

Nonsurgical Treatment for Hallux Abducto Valgus with Botulinum Toxin A

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Hallux abducto valgus is a frequently seen abnormality of the first metatarsophalangeal joint. Limited conservative treatment options exist, making surgery the only definitive treatment option for a mild-to-moderate deformity. A problem arises if the patient is not a surgical candidate owing to comorbidities, noncompliance, or personal reasons, such as work or family obligations. We describe a case in which the use of botulinum toxin A injection reduced not only the hallux abducto valgus deformity clinically and radiographically but also its associated pain. (J Am Podiatr Med Assoc 98(1): 61-65, 2008)

Botulinum toxin is a protein produced by the anaerobic bacterium *Clostridium botulinum*. Seven serotypes (A-G) of botulinum neurotoxin exist; type A was the first to be approved by the Food and Drug Administration and is the most frequently used.¹ In small amounts, botulinum toxin A causes muscle paralysis by blocking presynaptic release of the neurotransmitter acetylcholine. Acetylcholine plays a vital role in sending signals from the nerve to the muscle, causing movement. Botulinum toxin A blocks the synaptic transmission and causes the muscle to which the nerve is attached to become temporarily paralyzed.²

The clinical applications of botulinum toxin A have been expanding since its first use in the 1980s for strabismus, or misalignment of the eyes.³ The scope of treatment in the lower extremity has broadened, suggesting its use not only for a spastic foot or ankle, as seen in patients with cerebral palsy, but also for spastic toes,⁴ plantar hyperhidrosis,⁵ and plantar fasciitis.⁶

To our knowledge, no studies have been published regarding botulinum toxin A or any other serotypes that address the treatment of hallux abducto valgus. Muscle imbalance of the abductor and adductor hallucis muscles has been demonstrated to be apparent in hallux abducto valgus.^{7, 8} The transverse and oblique adductor hallucis heads join and insert into the fibu-

lar sesamoid and the lateral aspect of the proximal phalanx base. In hallux abducto valgus deformity the abductor hallucis muscle demonstrates decreased activity compared with the adductor muscle.⁷ This discrepancy allows the adductor hallucis muscle to gain mechanical advantage and to pull the hallux laterally while forcing the metatarsal medially. The senior author (P.A.R.) has shown that injecting botulinum toxin A into adductor hallucis muscle motor end plates in a predetermined quantity could temporarily paralyze the muscle by eliminating one of the deforming forces of hallux abducto valgus deformity. We believe that the injection indirectly strengthens the abductor hallucis muscle and allows it to regain some advantage and to reverse or prevent, at least temporarily, progression of the deformity.

Materials and Methods

Materials used are a nerve/muscle stimulator (DigiStim III; Neuro Technology Inc, Kerrville, Texas); a lead wire with a gel electrode; a needle electrode (Neuroline Inoject; Ambu, Ballerup, Denmark), 35 × 0.40 (1.4 inches × 27 gauge), with a 75-cm lead wire; 100 U of botulinum toxin A solubilized in 0.9% sterile saline without preservative; and a 3-mL sterile syringe with a draw needle.

The patient is placed supine with the low-voltage lead (gel electrode) placed on the thigh. Lead wires are attached to the DigiStim jacks. The Inoject needle attached to the DigiStim is placed from the dorsal middle first interspace toward the first and second metatarsophalangeal joint.

The DigiStim is turned on and the 2-Hz button is

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The procedure described herein is patented (US Patent 7,276,244 B2).

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depressed, allowing for a frequency of two pulses per second to be introduced into the needle. The needle is gently advanced plantarly toward the second metatarsophalangeal joint area in the direction of the transverse adductor hallucis muscle belly until an abduction motor response is noted. A low frequency is used to confirm the motor response of the adductor hallucis. At this point 25 U of toxin is administered. The needle is then partially retracted and redirected toward the oblique arm of the adductor hallucis muscle. Care is taken in obtaining the motor response from the correct muscle by avoiding stimulation of the muscles in the surrounding area by using a high frequency. The needle is gently advanced plantarly until abduction of the hallux is noted again. Seventy-five units of toxin are then administered. The dose selected was based on the use of botulinum toxin A in other disorders, and the muscle size, the innervation ratio, and the end plate density were noted to be variables.⁹

Case Report

A 43-year-old woman presented with a chief complaint of bilateral bunion pain since 2002. The patient stated that she was on her feet 20% of the time at work. She would have an aching pain in the morning that was temporarily relieved with massage and “cracking” of her first metatarsophalangeal joint. Previous treatments consisted of padding, orthotic devices, and different shoes. Her surgical history consisted of an appendectomy in 1965 and cholecystectomy in 2001, without complications. Her medical history was positive for low-back pain and migraines. The patient took sumatriptan succinate as needed for migraines and denied allergies. Her family history was significant for cardiovascular disease and high blood pressure.

Lower-extremity physical examination revealed a neurovascular status within normal limits, with no break in the integument and no edema. Bilateral tracking range of motion of the first metatarsophalangeal joint without crepitus was demonstrated. Bilateral erythematous dorsomedial bony prominence with slight discomfort during range of motion of the metatarsophalangeal joint was also noted. All of the findings were significant for the right foot greater than the left.

Radiographically, the right foot initially demonstrated an intermetatarsal angle of 14°, a hallux abductus angle of 20°, and a tibial sesamoid position of 4 (Fig. 1). The metatarsus adductus angle, proximal articular set angle, distal articular set angle, and hallux interphalangeus angle were within normal limits. For this study, values considered within normal limits



Figure 1. A baseline radiograph of the patient's right foot demonstrates an intermetatarsal angle of 14°, a hallux abductus angle of 20°, and a tibial sesamoid position of 4.

were an intermetatarsal angle of 8° to 12°, a hallux abductus angle of 0° to 15°, and a tibial sesamoid position of 1 to 3. A metatarsal protrusion distance of -3 mm was noted, with a round metatarsal head. No other bony abnormalities were present.

A total of 100 U of botulinum toxin A solubilized in 0.9% sterile saline was administered to the patient's right foot in accordance with the previously described technique. The patient was instructed to continue with routine activities and shoes. No adjunctive therapy was advised in an attempt to avoid variables affecting the outcome. The patient was asymptomatic the following morning. She denied aching, bruising, and pain with range of motion of the first metatarsophalangeal joint.

A series of weightbearing standard foot radiographs were taken throughout the year by the same physician using the same technique (Fig. 2). The first radiograph, taken approximately 3 weeks after injection, demonstrated an intermetatarsal angle of 10°, a hallux abductus angle of 10° and a tibial sesamoid position of 3 (Fig. 2A). Six weeks after injection, the intermetatarsal angle reduced to 9°, the hallux abductus angle decreased to 7°, and the tibial sesamoid position changed to 2 (Fig. 2B). An increase was noted at week 13 in the intermetatarsal angle from 9° to 11°. The hallux abductus angle increased from 7° to 7.5°, and the tibial sesamoid position increased to 3 (Fig.

2C). At 31 weeks the hallux abductus angle increased to 9°, with no changes in the intermetatarsal angle and tibial sesamoid position (Fig. 2D). At 49 weeks no changes were noted (Fig. 2E). At 69 weeks, the intermetatarsal angle was still 11°, the hallux abductus angle was 9°, and the tibial sesamoid position was 3

(Fig. 2F). It was noted that the increase in the angles was still less than the baseline angles of the original deformity. Fourteen months after the injection, the patient is asymptomatic despite the increase in the angles and the recurrence of the hallux abducto valgus deformity.

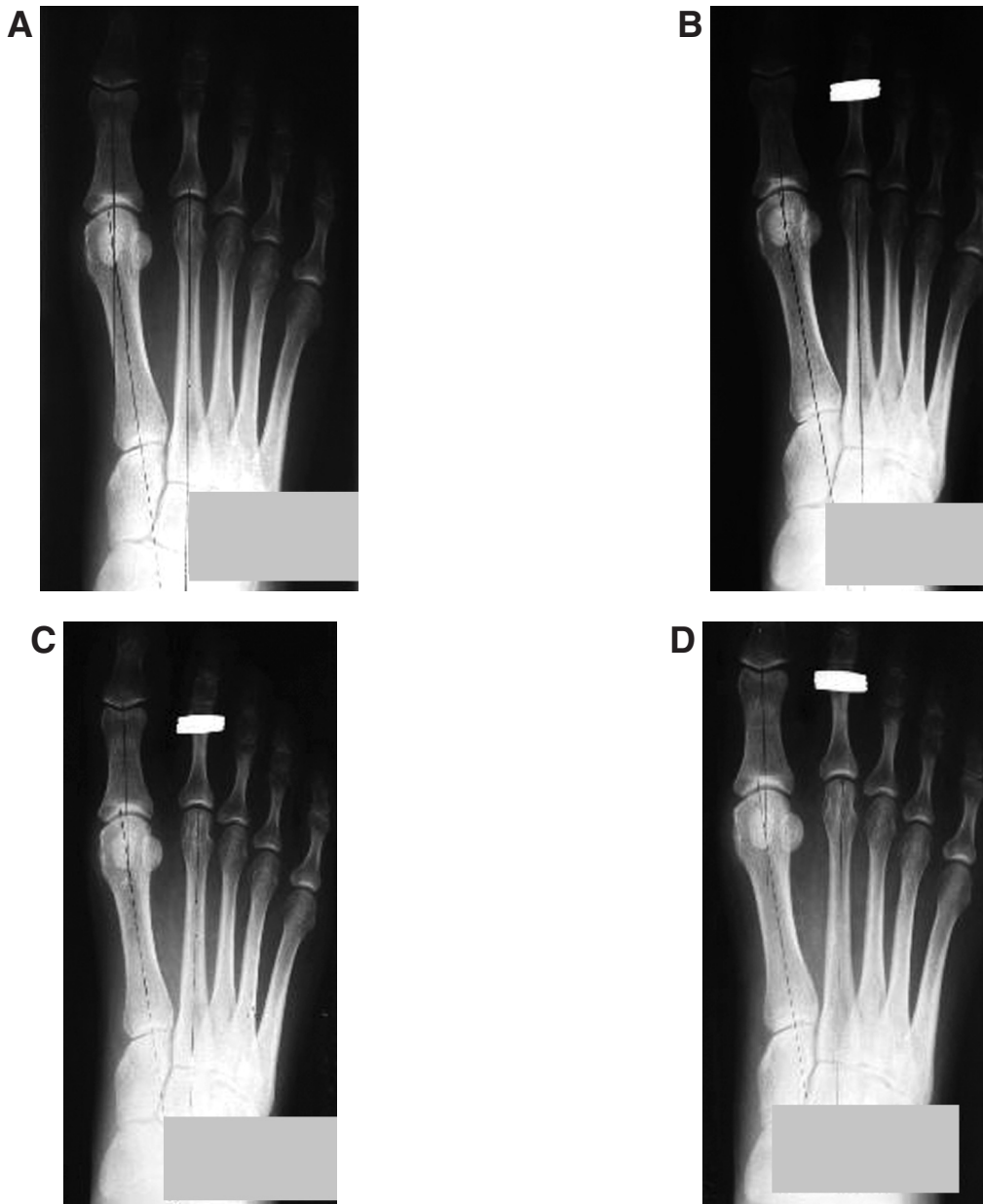


Figure 2 A–D. Weightbearing standard radiographs of the patient’s right foot were taken periodically after botulinum toxin A injection. A, Three weeks after injection the intermetatarsal angle was 10°, the hallux abductus angle was 10°, and the tibial sesamoid position was 3; B, At 6 weeks the intermetatarsal angle was 9°, the hallux abductus angle was 7°, and the tibial sesamoid position was 2; C, Thirteen weeks after injection the intermetatarsal angle was 11°, the hallux abductus angle was 7.5°, and the tibial sesamoid position was 3; D, At 31 weeks the intermetatarsal angle was 11°, the hallux abductus angle was 9°, and the tibial sesamoid position was 3. (*Figure continues on next page.*)

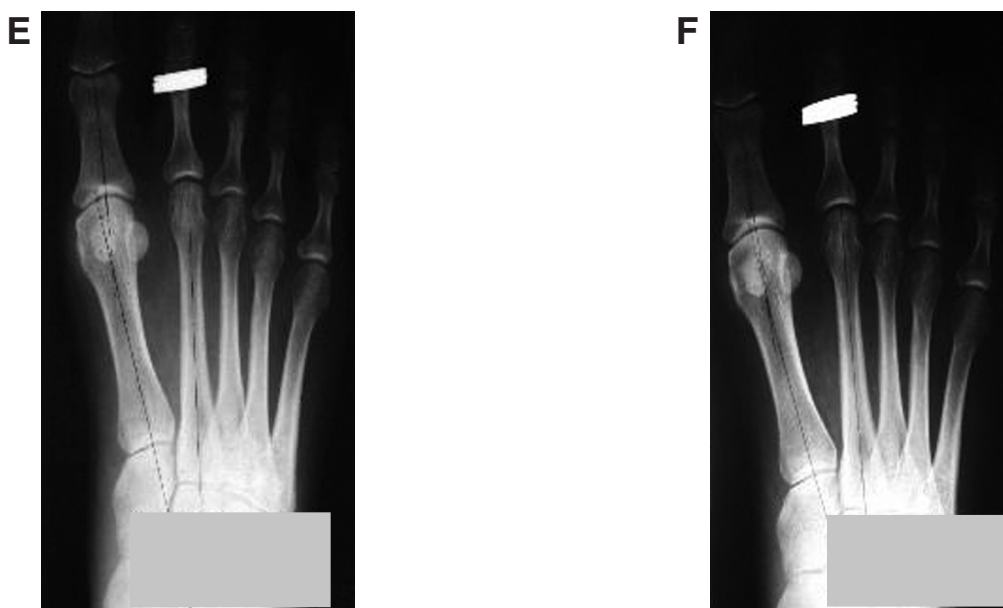


Figure 2 E and F. E, At 49 weeks the intermetatarsal angle was 11° , the hallux abductus angle was 9° , and the tibial sesamoid position was 3; F, Sixty-nine weeks after injection the intermetatarsal angle was 11° , the hallux abductus angle was 9° , and the tibial sesamoid position was 3.

Discussion

The literature has demonstrated that botulinum toxin A therapy is very useful in cases of muscle imbalance and spasms. Applications for botulinum toxin A therapy have increased tremendously and play an important role in the conservative management of musculoskeletal system imbalances. In the case of hallux abducto valgus, few effective conservative measures are available. According to Ferrari et al¹⁰ orthotic devices and night splints did not seem to be any more beneficial than no treatment at all for mild-to-moderate hallux abducto valgus. Padding, orthotic devices, and larger shoes are patient dependent and at times are seen as an inconvenience. On the other hand, owing to comorbidities and noncompliance, not all patients are surgical candidates.

Botulinum toxin A therapy to decrease hallux abducto valgus deformity and its associated pain could be a great treatment option for many patients. Although the effects of botulinum toxin A therapy are limited and short-term, the results can be a milestone for nonsurgical candidates with painful deformity of the first metatarsophalangeal joint who cannot have surgical correction for multiple reasons.

In this case study, the patient was asymptomatic the day after the injection, and she continues to be asymptomatic even with a mild recurrence of the de-

formity. This study addresses the question concerning the length of efficacy of botulinum toxin A in the first metatarsophalangeal joint, providing longer relief than once thought, and further insight on botulinum toxin A use for pain control. Studies^{11, 12} have demonstrated that the pain relief associated with botulinum toxin A therapy is often seen earlier and with greater extent compared with muscle relaxation owing to botulinum toxin A receptors also found on autonomic nerve terminals. It has been shown that botulinum toxin A blocks peripheral sensitization and indirectly reduces central sensitization via its antinociceptive effect.¹³

Adverse events are minimal to none with botulinum toxin A therapy, especially in the foot when no other neurologic conditions are associated.^{4, 9, 11} The present case study demonstrates no negative adverse effects with the treatment. We are aware of possible antibiotic formation from large doses and frequent use of botulinum toxin A.⁴ Therefore, the smallest doses needed to reproduce similar results are being studied, thereby decreasing the cost of botulinum toxin A as a whole.

We are currently conducting larger studies and possibly expanding the application of botulinum toxin A treatment to other deformities of the first metatarsophalangeal joint, such as hallux limitus and hallux varus, where muscle contracture is noted to be

the cause. Criteria bunion angles and first metatarsophalangeal joint range of motion are being evaluated to obtain maximal results with this technique. We are also assessing the use of adjunctive therapy, splints, muscle stimulation, and physical therapy along with botulinum toxin A therapy. We believe that botulinum toxin A therapy will play a beneficial role when used as a prophylactic treatment option during the initial stage of bunion deformity and may possibly even slow its progression. The pain associated with the deformity may also be managed with this therapy and may, in fact, have long-term benefits with serial applications.

Financial Disclosures: None reported.

Conflict of Interest: None reported.

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