

Formation of intermetatarsal syndesmosis and maintenance of deformity correction following syndesmosis bunionectomy: A case study

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Hallux Valgus is a common foot deformity with a main surgical objective of correcting the deformity in all three planes, typically using screws, wires, and other hardware to correct the deformity. The deformity often involves normal bones or variations of normal bones that have migrated out of their normal anatomical position. The syndesmosis bunionectomy can be used to correct these deformities without relying on hardware for adequate correction, omitting osteotomies, and instead forming a syndesmosis between the first and second metatarsals. The initial correction of the bunion involves the usage of strong, non-absorbable suture, followed by long-term correction by the formation of an intermetatarsal syndesmosis. This article presents a case of significant hallux valgus previously treated surgically with a syndesmosis bunionectomy, now presenting for hardware removal 30 months later and histological examination to evaluate true formation of an anatomical syndesmosis following bunion correction as well as maintenance of intermetatarsal angle correction.

Keywords: intermetatarsal syndesmosis, bunion, bunionectomy, hallux valgus

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The syndesmosis bunionectomy was first described by Leggenhager in 1935, and further research was done by Botteri in the 1960's and 1970's where he described an osteodesis procedure between the first two metatarsals in order to correct hallux valgus. Later this procedure was popularized and further described and advanced by orthopedic surgeon Daniel Wu, MD in a study in 2006, where he described a technique for using intermetatarsal cerclage sutures for initial correction, followed by formation of a ligament or "syndesmosis" between the first and second metatarsals for adequate correction. Historically, soft tissue procedures for correction of hallux valgus have been considered inadequate at treating moderate and severe bunion deformities and required the use of first metatarsal osteotomies with screw fixation to achieve adequate reduction of the deformity. Although osseous procedures have become popular over the years, it relies on hardware and bone healing in order to maintain adequate correction, often with very minimal soft tissue augmentation being performed.

This can lead to complications including delayed or nonunion, malunion, recurrence of deformity, shortening of the first ray, and transfer metatarsalgia [1-3].

It is known that a fibrous union occurs following an osteodesis or "syndesmosis" procedure, but it has not been studied as to length of time it takes to perform a fibrous union or syndesmosis, as well as the histological examination of the fibrous union. It is presumed that the normal postoperative reactive fibrous tissue grows in between the bone cortices of the first and second metatarsals, although the exact timing of its formation is unknown [4]. This case demonstrates a patient who is 30 months post-op from a syndesmosis bunionectomy and evaluates the maintenance of deformity correction and focuses on the presence of a fibrous syndesmosis formation between the first and second metatarsals.

Case Study

This patient is an 80-year-old female who presents with mild right foot pain following syndesmosis bunionectomy 30 months prior. She has been quite active since her initial surgery, noting that she walks about 2 miles or more, 3 times a week. The patient arrived with a stated goal of walking this same distance up to 5 times a week. The patient was hoping to have her surgery earlier but was unable due to other orthopedic surgeries. Objectively the patient possesses a clinical hallux valgus angle of 20 degrees with 65 degrees of dorsiflexion and 5 degrees of plantarflexion in the first metatarsophalangeal joint. First ray range of motion is +/- 3mm relative to the plane of the lesser metatarsals, displaying continued correction of first ray hypermobility from her initial surgery. All clinical exam measurements were performed using a goniometer, while objective angles were measured on x-ray. On x-ray the patient exhibits signs of adequate correction including a hallux valgus angle of 20 degrees, a 1st intermetatarsal angle of 9 degrees, a tibial sesamoid position of 4, excellent joint congruency, and moderate indentation of the proximal aspect of the plate into the second metatarsal.

The decision was then made to perform a hardware removal of the plates and non-absorbable suture, as well as evaluate the stability of the syndesmosis and maintenance of correction. This patient had no complications such as recurrence of bunion deformity, infection, or dehiscence. During the procedure it was planned to take a specimen of the intermetatarsal syndesmosis and send the specimen for histological examination to confirm a true syndesmosis had formed between the metatarsals. The syndesmosis would also be stressed intra-operatively to confirm strength of the syndesmosis has persisted over time and will continue to resist recurrence.

For the procedure, a linear incision is made about 3 cm in length in the first interspace overlying the same surgical incision from the bunionectomy and careful dissection is carried down into the interspace, taking care to preserve all neurovascular structures. The goal is to first identify the plates located on the lateral aspect of the second metatarsal and medial aspect of the first metatarsal. Once identified, the plates are freed from the bone using a freer and removed in total. Next a rongeur or hemostat is used to remove

the non-absorbable suture which was used for initial stabilization and formation of the intermetatarsal syndesmosis. Using a blunt probe, palpation is performed to identify a strong, fibrous syndesmosis between the first and second metatarsals. Using a small rongeur, a specimen was removed from the fibrous union in order to confirm the presence of a syndesmosis and the specimen was sent for pathology and histology. After completion of the procedure, a lamina spreader was used to stress the intermetatarsal syndesmosis. Intraoperative fluoroscopy was used to confirm that there was no evidence of laxity or disruption of the syndesmosis. Following the procedure, the patient can immediately bear weight in a surgical shoe.

Follow up for histology and pathology of the syndesmosis specimen was reviewed once made available. The pathology report was performed by the University of Washington. The final specimen report displayed "tendinoligamentous/fibroconnective tissue with mild chronic inflammation, degenerative changes, and fibrin deposition." The results displayed the presence of a fibrous connection resembling a syndesmosis between the first and second metatarsals.



Figure 1 Preoperative and post-operative radiographs from initial surgical evaluation displaying correction of first intermetatarsal angle, improvement of tibial sesamoid position, as well as second hammertoe repair.



Figure 2 Intraoperative images from hardware removal surgery displaying fibrous connective tissue between the first and second metatarsal bones. Maintenance of correction while stressed using a lamina spreader.

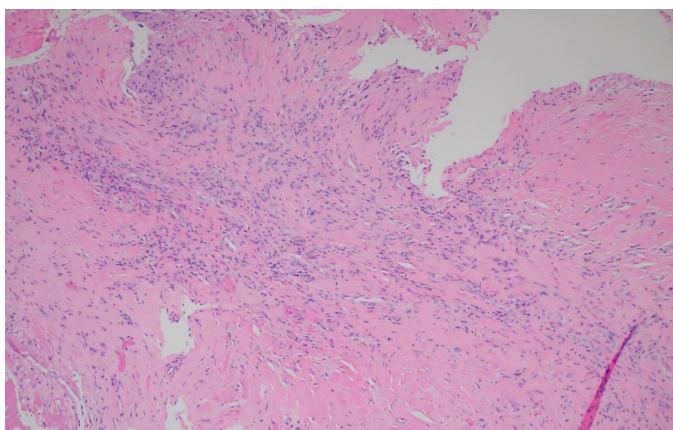


Figure 3 Histology slide of syndesmosis specimen retrieved intra-operatively displaying tendinoligamentous and fibroconnective tissue with mild chronic inflammation, degenerative changes, and fibrin deposition.

Discussion

While the usage of osteotomies with screw technology may continue to be a popular option for treatment of hallux valgus and metatarsus primus varus, the syndesmosis bunionectomy illustrates a successful procedure involving utilizing no bone cuts and rather focusing on soft tissue correction via a fibrous union between the distal cortices of the first and second metatarsals. Wu describes many studies in which significant first intermetatarsal angles are corrected using the syndesmosis bunionectomy procedure, including long term follow up demonstrating maintenance of the IM angle. Wu demonstrated maintenance of correction in a study with an average of 6 years and 10 months of follow up for 11 total patients. The average preoperative hallux valgus angle was 29.5 and the final hallux valgus angle was 13.5. AOFAS scores at final follow up time average at 93. This displayed a long term retrospective study which provided encouraging long term results for treatment of hallux valgus and metatarsus primus varus [4].

Wu and Lam studied 55 feet from 60 consecutive procedures for patients with a first intermetatarsal angle of >9 degrees and a metatarsophalangeal angle of >20 degrees. Initial radiographs following treatment with syndesmosis bunionectomy displayed significant correction of deformity. Over a 4.5 year follow up it was displayed that none of the patients had recurrence to where the IM angle was 9 degrees or greater and no other significant complications were present [3]. This appeared to be the first study showing metatarsus primus varus and hallux valgus deformity both being treated with a single specific procedure.

When the cause of a bunion deformity involves failure of soft tissue, ligaments, and tendons it seems reasonable to correct this by augmenting the soft tissue. The complication with this is that it often can lead to under correction of the initial deformity, or eventually lead to long term failure of correction. The syndesmosis bunionectomy described in this case uses 2-0 Fiberwire in order to maintain initial correction while a fibrous syndesmosis is formed between the first and second metatarsals. In this case, it was demonstrated the correction was able to be maintained throughout a period of 30 months, with demonstration of true fibrous syndesmosis formation that can be actively stressed and maintain its integrity.

The syndesmosis bunionectomy appears to be a viable option for mild, moderate, and severe hallux valgus and metatarsus primus varus correction results that are equally as satisfactory to osteotomy procedures.

Following our research, we believe soft tissue augmentation using the syndesmosis bunionectomy procedure is a viable option for treatment of mild to severe hallux valgus with reliable long-term successful results. More research should be performed to investigate timing for the formation of the syndesmosis, as well as considering more low-profile plates and non-absorbable suture material to limit the amount of required hardware removals. Osteotomy procedures continue to be viable options, although the syndesmosis procedure focuses on fixing the deforming forces of the bunion while maintaining long-term correction, such as the procedure illustrated by Wu [5].

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