attachments, (leaving only the intersesamoid ligament intact), if the sesamoid is completely subluxed and lying in the interspace, with a tibial sesamoid position of 5 or greater, or if there are significant degenerative changes radiographically that can be confirmed upon gross inspection. Next a lateral capsulotomy was performed, completing the lateral release.

After addressing the fibular sesamoid, the McGlamry elevator was used to release the flexor plate apparatus, and the forefoot was loaded to

evaluate the position of the first metatarsophalangeal joint and hallux. The final goal of the procedure was to restore a congruous joint while reducing the metatarsal primus varus component, as well as correcting the hallux valgus. A Xi-scan or Flouroscan can be used to evaluate the position of the joint and the sesamoid.

If needed, an adductor transfer was performed at this time. It was accomplished by creating a subperiosteal opening across the dorsal neck of the first metatarsal, and suturing the tendon into the proximal-medial capsular tissue with an out and in mattress stitch using nonabsorbable suture. The site of transfer was very important. If the tendon was transferred too far distally into the tibial sesamoid suspensory ligament, it would have too powerful a pull on the sesamoid and cause tibial "sesamoid peaking." This would increase the chance of postoperative hallux varus. The correct placement for the transfer was in the area which represents the proximal junction where the periosteum thickens to become capsule. Enough tension was then created on the medial capsular apparatus to further close down the IM angle and relocate the sesamoids into a more anatomical position. This would avoid the creating of excessive tension on the tibial sesamoid ligament.

The next step was considered only after carefully ascertaining the amount of deformity still present. This is the point at which the extensor hallucis brevis transfer was performed. This was done by tenotomizing the tendon as far distal as possible, and re-routing the tendon underneath the extensor hallucis longus tendon. It was then sutured with 3-0 absorbable suture extracapsularly into the dorsal aspect of the vertical arm of the inverted "L" capsulotomy. This helped to further derotate the valgus component of the hallux.

The extensor hallucis longus tendon was then addressed. In long standing HAV contracture, the EHL tendon could become tight and therefore may need to be evaluated and perhaps lengthened. The authors typically performed a "Z" slide lengthening technique if there is a tight EHL.

The final soft tissue adjunct used in the procedure was the capsulorrhaphy, where a section of capsule was excised medially and the remaining capsule reapproximated with 3-0 absorbable suture to further "reef-up" the medial aspect of the first metatarsophalangeal joint. The remaining portion of capsule was reapproximated with 3-0 absorbable suture, the subcutaneous tissue with 4-0 absorbable, and the skin with 5-0 absorbable using a running subcuticular type technique.

Postoperative management consisted of a compressive bandage applied in the operating room, with initial postoperative weight bearing in a post-surgical shoe. The dressings were left on for 1 to 2 weeks. Compressive dressings were then maintained for an additional 2 weeks to reduce swelling. The patient was encouraged to begin wearing sensible routine footwear, as tolerated at approximately 3 weeks.

RESULTS

Twenty-one patients, with a total of 25 hallux abducto valgus soft tissue rebalancing procedures were presented. The mean age of the patients was 64.5 years. The youngest patients included were 40 and 41 years respectively, and were included on the basis of significant cystic changes in the head of the metatarsal which contraindicated an osteotomy. The remaining patients were at least 55 years old, with the eldest being 80. Four of the patients underwent bilateral surgery, with the second surgery being performed after adequate recovery from the initial repair.

The mean postoperative follow-up was 15.7 months. The chart review, which included both a subjective and objective rating, revealed that of the 25 procedures performed, there were two procedures that resulted in an outcome that was less than satisfactory to both the authors and the patient, necessitating an additional surgery. The first was for repair of postoperative hallux varus. The second procedure was an metatarsophalangeal joint arthrotomy, with an EHL lengthening, for treatment of postoperative hallux limitus. There was one additional patient with a bilateral repair, who subjectively was satisfied with the result, however the clinician considered the postoperative range of motion less than sufficient, and therefore prescribed a physical therapy regiment leading to improved clinical motion.

The remaining 17 patients, with 20 procedures, were discharged with both excellent clinical and subjective results. These results were based on the improved position and function, compared to the preoperative deformity, and the reduction in the patient's symptoms following the repair.

All 21 patients had a Modified McBride bunionectomy. In addition, each of the 25 procedures included an adductor tendon transfer as part of the procedure. The fibular sesamoid was excised in 7 cases. The extensor hallucis brevis was transferred in 19 of the 25 procedures, with lengthening of the extensor hallucis longus tendon carried out in 3 cases.

The preoperative radiographic evaluation found the measured IM angle to average 16.3 degrees, with a high of 22 degrees and a low of 14 degrees. The average HA angle was determined to be 27.5, with a high of 42 and a low of 13 degrees. When the preoperative films were compared with the final postoperative films, (taken at discharge, or the last patient visit), the values were as follows: The average IM angle, post-rebalancing procedure, was 10.2 degrees, with the average degree of achieved correction being 6.1 degrees; the average postoperative HA angle, as measured by the radiographic evaluators, was 14.6 degrees, with the average degree of correction being 12.9 degrees.

Table 1 depicts the patients included in the study. Figures 1,2, and 3 represent the pre- and postoperative radiographs of three patients included in the study. In all preoperative films, there is the presence of some degree of structural deformity; however, all three postoperative films demonstrate adequate reduction of the intermetatarsal angle, hallux abductus angle, and establishment of a rectus first metatarsophalangeal joint.

Table 1

INFORMATION ON PATIENTS INCLUDED IN STUDY

Patient#	Age	Modified McBride	Fibular Sesamoid Excision	Adductor Tendon Transfer	EHB Transfer	EHL Lengthen	Preop X-Rays IM-HA	Postop X-Rays IM-HA
1	65	Y	N	Y	Y	N	22-32	14-14
"	65	Y	N	Y	Y	N	21-25	12-10
2	60	Y	Y	Y	Y	N	14-28	6-15
"	60	Y	Y	Y	Y	N	15-35	11-26
3	56	Y	N	Y	Y	N	16-24	14-20
4	64	Y	N	Y	N	Y	14-13	10-13
5	70	Y	Y	Y	N	N	18-37	12-15
6	69	Y	N	Y	N	Y	16-33	9-11
7	71	Y	N	Y	Y	N	15-18	12-12
8	80	Y	Y	Y	Y	N	16-25	10-12
9	55	Y	Y	Y	N	N	16-16	12-6
10	64	Y	Y	Y	Y	N	18-40	8-14
11	41	Y	N	Y	Y	N	14-22	8-9
12	40	Y	N	Y	Y	N	15-22	9-14
13	65	Y	N	Y	Y	N	15-20	8-5
14	60	Y	N	Y	Y	N	15-23	8-12
15	69	Y	N	Y	Y	N	15-42	11-12
16	71	Y	Y	Y	Y	N	17-32	8-12
17	78	Y	N	Y	Y	N	15-30	12-16
18	67	Y	N	Y	Y	N	18-26	9-13
"	66	Y	N	Y	Y	N	18-32	10-17
19	72	Y	N	Y	Y	N	15-29	14-18
20	66	Y	N	Y	Y	Y	18-35	14-24
21	69	Y	N	Y	N	N	16-24	5-22
"	69	Y	N	Y	N	N	15-25	9-24

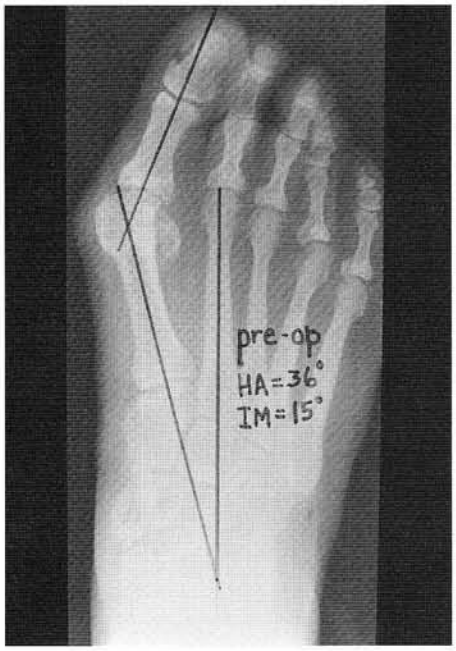

Figure 1A. Preoperative dorsoplantar projection depicting an intermetatarsal deviation angle of 15 degrees, a hallux abductus angle of 26 degrees, and a tibial sesamoid position of 6. The first metatarsophalangeal articulation is subluxed, and the fibular sesamoid is completely within the interspace.

Figure 1B. Twenty-month postoperative dorsoplantar projection demonstrating reduction of the intermetatarsal and hallux abductus angles to 12 and 17 degrees, respectively. The fibular sesamoid has been excised, and the first metatarsophalangeal joint is congruous.

Figure 2A. Preoperative dorsoplantar projection depicting an intermetatarsal deviation angle of 21 degrees, a hallux abductus angle of 25 degrees, and a tibial sesamoid position of 7. The first metatarsophalangeal articulation is subluxated, and the fibular sesamoid is completely within the interspace.

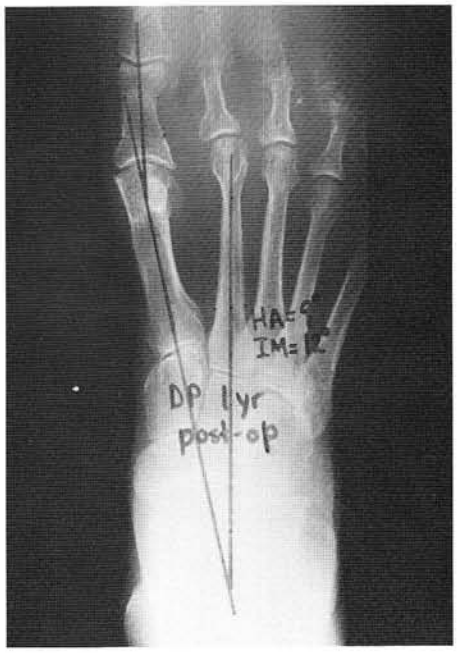

Figure 2B. One-year postoperative dorsoplantar projection demonstrating reduction of the intermetatarsal and hallux abductus angles to 12 and 9 degrees, respectively. The fibular sesamoid has been excised, and the first metatarsophalangeal joint is congruous.

Figure 3A. Preoperative dorsoplantar projection depicting an intermetatarsal deviation angle of 15 degrees, a hallux abductus angle of 28 degrees, and a tibial sesamoid position of 6. The first metatarsophalangeal articulation is subluxated, and the fibular sesamoid is completely within the interspace.

Figure 3B. Six-month postoperative dorsoplantar projection demonstrating reduction of the intermetatarsal and hallux abductus angles to 11 and 15 degrees, respectively. The fibular sesamoid has been excised, and the first metatarsophalangeal joint is congruous.

DISCUSSION

This strictly sequential soft tissue approach can be an extremely powerful force in reducing long-standing deformity. The term "rebalancing" is used to help describe this procedure, because the normal position of the hallux, as it articulates with the first metatarsal head, is literally a balance of forces, equally stacked on the positional scales between varus and valgus by well-opposed soft tissue structures. There are a number of conditions however that can affect the balance of power about the joint, tipping the scales most commonly in the direction of valgus, as the soft tissue structures re-adapt and become malaligned leading to a mechanical advantage. Occasionally, in long-standing deformity, some actual secondary structural changes can take place about the first metatarsophalangeal joint, which some have attempted to identify by looking at PASA and DASA versus the hallux abductus angle:

Structural Deformity, PASA + DASA = HA and the PASA and DASA are abnormal with a congruent joint.
Positional Deformity, PASA + DASA < HA and the PASA and DASA are normal with a deviated or subluxed joint.
Combined Deformity, PASA + DASA < HA and the PASA and DASA are abnormal with a deviated or subluxed joint 10.

The soft tissue procedure described is limited in its application to only those deformities where secondary structural changes are minimal. Less frequently, there may be other primary etiological factors that are structural in nature that are believed to be the true etiology of the condition, such as long first metatarsal, atavistic cuneiform, or metatarsus adductus. This procedure is not a panacea. It is a powerful procedure that can be implemented in even severe deformities, as long as the deformities have a positional component present. A reconstruction of the soft tissue structures about the first metatarsophalangeal joint, can harness the intrinsic power of this anatomy and use it to "sequentially rebalance" and realign the first metatarsophalangeal joint. The term structural deformity is not defined by the degree of the intermetatarsal angle, but rather relates only to actual primary or secondary deformation in the actual bony architecture of the foot.

No procedure is without potential complications, and the sequential soft tissue rebalancing procedure is no exception. The same routine risks and considerations associated with all surgery should be carefully reviewed with the patient before proceeding. All of the patient factors relating to health, age, postoperative expectations, and goals, should be discussed with the patient.

Although postoperative hallux limitus can be a potential complication of any bunion surgery, it should be remembered that the patient will have no more postoperative motion than what was achieved on the operating table. It is possible to be overly aggressive with the soft tissues used in this procedure, and limit or restrict joint motion that could result in clinical and patient disappointment. Therefore, it is important to evaluate the motion present after each step of the described procedure. Sequential approach implies a step-wise, intraoperative evaluation with attention to the amount of dorsiflexion and plantarflexion present after each step as well.

Hallux varus is an additional possible complication. Although is not a potential complication with this soft tissue approach alone. Overaggressive correction with any of the bunion corrective procedures carries with it the possibility of a varus. There are also complications associated with the procedures using osteotomies and internal fixation that do not apply to this soft tissue rebalancing procedures, such as aseptic necrosis, delayed or nonunion, and metatarsus primus elevatus.

A factor that is crucial with any corrective bunion procedure is the position of the second toe. A proper anatomical second toe and metatarsophalangeal joint will give more predictable long-term success with the sequential soft tissue procedure. A properly positioned second toe will act as an anatomical strut or buttress to help maintain a long-term corrected hallux position.

SUMMARY

Podiatric surgeons today have an extensive armamentarium of procedures to perform in the correction of hallux valgus. Certain factors can limit the procedural choices to those consisting of soft tissue correction. The authors have provided an extensive review of soft tissue procedures utilized in the surgical repair of hallux abducto valgus deformities. A detailed description of the soft tissue rebalancing procedures utilized by the authors has also been provided. Twenty-one patients underwent twenty five soft tissue rebalancing procedures and were reviewed postoperatively on subjective, objective, and radiographic criteria. The authors have shown that the soft tissue rebalancing procedures described in this study are a viable option to adequately correct severe hallux valgus deformities, when certain factors dictate that an osteotomy should not be performed.

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