Non-surgical treatment for foot deformities and lesions in patients with diabetes mellitus

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Abstract:
Patients with diabetes mellitus (DM) are likely to also have a variety of deformities and lesions in the feet such as ingrown toenails, hallux valgus, hammertoes, flat feet, and cracked feet. Left untreated these mild deformities and lesions frequently and gradually increase in severity, causing paronychia, callus, and corns. These often lead to pressure ulcer and foot infections. This acquired condition of poor blood glucose control frequently predisposes these patients to a high risk of post-operative infection and delayed wound healing; therefore, these patients are regarded as poor surgical candidates. In this study we review the option of non-surgical management for these patients with the goal of alleviating foot deformities and heel fissures, and reducing the incidence of foot ulcer and infection.

Key words: Diabetic Foot, Foot Deformities, Foot Lesions, Foot Orthoses

INTRODUCTION
Diabetic foot ulcer (DFU) is a serious complication of diabetes that is usually marked with a long healing period, high disability rate, and great medical expense.¹ Due to peripheral neuropathy and angiopathy patients with DM are prone to present with a variety of deformities and lesions in their feet. These include hammertoes, Charcot foot, cracked/fissuring skin, etc.²,³ Previous studies indicated that toe and foot deformities are the major causes of abnormally increased plantar pressure, which is the early predictor for foot ulcer.⁴,⁵ In addition, untreated ingrown toenails and cracked feet (fissures) also lead to foot ulcer and infection.⁶,⁷

Surgical management has been shown to be effective for correcting foot deformities and treatment of these lesions. However, most of these surgical procedures are operated on soft tissues, joints, and bones.⁸,⁹,¹⁰ With poor blood glucose control or insufficient perfusion in the lower limb, a surgical option is often deferred by the attending physician, or patients themselves, after consideration of post-operative complications such as infection or delayed wound healing.¹¹ Even with mild lesions, if left untreated, the gradual deterioration of a foot deformity will subsequently decrease the foot weight-bearing area, thus abnormally increasing plantar pressure. This then causes callus, corn, paronychia, and foot ulcer development.¹²

Foot orthoses can treat foot deformities and lesions with the goal of reducing the incidence of foot ulcer.¹³,¹⁴,¹⁵,¹⁶ In this study we review the common foot deformities and lesions, as well as conservative management options.
Common Foot Deformities and Lesions in Patients with Diabetes Mellitus

1. Skin Lesions
   Diabetic peripheral neuropathy (DPN) is usually associated with a skin nutrition disorder, subsequently resulting in lowering of skin temperature, skin paleness, sweating deficiency, and dry skin. Left untreated, dry and cracked feet will occur, with eventual development of foot ulcer (Figure 1).

   Figure 1. Heel fissure.

2. Nail and Toe Deformities
   DPN is usually accompanied by sensory disturbance and movement disorder in feet. Due to decreased pain sensation, patients may not realize that unfitted shoes can lead to the toenails, hallux, and lesser toes being constantly under significant pressure. This causes the sides or corners of the toenail to be forced into the skin at the end or side of the toe, leading to ingrown nail and paronychia (Figure 2). Furthermore, the hallux is bent outward and the first metatarsal head is bent inward, and the lesser toe is bent inward and the fifth metatarsal head is bent outward toward the midline of the body leading to hallux valgus (Figure 3) and little toe varus (Tailor’s Bunion) (Figure 4), respectively. Due to uncoordinated movement of joints and muscle tendons, the joints of toes may be dislocated, and hammertoe, mallet toe, or claw toe may occur.

   Figure 2. Ingrown nail.

   Figure 3. Hallux valgus.

   Figure 4. Little toe varus (Tailor’s Bunion).
Hammertoe is defined as downward bending of the proximal interphalangeal joints of a toe (Figure 5), and mallet toe is defined as downward bending of the distal interphalangeal joints of a toe (Figure 6). Claw toe is defined as downward bending of both the proximal and distal interphalangeal joints (Figure 7).

3. Foot Arch Deformities
If left untreated, joint and muscle tendon deformities and lesions often lead to the development of flat feet. Flat feet is defined as flattening of the arch on the inside of the feet, allowing entire soles of the feet to have contact with the floor when in a standing posture.

4. Foot and Ankle Deformities
Neuropathic arthropathy, usually known as Charcot foot, refers to progressive degeneration of the weight bearing joints, a process marked by bone destruction, bone resorption, and eventual deformity (Figure 8). If the pathological process is left unnoticed and untreated, it can develop into joint deformities, ulcers, infection, loss of function, and in the worst-case scenario, amputation or even death.
Foot Orthoses
1. Silicone Gel Heel Protector
   This soft medical silicone gel product helps to protect the skin against peeling and cracking (Figure 9).

2. Ingrown Toenail Bracing
   The toenail strip is comprised of a thin and flexible material with good elasticity. It is bonded across the surface of the ingrown toenail to apply a gentle and persistent force that straightens the curve of the toenail. The toenail strip gradually lifts each side of the nail reducing its pressure against the skin. When pressure from each side of the toenail is reduced, the ingrown toenail is corrected (Figure 10).

3. Hallux Valgus Corrector
   The hallux valgus corrector applies a 3-point pressure system. Adjustable toe strap and hinge realign the big toe and stabilize the foot arch, helping to reduce the hallux valgus angle for gradually relieving the hallux valgus deformity (Figure 11).

4. Lesser Toe Separator
   This soft medical silicone gel product helps to protect the lesser toe and the fifth metatarsal from knocking and bumping to restore the normal alignment of toe shape (Figure 12).
5. **Toe Straighter**
   This is designed for the correction of hammertoe, mallet toe, claw toe, and overlapping toes. The adjustable, cotton-covered elastic sleeve holds the toe in the proper position as the attached pad cushion separates adjacent toes and protects the ball of foot *(Figure 13).*

![Figure 13. Triple toe straighter.](image)

6. **Orthotic Arch Support Insole and Diabetic Shoes**
   These are designed to provide stable support for hindfoot, midfoot, and forefoot to evenly distribute body weight across the foot. Doing this avoids persistent painful pressure points, and finally minimizes the risk of skin ulcers for diabetics *(Figure 14 and 15).*

![Figure 14. Orthotic arch support insole.](image)

![Figure 15. Diabetic shoes.](image)

7. **Diabetic Walking Boot**
   Charcot foot is usually accompanied by severe deformities of the foot and ankle, including collapse of the midfoot arch and/or instability of the ankle and hindfoot. Early correction is recommended to limit morbidity. The diabetic walking boot is designed to support, or stabilize, the foot to minimize weight-bearing and deformity on the affected foot/ankle *(Figure 16).*

![Figure 16. Diabetic walking boot.](image)
SUMMARY

Diabetic patients with lower limb peripheral neuropathy are prone to developing foot deformities and lesions. For patients who cannot tolerate, or refuse to accept surgical corrections, foot orthoses should be considered. A comprehensive assessment of the foot function is required, including the range of joint motion, strength of the muscles, position of the bones when standing, and gait. Nocturnal application of a silicone gel heel protector, hallux valgus corrector, lesser toe separator, and toe straighter are optimal for patient convenience. Orthotic arch support insole and diabetic shoes are fundamental treatments that should be applied on a daily basis. Patients need to regularly clean the orthoses with mild soap and rinse thoroughly with water. They should be dried before use. Foot orthoses are usually prescribed with rehabilitative training, such as a program with stretching and strengthening exercises to improve the posture and alignment. Finally, foot deformities and lesion correction are long-term problems; patients should be advised to visit an orthopedic surgeon or podiatrist regularly until foot orthoses are fitted for proper functioning. In some cases, small adjustments are needed.

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References

References (continued)


