

CORRECTION OF THE TRANSVERSE LESSER MTPJ DEFORMITY

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Transverse plane deformity at the lesser metatarsophalangeal joint (MTPJ) can be extremely difficult to correct in the surgical setting. Often a compound deformity, including both transverse and sagittal plane components, is present. Multiple methods for correction have been described ranging from soft tissue rebalancing procedures¹⁻⁶ to osseous procedures.⁷ This deformity can range from a mild pre-dislocation syndrome⁶ to a severely dorsally dislocated overlapping toe. The method of correction will often depend on the degree and components of the deformity, the expectations of the patient and surgeon, and the surgical expertise of the surgeon. When considering reconstructive correction, it is important to address each element of the deformity. Often adjunctive procedures will be necessary in order to correct all components of the deformity. (Table 1) The methods described in this paper will cover soft tissue rebalancing procedures utilized by members of The Podiatry Institute to correct the lesser MTPJ transverse plane deformity. Criteria used in procedure selection will also be discussed.

CONSERVATIVE TREATMENT

Conservative treatment is aimed at the reduction of symptomatology without correction of the deformity.² Multiple methods have been described^{2,6} to reduce

pain and allow for return to normal function. In the presence of moderate to severe deformity, a return to normal function is often not possible without surgical intervention. Conservative treatment options include: orthodigital devices, orthoses, orthopedic shoes, taping, anti-inflammatories (NSAIDs, corticosteroid), physical therapy, ultrasound, and whirlpool.

SURGICAL CORRECTION

When correcting deformity at the lesser MTPJ, it is important to keep the final goal in mind. All tight and contracted tissues must be released and all loose and attenuated tissues will need to be plicated in some manner. The description of each method of correction will be based on a "predislocation syndrome" type of deformity with dorsal contracture at the MTPJ and medial deviation at the MTPJ. With this deformity, the medial MTPJ capsule will need to be released down to the level of the plantar plate. Depending on the extent of dorsal contracture at that joint, the lateral capsule will also need to be released in order to allow the toe to come down in the sagittal plane. (Fig. 1)

Once sufficient releases have been performed (i.e. the toe can easily be placed in corrected position without resistance), the reconstructive process will begin. Arthrodesis at the second through fourth proximal interphalangeal joints (PIPJ) is preferred over arthroplasty, as it leads to stability of the digit and helps to prevent recurrence of contracture deformity at the PIPJ. Resection of the head of the proximal phalanx and base of the middle phalanx as part of the digital arthrodesis, also aids in the reduction of retrograde buckling by decreasing the length of the bony column in the toe. A dorsal midline approach to the PIPJ and MTPJ is preferred, and will allow access to the areas of interest without violating neurovascular structures to the digit. (Fig. 2)

Anatomic dissection, with separation of subcutaneous tissues from the deep fascial/capsular layer, is crucial in order to gain access to the

Table 1

Adjunctive Procedures to Correct Transverse Plane Deformity

Flexor Tendon Transfer
Extensor Tendon Lengthening
Lesser Metatarsal Osteotomy
Other Forefoot Reconstructive Procedures
(bunion procedures, PIPJ work...etc.)

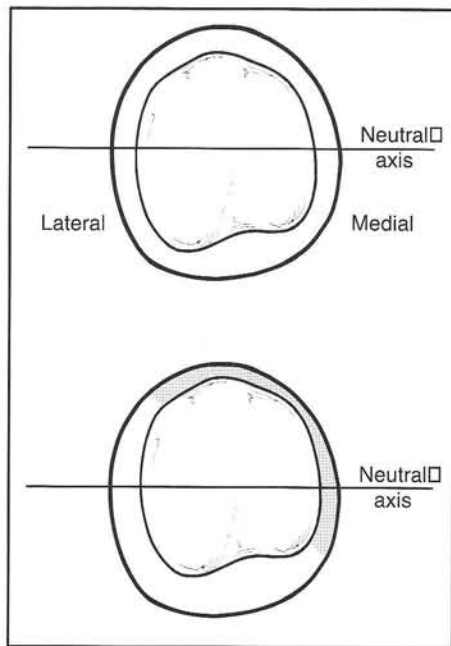


Figure 1. **Top.** Cross section of lesser MTPJ. Neutral axis is located near the midline of the joint. With dorsal contracture all capsular tissues dorsal to the neutral axis will be contracted and all tissues plantar to the axis will be attenuated. **Bottom.** Cross section of lesser MTPJ with both transverse and sagittal plane deformity. Note that the axis shifts obliquely. Contracted tissues need to be released down to the plantar plate medially. Dorsolateral tissues need to be released sufficient to allow reduction of the toe in the sagittal plane.

deeper capsular tissues without compromising neurovascular structures deep in the interspace. The separation of the subcutaneous tissue from the capsular tissues needs to be carried down to the floor of the interspace. At this point you can determine which of the following methods to use to correct the transverse plane deformity.

Standard Capsulotomy/ McGlamry Scoop with K-wire Fixation

This method of correction begins with the standard step-by-step hammertoe release as described by McGlamry.⁸ The work at the PIPJ is done first. If the toe does not reduce with the push-up test, an extensor hood recession and/or an extensor tendon lengthening is performed. Reduction is again checked, and if further work is required, a MTPJ capsulotomy is performed. Keep in mind that this

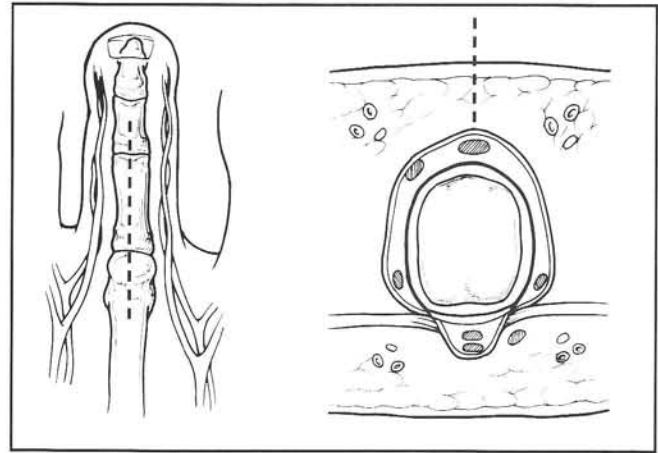


Figure 2. Dorsal midline incision to the PIPJ and MTPJ avoids neurovascular structures.

correction is being done to correct transverse plane deformity as well as any sagittal plane deformity which may be present. Therefore, all areas of the capsule that are contracted should be released completely.

In the case of a "pre-dislocation syndrome" with dorsal and medial deviation at the MTPJ, a dorsal capsulotomy and release of the capsule down to the level of the flexor plate should be performed medially. All of the tissues on the plantar lateral MTPJ will be attenuated. Often, the capsulotomy will be done to the level of the flexor plate on the lateral side as well, before moving on to the next step. If further release is required to release the dorsiflexion contracture due to plantar adhesions, a McGlamry elevator can be introduced into the joint. The correction relies on the pinning of the toe across the MTPJ in the corrected position, and relying on scarring to hold the toe in the corrected position. A 0.062 smooth K-wire is preferred, as it will better resist bending across the MTPJ compared to smaller diameter wires. The wire should be left across the MTPJ for 3 to 6 weeks. If the wire is pulled distal to the MTPJ prior to six weeks, it should be rebent and left across the PIPJ until six weeks, or until bony union occurs. (Figs. 3-5) The patient should be placed in a hard soled postoperative shoe to prevent bending forces across the MTPJ. A felt pad cutout placed in the shoe to the level of the sulcus will further prevent bending forces across the MTPJ. This method can be used in cases with mild to moderate deformity.



Figure 3. Preoperative radiograph with medial deviation at the MTPJ.



Figure 4. Postoperative radiograph with 0.062" K-wire across the PIPJ arthrodesis site and MTPJ to stabilize correction.

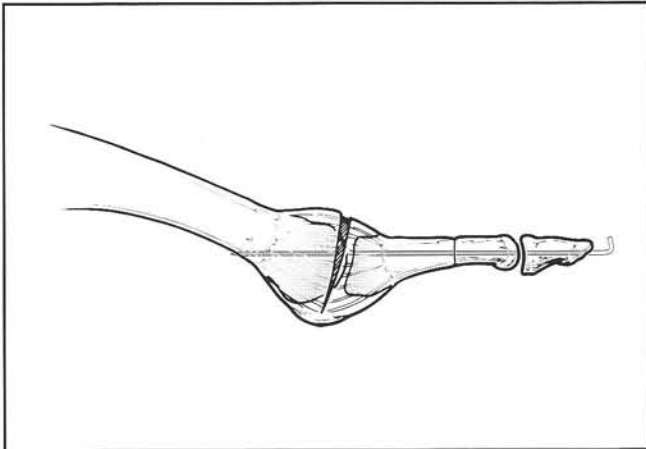


Figure 5. Note that the capsule has been released down to the plantar plate. The K-wire is pinned across both PIPJ and MTPJ.

Capsulotomy/Medial Release with Plantar Lateral Retention Stitch

This method begins similar to the standard capsulotomy. Anatomic dissection is performed down to the level of the deep fascia. After work at the PIPJ is done, the extensor hood recession, and z-plasty lengthening of the extensor tendon(s) are performed. Sufficient release of contracted capsular tissues allows the toe to be placed in the corrected position without resistance. (Fig. 6) Attention is then directed to the attenuated capsular tissues on the plantar-lateral joint.(Fig. 7)

A 2.0 non-absorbable braided suture is used in an over-and-over pulley-type stitch to plicate the plantarlateral capsule.(Figs. 8,9) Not only will this

placement correct the deformity in the transverse plane, but it will also help with the sagittal plane deformity as it lies plantar to the neutral axis of the joint. It is crucial to retract all subcutaneous tissues when placing this stitch in order to avoid damage to neurovascular structures and to allow for maximum correction. All slack in the suture line should be taken up, and the correction should be obtained before the knot is tied. Depending on whether other pathology or residual deformity is present, ancillary procedures may be required. Attention is then focused on the PIPJ fusion site where a K-wire is driven across the fusion site. Depending on the stability and correction, the wire may or may not be driven across the joint.(Figs. 10,11)

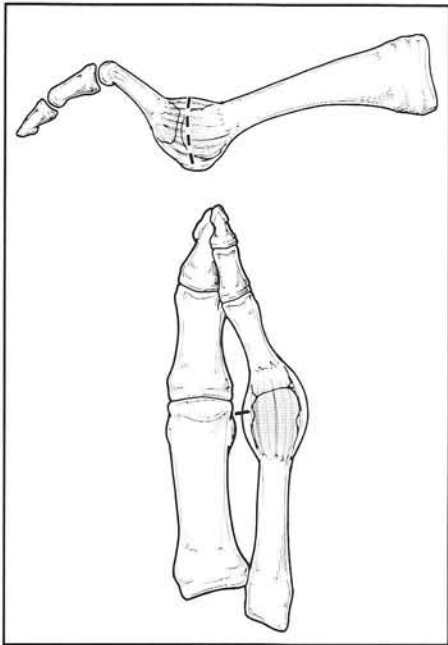


Figure 6. With compound deformities with both transverse and sagittal plane components, all tight structures need to be released. Both the dorsal capsule and plantar medial capsule will need to be released. The lateral capsule needs to be released sufficiently to allow the toe to reduce in the sagittal plane.

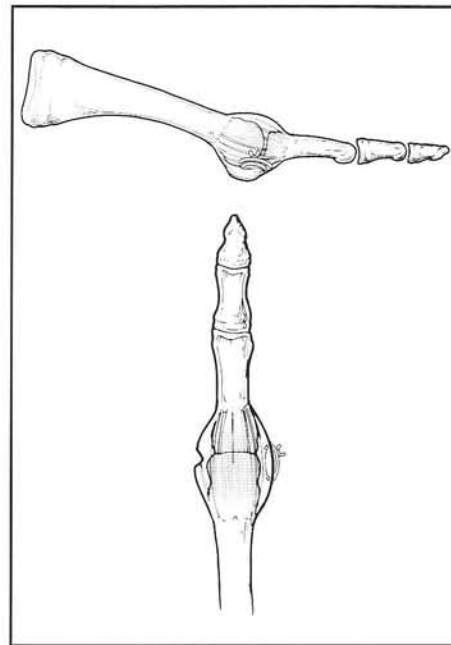


Figure 7. Plantarlateral Retention Stitch. Note the placement of the plantarlateral retention suture. As the toe realigns in the transverse plane, the medial capsule will gap open.

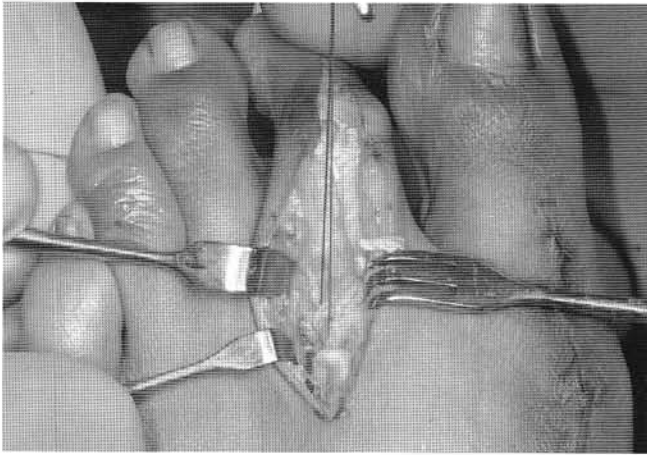


Figure 8. Plantar lateral Retention Stitch. Note placement of pulley-stitch in plantar lateral capsule. All slack in the suture line should be taken up prior to tying the knot. The deep end of a Senn to retract the subcutaneous tissues will facilitate placement of this stitch.

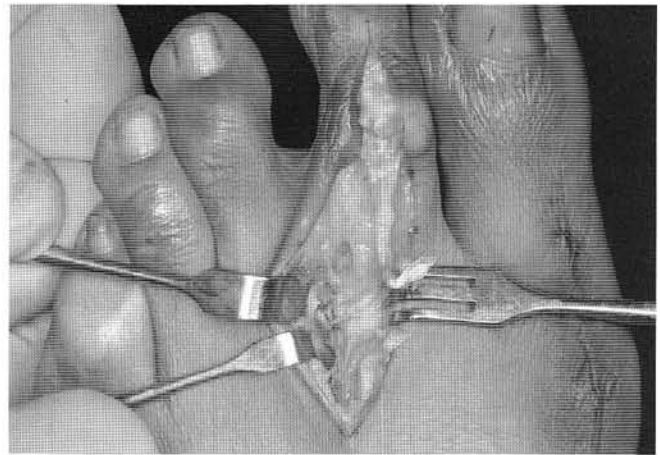


Figure 9. Plantar lateral Retention Stitch. Final placement of stitch in plantar lateral capsule. Note the corrected position of the toe in the transverse plane.



Figure 10. Plantar lateral Retention Stitch. Preoperative x-ray with severe DJD of 1st MTPJ, both transverse plane and sagittal plane deformity at 2nd PIPJ, and hammertoes 3-4.



Figure 11. Plantar lateral Retention Stitch. Postoperative x-ray with Keller Bunionectomy, PIPJ arthrodesis of toes 2-4, and placement of a plantar lateral retention stitch at the 2nd MTPJ. Note position of 2nd toe in the transverse plane without pinning across the joint.

Postoperative weight-bearing status will often depend on other ancillary procedures performed at the same time. Generally, if the procedure is done alone, patients are allowed to be full weightbearing in a protective postoperative shoe. K-wires are usually left in place for six weeks across the MTPJ if pinning was necessary across that joint. This method works well in cases with mild to moderate deformity.

The placement of the plantar lateral retention stitch can be one of the most difficult and frustrating sutures placed. Two surgical "pearls" will greatly facilitate the placement of this stitch. The first is placing the deep end of a Senn retractor on the side of the soft tissue to retract the subcutaneous tissue. This allows for access to the plantar lateral joint capsule without damaging or wrapping up neurovascular tissues. The second pearl is to load the needle in the driver at an obtuse angle. This allows a greater excursion of the needle so the stitch can be thrown into the deep interspace. (Fig. 12)

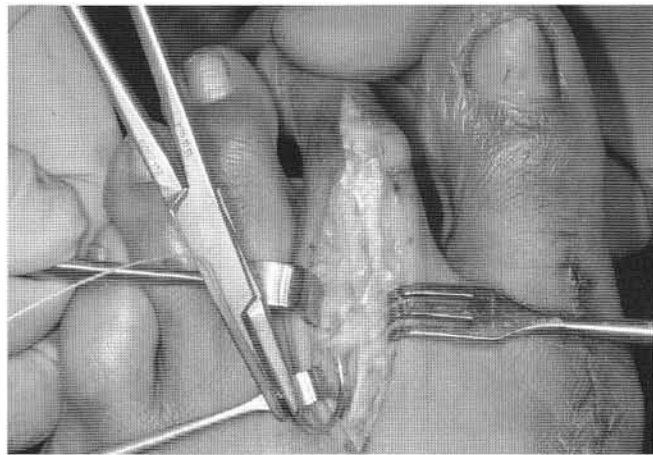


Figure 12. Note the placement of the Senn retractor deep in the interspace to allow access to the plantar lateral joint capsule. Also note the obtuse angle that the needle is loaded in the needle driver. This will allow for full excursion of the needle deep in the interspace.

Capsulotomy/Medial Release With Lateral Capsulorrhaphy

At times the lateral tissues about the MTPJ are so attenuated that redundant capsular tissue needs to be excised in the form of a capsulorrhaphy. The exposure to the MTPJ is identical to the previously-described procedures. After sufficient release has been performed, a capsulorrhaphy is done laterally (on the attenuated side of the joint). This is done in the way of a double semi-elliptical resection of capsular tissue. (Figs. 13-16) A 2.0 braided non-absorbable suture placed with an over-and-over pulley type stitch is used to reapproximate the capsule laterally. The wire from the arthrodesis site of the PIPJ may or may not need to be driven across the MTPJ depending on the stability and correction obtained with the release and capsulorrhaphy. Adjunctive procedures should be performed as deemed necessary. This method works well for moderate to severe deformities.

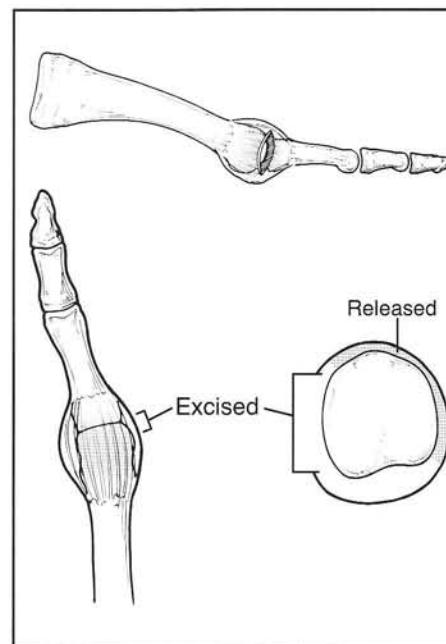


Figure 13. Capsulorrhaphy. A double semi-elliptical excision of redundant capsular tissue is performed laterally. Note the location of where capsule is to be released and where capsulorrhaphy is performed.

Mini-Keller with Syndactylization

This procedure is reserved for more severe overlapping toes with dorsal dislocation at the MTPJ. (Fig. 17) It is often impossible to reduce the toe at the MTPJ as a result of the severe dorsal contracture. In order to bring the toe down in the sagittal plane it is sometimes necessary to resect the



Figure 14. Capsulorrhaphy. Preoperative x-ray. Note severe DJD at 1st MTPJ, both transverse and sagittal plane deformity at 2nd MTPJ, and hammer toe deformity of toes 2-4.



Figure 15. Capsulorrhaphy. Postoperative x-ray. Note 1st MTPJ fusion and slightly flexed fusions of toes 2-4. A capsulorrhaphy was performed laterally. Note the realignment of the 2nd toe at the MTPJ in the transverse plane.



Figure 16. Capsulorrhaphy. 6 weeks postoperative x-ray. Note the transverse plane correction of the 2nd toe. Bony union present at other arthrodesis sites.

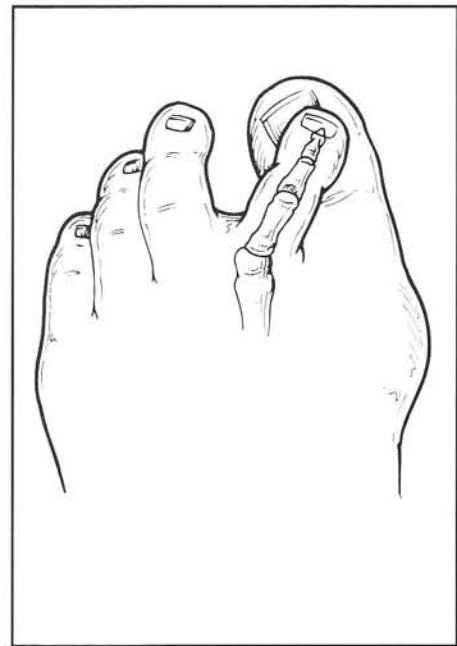


Figure 17. Mini-Keller. Both transverse and sagittal plane deformity are present at the 2nd MTPJ.

base of the proximal phalanx in order to decompress the joint.(Fig. 18) This approach has been used in the past for severely contracted digits such as with the Clayton (Hoffman-Clayton) pan-metatarsal head resection.^{9,10}

Once the base of the proximal phalanx has been resected, the stability of the MTPJ is compromised as a result of the loss of the attachment of capsular tissues and intrinsic musculature to the base of the proximal phalanx. A portion of the long flexor tendon is then resected as it can act as a deforming force causing medial deviation and/or frontal plane rotation when fired. In order to help maintain the transverse and sagittal plane correction of the toe, syndactylization to an adjacent digit is performed.(Fig. 19) Fusion of the PIPJ of both the dislocated and adjacent toes can help to further stabilize the syndactylized digits.(Figs. 20-22) It is sometimes necessary for a K-wire to be driven across the MTPJ in order to hold the position while healing occurs. The wire should be left across the MTPJ for 6 weeks to allow for more scarring to help maintain the correction. This method has provided good results for some surgeons.²

Reconstructive Disarticulation at MTPJ

On occasion you will encounter older individuals with severe HAV and crossover toe deformities. (Fig. 23) When the only presenting complaint is the painful toe with no complaints of the bunion, it may be acceptable to simply disarticulate the toe, especially if the patient has an apopulsive gait. This procedure is reserved for older individuals with severe deformity whose only complaint is the contracted crossover toe. In these individuals the only way to relocate the toe and MTPJ would be to reconstruct the entire foot with correction of the HAV and fusion of the lesser digits. Frequently, these patients are not good surgical candidates and do not want to have the entire foot reconstructed. A viable option is to simply disarticulate the toe at the MTPJ (Thomas F. Smith, DPM, personal communication April, 2000).

When doing a "reconstructive disarticulation" it is important to follow different guidelines than if doing an amputation in the diabetic with an infected digit. Keep in mind that the long flexor and long extensor tendons are conjoined tendons which evenly distribute the force of the pull through each of the lesser toes. If one of the tendon slips is simply cut and allowed to retract, the same amount of force will now be distributed through three

tendons. If there is already some digital deformity with musculotendinous imbalance at the lesser MTPJ's, simple tenotomy may accelerate further digital deformity to the other toes. Sufficient soft tissue to close over the metatarsal head is necessary, therefore it is better to allow for extra skin which can be trimmed at closure if necessary.

The long extensor and long flexor tendons should be isolated at the level of the PIPJ before disarticulating the toe at the MTPJ.(Fig. 24) The flexor and extensor tendons should then be sutured to one another over the end of the metatarsal head in order to help balance the pull of the conjoined tendons. Subcutaneous and skin closure should be performed. The patient is allowed to bear full weight in a postoperative shoe. While this method does not correct all of the components of the deformity present in the foot, it does address the main complaint with very little postoperative recovery time necessary. This method is technically easy to perform. Patients should be made aware that following removal of one toe, the adjacent toes may shift toward the space that has been created

DISCUSSION

When correcting deformity at the lesser MTPJ, it is crucial to address each element of the deformity. When both transverse and sagittal plane deformities are coexistent, the correction becomes more difficult. For lasting correction to be obtained, it is necessary to identify each deforming force in order to properly nullify its effect. Simply put, all tight and contracted tissues should be released, and all loose and attenuated structures should be plicated.

Rebalancing of musculotendinous structures about the MTPJ helps to further realign vector forces across that joint to produce a long-lasting correction. Arthrodesis at the PIPJ will prevent further recurrence of deformity at that level as well as decompress the articulation at the MTPJ by shortening the bony column in the digit. Fusion at the PIPJ also lends itself well to adjunctive procedures such as flexor tendon transfers to further stabilize the MTPJ. The method used to correct lesser MTPJ deformity should be predicated on its ability to address each of the components of the deformity. The methods described previously can be utilized by the surgeon in the correction of compound deformities at the lesser MTPJ.

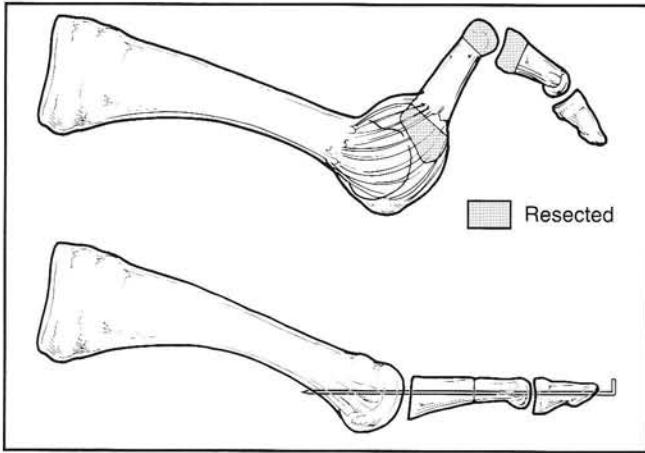


Figure 18. Mini-Keller. Note the severe dorsal contracture at the MTPJ. The base and head of the proximal phalanx, and base of middle phalanx are resected. Removal of the proximal phalangeal base allows for reduction of the MTPJ in the sagittal plane. The K-wire which is driven across the PIPJ arthrodesis site is also driven across the MTPJ to stabilize the correction during healing.

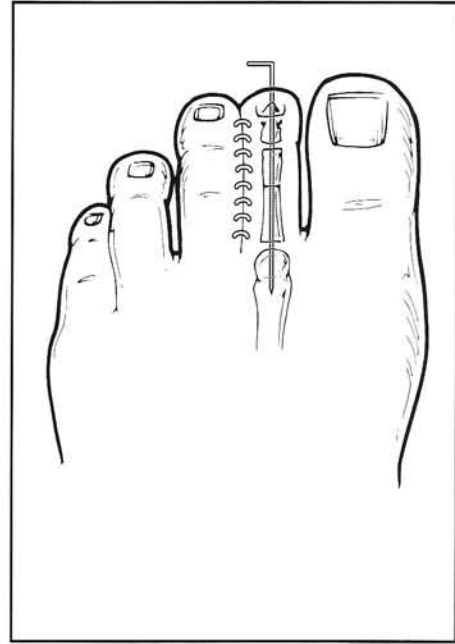


Figure 19. Mini-Keller. Final appearance of correction after syndactylization of the 2nd toe to the adjacent toe.



Figure 20. Mini-Keller. Preoperative x-ray. Note severe sagittal and transverse plane deformity of the 2nd toe.



Figure 21. Mini-Keller. Postoperative x-ray. Note that the proximal phalangeal base of the 2nd toe has been resected. The 2nd toe is in a slightly overcorrected position which parallels the 3rd toe. This is due to the syndactylization to the 3rd digit.



Figure 22. Mini-Keller. Five-month postoperative x-ray. Note the maintenance of the correction in the transverse plane.



Figure 23. Reconstructive Disarticulation. Severe crossover toe deformity

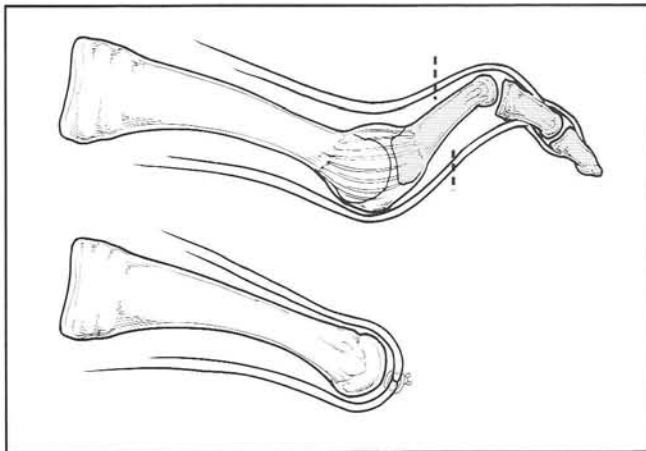


Figure 24. Reconstructive Disarticulation. The long extensor and flexor tendons should be isolated distal to the MTPJ before the bony segments distal to the MTPJ are disarticulated and discarded. The long extensor should then be sutured to the long flexor over the head of the metatarsal.

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