

# A NOVEL TENDINOUS INTERCONNECTION RELEASE TECHNIQUE FOR CLAW-TOE DEFORMITY

Tanawat Vaseenon, M.D.; Phinit Phisitkul, M.D.

## ABSTRACT

**Claw-toe deformity is a common and potentially debilitating condition that requires appropriate diagnosis and management. Operative treatments for claw-toe deformity depend on the severity and flexibility. In a subset of patients, causation for flexible clawed lesser toes can be related to the force transferred through the tendinous interconnection from the flexor hallucis longus tendon to the flexor digitorum longus tendon.**

**The authors present a surgical technique for claw-toe deformity correction by releasing the tendinous interconnection from the flexor hallucis longus tendon to the flexor digitorum longus tendon in the midfoot area combined with toe manipulation. This technique can theoretically prevent the lack of toe grasp function associated with a flexor tenotomy as well as excessive stiffness associated with a flexor tendon transfer. Meticulous soft tissue dissection and protection of the medial plantar nerve are required to prevent complications.**

## INTRODUCTION

Claw-toe deformity is defined as an anatomical deformity of the lesser toes with hyperextension at the metatarsophalangeal (MTP) joint while the proximal interphalangeal (PIP) joint is flexed and the distal interphalangeal joint is either flexed or extended. Numerous surgical techniques<sup>1-8</sup> for claw-toe correction have been described depending on the flexibility of the toes including long flexor tendon tenotomy, flexor tendon transfer, proximal phalangectomy, PIP joint resection, and PIP joint arthrodesis. However, sacrifice of the long flexor tendon and/or the PIP joints of the toes has been

shown to have suboptimal effects including recurrence of toe deformity, persistent edema, residual pain, cock-up deformity, callosities beneath the metatarsal heads, and excessive stiffness.<sup>6,9-11</sup>

We describe a technique in which the tendinous interconnection from the flexor hallucis longus (FHL) tendon to the flexor digitorum longus (FDL) tendon (TIFF) is released to correct the deformity of claw toes. This technique is indicated when flexible claw lesser toes are due to extrinsic force from the FHL tendon. Clinical diagnosis is made when the claw deformity in the lesser toes, mostly the 2<sup>nd</sup> and 3<sup>rd</sup>, is accentuated with isolated active plantar flexion of the hallux interphalangeal joint against resistance. This is confirmed by lack of active hallux interphalangeal joint flexion when the lesser toes are held in full extension<sup>12</sup>. The benefits of this procedure include preservation of the FDL tendon and the PIP joint function of the lesser toes while eliminating the deforming force transferred from the FHL tendon.

## SURGICAL TECHNIQUE

A patient with claw-toe deformity (Figure 1) was placed in the supine position with a thigh tourniquet. A bump was placed beneath the contralateral hip to improve accessibility to the medial aspect of the operative foot.

A four-centimeter longitudinal incision was made in the sole of the foot just medial to the palpable medial band of the plantar fascia (Figure 2A). The aponeurotic tissue between the plantar fascia and the abductor hallucis was sharply released. The medial plantar nerve was identified immediately deep to this layer and was protected throughout the procedure. The FHL and FDL tendons were identified by palpating and observing motion with manipulation of the toes. The TIFF was identified (Figure 2B). At this step, gentle traction on the proximal aspect of the FHL tendon caused a synchronous flexion of the great, second and third toes. The TIFF was then completely released. Isolated flexion of the hallux was demonstrated after traction was applied to the proximal aspect of the FHL tendon. The second and third toes were manipulated to full range of motion (Figure 3). The tourniquet was deflated and skin closure was performed. The second and third toes were taped in extension (Figure 4).

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Department of Orthopaedics and Rehabilitation  
University of Iowa Hospitals and Clinics  
Iowa City, IA

Correspondence to:  
Phinit Phisitkul, M.D.  
Clinical Assistant Professor  
Department of Orthopaedics and Rehabilitation  
University of Iowa Hospitals and Clinics  
Iowa City, IA 52242  
phone: 319-467-5014  
fax: 319-356-4576



Figure 1. Claw-toe deformity in the 2<sup>nd</sup> and 3<sup>rd</sup> toes is observed in standing. The deformity is increased with ankle dorsiflexion.

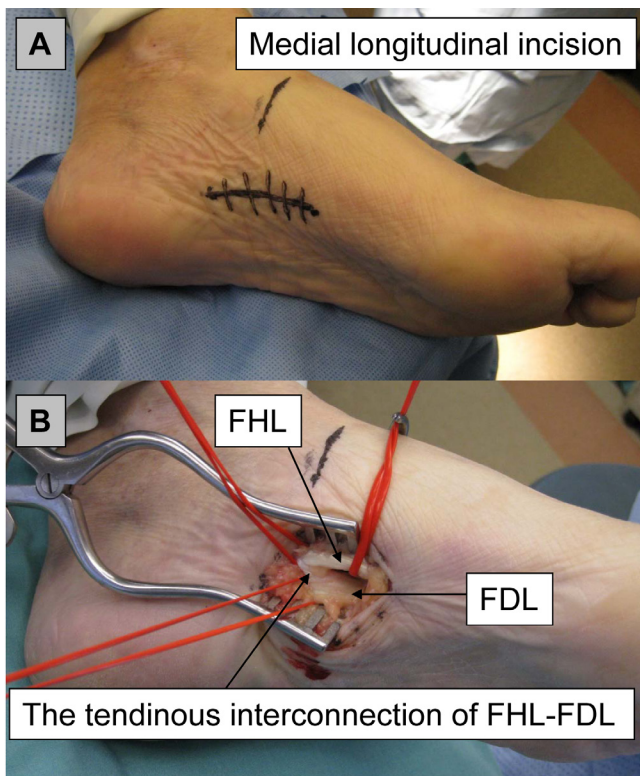


Figure 2. The medial longitudinal skin incision (A) and intra-operative finding of the flexor hallucis longus (FHL) tendon, the flexor digitorum longus (FDL) tendon, and the tendinous interconnection from the FHL tendon to the FDL tendon (TIFF) (B).



Figure 3. Decreased deformity of the 2<sup>nd</sup> and 3<sup>rd</sup> toes immediately after release of the tendinous interconnection from the FHL tendon to the FDL tendon (TIFF).





Figure 4. Postoperative taping of the toes.



Figure 5. Deformity of the 2<sup>nd</sup> and 3<sup>rd</sup> toes is improved at five months postoperatively. The patient is symptom-free but residual claw deformity is observed when the ankle is in dorsiflexion.

### POSTOPERATIVE CARE

Immediate full weight-bearing as tolerated was allowed. Toe taping was maintained for four weeks followed by progressive rehabilitation in regular shoes. The patient was pain-free at five months post-op, and returned for care for their contralateral symptoms (Figure 5).

### DISCUSSION

Claw-toe deformity treatment goals are pain relief, reduced deformity, improved function, reduced morbidity and prevention of progression of the existing deformity.<sup>13</sup> Although various surgical techniques have shown clinical success, a percentage of patients may not be completely satisfied with the results.<sup>7,13</sup> In general, types of operative treatment for claw-toe deformity depend on the severity and flexibility. When the deformity is rigid, a combination of bony correction and soft tissue release as well as a flexor tendon transfer may be required. For patients with flexible deformities, flexor tendon releases or transfers have been recommended.<sup>2</sup>

We have observed a subset of patients whose flexible claw lesser toes are related to the force transferred through the TIFF. Positive physical findings are dem-

onstrated when the claw deformity in the lesser toes, mostly the 2<sup>nd</sup> and 3<sup>rd</sup>, are accentuated with isolated active plantar flexion of the hallux interphalangeal joint against resistance. This can also be seen where there is relative shortening of the first ray.<sup>14,15</sup> Arthrodesis of the hallux MTP joint using bone graft can restore length.<sup>14</sup> In these situations, FHL tendon forces can bypass the main insertion at the base of the hallux distal phalanx through the tendinous interconnection toward the FDL tendon. Anatomic studies have shown that the tendinous slip from the FHL tendon to the FDL tendon of the 2<sup>nd</sup> toe is constant while the slip to the 3<sup>rd</sup> to 5<sup>th</sup> toes exists in decreasing frequency.<sup>16</sup> Extreme force from the FHL tendon, as high as six times that of the FDL tendon, can explain potential detrimental effects on the lesser toes, especially in variations where the tendinous slips insert on only one or two toes.<sup>17</sup>

Releasing the TIFP was mentioned by Gauthier<sup>12</sup> in 1987. This procedure was used to prevent a “harness syndrome” which occurred with shortening of the first metatarsal. We propose a similar surgical procedure in correction of select flexible claw toe deformities. This procedure theoretically can prevent the lack of toe grasping function associated with a flexor tenotomy<sup>18</sup> as well as excessive stiffness associated with a flexor tendon transfer.<sup>6,11</sup> Meticulous soft tissue dissection and protection of the medial plantar nerve are required to prevent complications.

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