

## Emerging Concepts In Treating Second Crossover Toe Deformity

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Given the complexities of the second crossover toe deformity, these authors discuss key pathomechanics, review essential elements to the clinical examination, offer conservative care options and provide insights on different surgical techniques.

The crossover second toe deformity may be one of the most challenging surgical disorders foot and ankle surgeons face. The condition is most often associated with a pronounced hallux valgus deformity that one must address surgically in order to achieve a satisfactory and lasting result.

The pathomechanics of this condition are most interesting and can be documented throughout the developmental course of this foot disorder.

The patient typically will develop a cascade of deforming events. A hallux valgus deformity effectively “shortens” the great toe due to the angulation of the hallux. This leads to a relative increase in the length of the second toe.

The second toe becomes unstable due to a crowding and buckling effect caused by several factors.

### ▶ THESE FACTORS INCLUDE:

- Toe buckling caused by stockings or shoes;
- Intrinsic muscular instability as a result of a mechanical disadvantage;
- Increase of the first and second intermetatarsal angles leading to central metatarsal overload;
- A frequently elongated second metatarsal leading to second metatarsal overload and metatarsalgia accompanied by chronic capsulitis and/or intractable plantar keratosis (IPK);
- Hammertoe deformity with metatarsophalangeal (MPJ) extensor contracture; and
- Wearing of the plantar plate due to increased load and shear of the second metatarsal head, and lack of load sharing by the contracted second toe.



Here one can see a crossover second toe deformity with hallux valgus.

Other factors that may lead to the aforementioned crowding and bucking effect include further abduction and deviation of the hallux laterally due to a lack of resistance of the dorsally located second toe. Another potential cause may be adduction of the second toe dorsally due to a lack of intrinsic stability, weakness of the hallux due to deformity (flexor substitution) and a medial pull by the long flexor tendon to the second toe.

Ultimately, physicians may see a dorsal dislocation of the second MPJ due to a rupture of the plantar plate off the base of the second toe and proximal phalanx.

## ► KEY PEARLS FOR THE DIAGNOSTIC WORKUP

A thorough history and clinical examination will often direct the treatment of patients presenting with a crossover toe deformity. Patients with a history of inflammatory joint disease or destruction fall in a separate category and a global appreciation of the disorder will drive the treatment options.

Conduct a typical physical examination of the ankle and foot. Obtain standing radiographs with a minimum of three views. Palpate the plantar surface. Examine the second MPJ for pain and swelling at the distal metatarsal region. Concurrent examination of the contralateral foot is especially helpful in appreciating the swelling. Perform a Kelikian push-up test to evaluate the ability of the second toe to plantarflex with pressure beneath the second metatarsal. Compare the amount of plantarflexion to the asymptomatic contralateral foot.

Proceed to perform a sagittal plane drawer test on the symptomatic MPJ joint. Again compare the affected foot with the normal foot for dorsal instability.

One would perform this by firmly stabilizing the second metatarsal head between the thumb and forefinger of the left hand. Grasp the base of the proximal phalanx with the thumb and forefinger of the right hand, and perform a retrograde and purely vertical (not dorsiflexion) maneuver to evaluate laxity and the ability of the MPJ to dislocate. A positive test indicates a toe that is at high risk to dislocate and, in our opinion, warrants a surgical recommendation in the healthy patient.

When observing the radiographs, pay special attention to the relative metatarsal length pattern and use the contralateral foot as a reference. Most often, one will observe a relatively elongated second metatarsal corresponding to the symptomatic second MPJ. The oblique view is helpful to observe the degree of dorsal position or any existing dislocation.

There are several additional tests that may be helpful in the diagnosis of the pathology and establishing a treatment program. These tests are a Harris footprint evaluation to observe the weightbearing forces and a computerized footprint evaluation for a more scientific and accurate evaluation. Diagnostic ultrasound is a dynamic test that has shown benefit in observing the physical changes in the plantar plate and the presence of rupture pathology.<sup>1</sup>

A presentation at the American Orthopedic Foot and Ankle Society 2009 Annual Meeting recommended the combination of magnetic resonance imaging (MRI) with a localized injection of gadolinium for a clearer evaluation of the plantar plate, which plays an important role in the function of the MPJ.

In our experience, when there is a ruptured or partially injured plantar plate, attempting conservative options for care leads to a less than satisfactory outcome.

## ► PERTINENT INSIGHTS ON CONSERVATIVE TREATMENT

When patients present with early crossover second toe with an absence of significant deformity, pain and interference with activities of daily living, one may consider conservative options.

During the acute phase of this disorder, physicians can consider the use of a digital strapping, a Budin splint, crest pads, silicone molded orthodigital devices, accommodative orthoses, extra-depth shoes, carbon fiber or steel foot plates. One can also consider shoe modifications with stiff soled shoes or “clog” type shoes, metatarsal bars and even “forefoot floating” postsurgical shoes or CAM walkers.

It has been our experience that the aforementioned cascade of deforming events can be accelerated by cortisone injections into the second MPJ in an attempt to alleviate the acute pain noted in the early and mid-term development



This X-ray shows a hallux valgus with a dislocated second MPJ.



Here is an example of the drawer test for instability. A positive test indicates a toe that is at high risk to dislocate and, in the authors' opinion, suggests a surgical recommendation in the healthy patient.

of this condition. Since 1983, we have seen more than 125 cases of dislocated second MPJ joints with a history of unprotected splinting or strapping following a local cortisone injection within the previous 12 weeks. Accordingly, this has not become part of our nonoperative options for patients with crossover second toe deformity.

However, there are situations when nonoperative options have not been effective or the condition is such, that in the opinion of the well trained and/or experienced foot and ankle surgeon, surgical options would be appropriate. In such situations, one counsels the patient with alternative options and then the foot and ankle surgeon renders an opinion as to the best manner in which to proceed. Of course, physicians must clearly delineate the risks and complications of continuing with nonoperative care as well as the risks of surgical treatment. As in all elective surgical cases with the lower extremity, the patient makes the final choice of how to proceed.

► **EXPLORING SURGICAL OPTIONS WITH ELDERLY PATIENTS**

Surgical correction of the crossover toe deformity is patient dependent. Consider the patient's desired postsurgical activities, physical status, age and associated orthopedic problems.



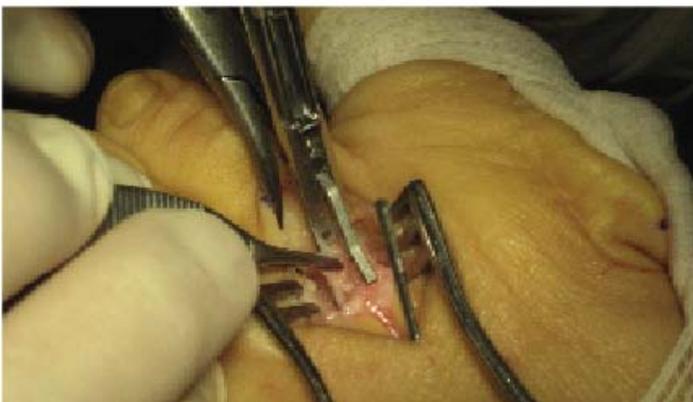
As one can see, phalangeal base resection has resulted in a flail toe. Resection of the second proximal phalangeal base to correct this deformity has pretty much fallen into disrepute unless one combines it with a syndactyly procedure and this is most often reserved for revision procedures.



This postoperative X-ray shows hallux valgus correction with a combination Scarf Akin procedure and correction of the second MPJ deformity with a Weil osteotomy and a hammertoe fusion.



In certain patients, a Weil osteotomy with medial displacement and repair of the plantar plate is the procedure of choice. Use a McGlamry elevator to free the plantar plate from the undersurface of the second metatarsal head and neck.



This picture shows the plantar plate being secured with a device that will place a suture in the plantar plate. The surgeon will then use the device for reattachment of the plantar plate to the plantar aspect of the base of the proximal phalanx.

For example, I can recall an 89-year-old patient who had a keen mind and energy beyond her age. She had bilateral hip and knee replacements, and used a walker to ambulate. Her chief complaint was pain overlying her second hammertoe. The second hammertoe was dislocated and overlapping her severe hallux valgus deformity with her great toe, which was abutting against her third toe. She just wanted to be able to wear a decent shoe to attend the symphony, flower club and weekly bridge game.

For this patient, I recommended second toe ablation at the MPJ. This allowed her to return to a closed shoe in one week following the procedure with little risk of complications. In other cases, an arthroplasty of the second toe will suffice but still requires several weeks for swelling to resolve.

Resection of the second proximal phalangeal base to correct this deformity has pretty much fallen into disrepute unless one combines it with a syndactyly procedure. Surgeons most often reserve this option for revision procedures.

Flexor tendon transfer is also an option that surgeons can combine with a hammertoe arthroplasty or fusion. Although we have had extensive experience with this procedure, our anecdotal experience mirrors that of recent literature from Myerson. His study states that patient satisfaction was not great with the flexor tendon operation because of an unusual feeling of tightness of the second toe.

**▶ A GUIDE TO FOREFOOT RECONSTRUCTION WITH PLANTAR PLATE REPAIR**

In a more typical middle-aged patient with no comorbidities, a forefoot reconstruction with plantar plate repair is our procedure of choice. We believe one needs to address the entire pathology to render a long-term solution to this problem and not just a Band Aid that will result in further surgeries in the future. Forefoot reconstruction with plantar plate repair usually involves:

- A Scarf-Akin bunionectomy for correction of the hallux valgus deformity;
- A Weil metatarsal osteotomy of the second and third metatarsals;
- Weil repair of the plantar plate using a dorsal approach;
- A hammertoe implant, arthroplasty or arthrodesis of the second toe; and
- Extensor release of the second MPJ contracture.

Occasionally, the hallux valgus deformity is not so severe so one can eliminate the Scarf-Akin bunionectomy in those cases. We see this most often when the dislocation of the second toe has been caused by an ill-advised cortisone injection (without post protection) into the second MPJ to treat acute metatarsalgia. The plantar plate, already weakened by the anatomical forces (long second metatarsal), may weaken further, leading to a sudden dorsal dislocation of the second toe. For these patients, the procedure of choice is a Weil osteotomy with medial displacement and repair of the plantar plate.

Correct the hallux valgus deformity first in order to allow for adequate interdigital space for placement of the crossover toe after correction. We use a Scarf bunionectomy with an Akin osteotomy when indicated.

Proceed to make an incision in the second interspace, extending to the second toe to address the second and possibly the third MPJ. When there is shortening of > 4 mm of the second metatarsal, the third metatarsal usually needs corresponding shortening to avoid transfer metatarsalgia. Perform an extensor release on the hood of the toe extensor and carry it proximally to the MPJ.

Using a McGlamry elevator, gently free the plantar plate from the undersurface of the second metatarsal head and neck. Then perform a Weil osteotomy and push the capital fragment proximally as far as possible. Temporary fixation will subsequently allow visualization and exposure to the plantar plate.

At this time, the surgeon can appreciate partial tears, attenuations or complete rupture of the plantar plate, and repair those conditions. Free the distal plantar plate completely from its attachment at the base of the proximal phalanx. Then utilize a device that can both grasp soft tissue and place a suture to secure the plantar plate. Utilize 0.062 K-wires to create two tunnels in the base of the proximal phalanx (central medial and central lateral). Pass the suture from the secured plantar plate from plantar to dorsal through the tunnels. Displace the toe in a maximally plantar fashion and secure the suture dorsally.

Then remove the temporary fixation of the metatarsal and bring the capital fragment to proper alignment and length. Proceed to fixate the fragment. Remove the redundant bony overhang of the metatarsal. Perform dorsal capsular closure and reapproximate skin with 5-0 vicryl in subcuticular fashion.

Following the surgical procedure, use Steri-Strip splintage to maintain the position and support of the absorbable wound closure. Place the patient in a short CAM walker or facilitate forefoot unloading in a Darco wedge type postoperative shoe. Patients can have guarded weightbearing within the confines of their residence for seven to 10 days.

At the first postoperative visit, remove the bandage. Barring any problems, refer the patient to physical therapy for a strict rehabilitation program that begins with active range of motion exercises for three weeks. The physical therapist follows this by administering passive range of motion for an additional three weeks.

One may permit patients to bathe after the initial postoperative visit and return to a large comfortable shoe (a running shoe with the insole removed). Patients may drive a car and return to a sitting job at that time. Patients should maintain frequent leg elevation and limited weightbearing with the use of compression anklets to control postoperative edema, which can last for three to four months.

► **IN SUMMARY**

The crossover toe deformity is a multi-anatomical deformity that involves the major structures of the forefoot. Treatment can range from a simple hammertoe correction to a complex correction of hallux valgus. Other options may include correction of metatarsalgia with metatarsal deformity or correction of extensor apparatus contracture and rupture of the plantar plate leading to MPJ dislocation.

Careful attention and technical skill are necessary to master these techniques. These techniques have provided excellent results. The most common complications are transfer metatarsalgia when the third metatarsal was not surgically addressed and prolonged edema in excess of four months.

The one-year follow-ups have shown excellent reduction of the second MPJ deformity with some limited range of motion.

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