

# Effective Conservative Treatment for Managing Painful Hallux Valgus

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## Abstract

Hallux valgus (HV) is a foot disorder manifesting by lateral deviation of the great toe and medial deviation of the first metatarsal. HV not only affects foot appearance, but also causes functional disability, including foot pain, impaired gait patterns, balance disorders, which further lead to easily falling and impaired quality of life. It affects approximately 23% of adults, but so far effective conservative interventions are limited. Patients generally receive conservative treatments when having a mild (<30°) HV angle, including night splints, foot exercises, and orthotic application. But previous studies suggested that the effectiveness of orthotic devices and night splints were no superior to no treatment at all for mild-to-moderate HV patients. In recent studies, conservative treatment such as using foot insoles with fixed toe separator and managing with Botulinum toxin type A (BTA) could lead to sustained relief of symptoms. The procedure was less invasive than surgical intervention and relatively easy to perform.

**Key words:** Hallux valgus; Botulinum toxin type A; Insole; Pain

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## **1. Hallux Valgus**

Hallux valgus (HV) is a foot disorder manifesting by lateral deviation of the great toe and medial deviation of the first metatarsal [1,2]. Hallux valgus not only affects foot appearance [3], but also causes functional disability, including foot pain [4,5], impaired gait patterns [6], balance disorders [7], which further lead to easily falling [8,9] and impaired quality of life [10]. However, the effect of conservative interventions nowadays including night splints, foot exercises, and orthotic application are limited [11,12,13]. Recent studies showed that conservative treatment such as using foot insoles with toe separator and managing with Botulinum toxin type A (BTA) could lead to sustained relief of symptoms.

### **1.1. Pathophysiology of Hallux Valgus**

It is generally known that hallux valgus occurs on a background of several predisposing factors, including intrinsic and extrinsic. Previous researches confirmed that extrinsic factors such as high-heeled narrow shoes [14,15,16] and excessive weight-bearing were important [17]. And intrinsic factors such as genetics [18,19], ligamentous laxity [20,21], age

[22], metatarsus primus varus [23,24], pes planus [25,26], functional hallux limitus [27], sexual dimorphism [28,29], abnormal metatarsal morphology [30,31], first-ray hypermobility [32] and tight Achilles tendon [33,34] may also play a role.

The first ray biomechanics is very important in HV. It maintains the structure of the medial arch as the main load-bearing structure, and is dependent on the kinematics for optimal support during gait. Pronation of the subtalar joint lowers the first ray to the ground in early stance and shares the shock from heel impact [35]. As body weight moves forward across the foot, the pressure beneath the first metatarsophalangeal joint increases. This would further lead to inflammation of the surrounding structure, or even fracture.

Approximately 65 degrees of hallux dorsiflexion is required in gait, and a proper dorsiflexion of hallux could maintain the stability of first ray by using windlass mechanism [36]. There are several mechanisms that could diminish the stability of the first ray, and that cause increased pressure over the first metatarsophalangeal joint. Pronated foot

is the most frequent seen mechanism that causes first ray instability. The subtalar joint and the midtarsal joint axes during gait are inter-related, and the degree of total ROM at the midtarsal joint relies on the position of the subtalar joint. The midtarsal joint was formed by talonavicular and calcaneocuboid joints. When the subtalar joint is pronated, the axis between the talonavicular joint and the calcaneocuboid joint forms a parallel alignment, which allows free motions in these joints. On the contrary, a supinated subtalar joint causes the axis between the talonavicular joint and the calcaneocuboid joint to become divergent, and forms a locked position. In normal gait cycle, the subtalar joint shifts from pronation to supination at midstance, and locks the midtarsal joint which enhances the stability during push off [37]. However, a pronated foot will postpone the shifting between pronation and supination of the subtalar joint during gait cycle [38], and further lead to excessive increased pressure over the first metatarsophalangeal joint.

Hallux valgus does not necessarily develop in series but may transpire in parallel. The supporting structure at the medial side of the metatarsophalangeal

joint including medial sesamoid and medial collateral ligaments fail to retain their function. The metatarsal head can then drift medially, slipping off the sesamoid apparatus. The bursa at the medial eminence can be thickened because of the pressure caused by the footwear. The extensor and flexor hallucis longus tendons appear to bowstring laterally, increasing the valgus displacement and may act as dorsiflexors of the proximal phalanx. When plantar attachments rotate inferiorly, the adductor hallucis tends to pull the phalanx into pronation as well as tethering its base [39].

### **1.2. Managing Hallux Valgus with foot insole and fixed toe separator**

Non-operative intervention is always the first treatment option for patients with hallux valgus. Using foot insoles properly could reduce the pain caused by hallux valgus or even prevent further deterioration. The goal of performing surgery is to correct all pathologic elements while maintaining a biomechanically functional forefoot. However, surgery can not correct all predisposing factors such as joint laxity or hypermobility. Foot insoles may also be

needed after surgical interventions.

Nonetheless, previous studies for treating HV by using foot insole alone showed no significant effect. Maria Reina et al had investigated 45 patients with moderate HV and concluded that custom-made orthosis appeared to have no effect in the evolution of mild and moderate HV during a 12 month period [40]. Markus Torkki and his colleagues had studied 209 patients and also showed that using foot orthosis alone had no benefit comparing to control group [41].

Tang et al had proven that fixed toe separator with insole could relief hallux valgus pain [42]. Twelve women with single or bilateral painful hallux valgus and no foot operation history completed the study. Total contact insoles with fixed toe separator were made for each of the participants, and were evaluated with walking ability, hallux valgus angle, and NRS-11 pain scale. The results showed improvement in the hallux valgus angle ( $p < 0.001$ ) and the NRS-11 pain scale ( $p < 0.001$ ). And the results after wearing total contact insole with toe separator for 3 months showed improvement in the NRS-11 scale ( $p = 0.02$ ) and walking ability scale score ( $p = 0.02$ ). The author

mentioned that the disadvantage in this insole design was that manual manipulation is required to separate the first 2 toes in patients with moderate hallux valgus ( $30^\circ$ ) in order to fix the toe separator between the toes. Thus, the insole must be properly aligned with the foot outside the shoe, then insert together into the shoe.

More recently, an investigation of thirty women with painful bunion and hallux valgus angle  $35^\circ$  or less was conducted by Tehraninasr and colleagues [43]. The patients were randomly allocated in the group of wearing insoles with fixed toe separator or wearing night splint. It revealed that the intensity of foot pain decreased significantly after 3 months in patients wearing the insole with toe separator ( $p < 0.05$ ) and pain reduction was not significant in the second group wearing a night splint.

## **2. Botulinum Toxin Type A (BTA)**

### **2.1. Clinical use of BTA**

Botulinum toxin type A is one of the seven serotypes of the Clostridium botulinum neurotoxin. BTA acts as a presynaptic blockade, and targeting at soluble N-ethylmaleimide-sensitive factor

attachment receptor (SNARE), and further leads to inhibition of acetylcholine release at the neuromuscular junction. In animal models, re-innervation causes the restoration of muscle function which generally occurs within three months [44]. The use of intramuscular BTA injection to loosen the overacting muscle was well established in the management of focal or axial dystonia in adults and children with acquired brain injury. Recently, treating musculoskeletal conditions by intramuscular BTA injection was reported in several studies; however, most of the studies used BTA to relieve muscle spasm and associated pain.

## **2.2. The role of BTA in managing HV**

Wu et al investigated managing hallux valgus with BTA recently [45]. A group of 23 patients ( 29 feet ) with hallux valgus angle greater than 20° were enrolled in this investigation, and then randomly received either BTA injection or normal saline injection. Patients in the BTA group received intramuscular injections of BTA into the oblique head (40 U) and transverse head (30U) of the adductor hallucis muscle, the flexor hallucis brevis (30 U) muscle, and the

extensor hallucis longus muscle (30 U). All of the injections were guided by peripheral electrical stimulator. 26 out of 29 feet completed the assessment during 6 months of follow-up. The results revealed that both group improved in pain assessment ( $p < 0.001$ ), and pain decreased stronger in the BTA group than in the control group ( $F(2,48) = 8.07$ ,  $p < 0.01$ ). In disability assessment, the control group showed a temporary improvement and the BTA group revealed continuous improvement ( $p < 0.05$ ). In HV angle assessment, the control group also showed a temporary improvement and the BTA group revealed continuous improvement ( $p < 0.05$ ).

## **3. Conclusion**

Different studies use various measurements to evaluate the outcome of treatments (Table I). There are limited effective conservative treatments for managing painful HV. Managing HV with a conservative way such as a foot insole with toe separator and BTA injection shows promising results. Understanding the pathophysiology of HV is the key to these treatments. Applying insole with fixed toe separator and BTA injection may be effective treatment for hallux valgus.

**Table 1**

Method	Primary outcome	Significant improvement (p<0.05)
Insole only [40]	1.hallux abductus angle 2.first intermetatarsal angle	1. failed to reach significant improvement (p=0.395) 2. failed to reach significant improvement (p=0.288)
Insole only [41]	1. Pain and disability-first year 2. Pain and disability-second year	1. failed to reach significance (p=0.5) 2. failed to reach significance (p=0.9)
Insole with Toe separator [43]	Pain intensity	reached significant improvement (p<0.05)
BTA [45]	Pain intensity	reached significant improvement (p<0.05)

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