Case Report

Modified Surgical Correction of Over-riding Second Toe

Asihin M and Bajuri MY*

Faculty of Medicine, Department of Orthopaedic and Traumatology, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latiff, Kuala Lumpur, Malaysia

*Corresponding author: Dr. Mohd Yazid Bajuri MD, MSOrth, Faculty of Medicine, Department of Orthopaedics and Traumatology, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000, Cheras, Malaysia. Tel: +60391456031, Fax: +603-91456674; E-mail: ezeds007@yahoo.com.my

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Abstract

An Overriding toe is a deformity of the lesser toes and which commonly affects the second toe with unclear aetiology. It is speculated to be multifactorial. There are multiple factors leading to metatarsophalangeal joint (MTPJ) instability. These are attributed to chronic inflammation of the synovium, capsule overuse as well as muscle imbalance from neuromuscular disorder and a long second metatarsal bone. These can all result in an overriding toe deformity.

Keywords:
Metatarsophalangeal instability; Overriding toe; Surgery

Introduction

The patho mechanics of an overriding second toe involve imbalance between driving forces of three muscles; Extensor Digitorum Longus (EDL), Dorsal interossei and the Lumbricals. There are three type of deformity of the lesser toe as described below.

<table>
<thead>
<tr>
<th></th>
<th>Hammer</th>
<th>Claw</th>
<th>Mallet</th>
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<tbody>
<tr>
<td>MTPJ</td>
<td>Extended</td>
<td>Extended</td>
<td>Straight</td>
</tr>
<tr>
<td>PIPJ</td>
<td>Flexed</td>
<td>Flexed</td>
<td>Straight</td>
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<tr>
<td>DIPJ</td>
<td>Straight</td>
<td>Flexed</td>
<td>Flexed</td>
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</table>

Table 1: Type of deformities.

EDL divides into three slits, a central slit attaches to the base of middle phalanx and another two lateral slits attaches to the distal phalanx. EDL tendon extend the interphalangeal joint (IPJ) of second toe only when the MTPJ is in neutral or flexed position. However, when MTPJ is extended it becomes the deforming force to the MTPJ. This causes dorsal subluxation of the MTPJ. This is the first factor resulting in MTPJ instability.

The primary function of dorsal interossei muscle is flexion of the MTPJ. These dorsal interosseus muscles passes below the axis of rotation of MTPJ and are inserted into the extensor hood of extensor digitorum longus (EDL) tendon at the MTPJ and also the base of proximal phalanx. In a chronic extended MTPJ, the actions of these two muscle changes as it moves dorsally to the center of rotation of the MTPJ. This will result in a dorsal subluxation of force of the second MTPJ.

The lumbrical of the second toe is only present on the medial side of the second MTPJ and causes flexion and adduction of the joint. However, flexion becomes ineffective when the 2nd MTPJ is chronically extended. In this event, the muscle...

gives deforming force leading to adduction of the second toe.

In summary, there are three abnormal deforming forces in the development of overriding second toe caused by native extrinsic and intrinsic muscle of the second toe itself. In chronic MTPJ extension, the EDL in combination with dorsal interossei leads to dorsal subluxation of the second MTPJ, and lumbral muscle giving adduction force of the second toe resulting in second toe crossing over the great toe dorsally [1]. Other factors such as chronic synovitis may contribute to weakening of the capsule and collateral ligaments of MTPJ [2,3].

Prolonged extension of MTPJ in people wearing high-heeled shoes and athletes has been associated with formation of overriding second toe. Traumatic injury to the lateral collateral ligament of second toe and plantar plate may contribute to second MTPJ instability [1,3]. Systemic disease such as rheumatoid also contributes to weakening of the collateral ligament, capsule and plantar plate leading to instability and formation of overriding second toe. Hallux valgus deformity and long second metatarsal bone are some of the other factors included [1,3].

Case Report (RN: N309766)

A 65 year old lady presented with various deformity of the right second toe of more than 10 years. There was no history of chronic inflammatory joint disorders or trauma prior to developing the deformity. It was insidious and the deformity increased in severity over the years. It was painful and she had difficulty in wearing shoes.

Examination revealed an obvious overriding deformity of the right second toe over the big toe (Figure 1). There was a mild asymptomatic hallux valgus deformity of the great toe with evidence of hammering of all the lesser toes, most notably the second. Clinically they had grade-II second MTPJ instability.

**Figure 1:** Anteroposterior radiograph of the right foot and pre-operative picture of the right foot. There is claw toe deformity of the right second toe with overriding on the big toe.

**Surgical procedure**

In supine position and under general anesthesia, a tourniquet was first applied to the right mid-thigh. Patient's right leg and foot was cleaned with povidone liquid up to the knee level and then draped. The right leg was exsanguinated by elevation before tourniquet inflated to 350 mmHg to provide bloodless field of surgery.

An incision was made dorsally over the right second MTPJ and extended distally and proximally. A medial capsulotomy and soft tissue release was performed at the second MTPJ to allow first step of correction of the second toe.

The EDL was identified and split vertically into two (Figure 2). The medial half of the EDL is then sectioned just proximal to MTPJ and left intact distally. This technique provides a sling made of medial half of the EDL. The second stage of the correction is achieved by passing the sling laterally under the intact lateral 50% of EDL, then winding it around to reach the medial side of middle phalanx (Can you show a figure of this, do you pass it under the middle phalanx from the lateral side and then reattach it??) (Figure 2).

The sling was then passed underneath the remaining intact EDL before sutured to the base of the proximal phalanx laterally, together with the lateral collateral ligament. The lateral collateral ligament of the metatarsophalangeal joint augmentation was done by plicating it and suturing it with non-absorbable suture. Please explain this in
more detail as this is the most important part of the
discussion (you are continually mixing between the
past and present tense; Please alter this shown in
Figure 2).

Figure 2: The left diagram above is the final position of the tendon sling. The right picture showing the tendon sling passing under the remaining intact EDL. The tendon sling is passed from lateral to medial (here it is being passed from medial to lateral?) under the middle phalanx and under the intact EDL again to be anchored to lateral MTPJ capsule and collateral ligament (could you provide some further images of where it is actually attached).

Hammer toe correction for the second toe was done by performing resection of the head of the proximal phalanx. K-wire was not inserted to secure the middle phalanx to the resected proximal phalanx as vascular compromise was suspected intra-operatively. The Hallux valgus deformity was not addressed. The skin was closed with non-absorbable suture (Figure 3).

Figure 3: Postoperative anterior view of the foot and bandaging of the second toe postoperatively.

It is paramount to ensure correct method of bandaging of the foot after corrective surgery of overriding toe (you have said its paramount, describe the technique and show a further image). There was no specific technique to perform the bandaging, however the bandage should not be tight and the corrected toe is maintained in neutral position. Healing should occur with the corrected toe in desired position. The toe should be exposed for circulation monitoring in case of vascular compromise. Figure 4 shows two month follow up after surgical correction.

Figure 4: Two month follow up after surgical correction of over-riding right second toe.

Discussion

Conservative treatment is possible at the beginning of this deformity. In order to redistribute weight bearing surface, a pad was placed just proximal to metatarsal head. This also helps alleviate pain from uneven distribution of force. Taping technique can be used to minimize dorsiflexion of the second toe [4]. Symptomatic treatment with non-steroidal anti-inflammatory medication and intra-articular steroid injection was shown to be beneficial in treating synovitis and reducing pain in patient with this type of deformity [5].

Surgical correction of overriding second toe may combine bony procedure with soft tissue release and tendon procedure depending on the extent of the deformity [4]. The surgical procedure can be carried out with regional ankle block. Some of the issues encountered in overriding second toe deformity are: Contracted extensor tendon requiring lengthening, hyperextension of the MTPJ requiring capsulotomy, disrupted or weakened lateral collateral ligament of the MTPJ, dorsal subluxation of the second MTPJ requiring tendon transfer to maintain stability of the second MTPJ [6,7] and finally an osteotomy of the metatarsal or proximal phalanx to correct severe deformity [8,9]. Fusion of the second MTPJ was shown to be effective long term management of overriding second toe [10]. Amputation of the affected toe was shown to give better outcome in young patient with failed primary correction and elderly over 70 years old [11,12]. These techniques can be used in combination tailored according to the extent of deformity and patient’s concern.

In this patient, there was no bony procedure involved. The mild hallux valgus (stage 1; hallux valgus angle<25 degree and intermetatarsal angle<12 degree) [13] was not treated because it was asymptomatic. There were four steps involved in the corrective surgical procedure.

First, capsulotomy was performed dorsal to the second MTPJ with soft tissue release medially to allow adequate plantar flexion to be achieved. This is followed by creating a sling using 50% of EDL to further stabilize the plantar flexion created earlier. The sling wind around the shaft of the proximal phalanx and provide permanent retainer to keep the second toe in neutral position.

A flexor to extensor tendon transfer was not necessary in this case as there was no subluxation of the MTPJ noted in the radiograph preoperatively and intra-operatively. The third step is augmentation of the lateral collateral ligament and capsule of the second MTPJ. Finally, correction of the hammer toe by excising the head of the second metatarsal.

There was no k-wire inserted to secured middle phalanx to proximal phalanx to allow for fusion to occur as vascular compromise was suspected intra-operatively. The bandaging should be done properly to allow healing with the toe in the desired position i.e. neutral position (Figure 4).

Review of the case three month postoperatively reveal good outcome with the patient return to wearing her normal foot wear. Symptomatically, pain has improved tremendously and patient is satisfied with the outcome.
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Conflict of Interest

The authors declared that there is no conflict of interest.

References