

Diabetic Footwear

Introduction

- Diabetes is fast gaining the status of a potential epidemic in India.
- According to the published studies prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India.
- It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India.

Introduction

- According to an estimate by International Diabetes Federation (IDF), 80% of people with diabetes live in low-to middle-income countries including India.
- India has the second largest number of diabetic patients in the world after China

Introduction

- India is home to 69.1 million patients with diabetes mellitus with an overall prevalence of 9.3%.
- The regional prevalence of diabetes varies from as low as 5.3% in Jharkhand to 10.4% in Tamil Nadu and 13.6% in Chandigarh

Diabetic Foot Ulcer

- An increasing number of patients with diabetes translate into an increased burden of diabetic complications including microvascular and lower extremity complications.
- Lower extremity diseases, including peripheral neuropathy, peripheral arterial disease (PAD), and foot ulceration, **is twice as common** in diabetic subjects as compared with nondiabetic persons
- Affects 30% of diabetic people older than 40 years.

Diabetic Foot Ulcer

- The annual incidence of diabetic foot ulcer (DFU) in population-based studies is 1.0 to 4.1% and prevalence of 4.5 to 10%, with an overall lifetime incidence of up to 25%.
- Foot wounds not only add to morbidity but also to health-care cost, and are attributed as the most frequent cause for diabetes associated hospitalization

Diabetic Foot Ulcer

- The most feared consequence of it is limb amputation, which is seen 10 to 30 times more often in persons with diabetes than in general population.
- It is known that diabetes account for 8 of 10 nontraumatic amputations, of which 85% are due to DFU.
- The age-adjusted annual incidence for nontraumatic lower limb amputations in persons with diabetes ranges from 2.1 to 13.7 per 1,000 persons.
- Therefore, it is believed that in every 30 seconds a lower limb is lost somewhere in the world as a consequence of diabetes.
- After a unilateral amputation, rates for mortality are also very high, ranging from 13 to 40% in 1 year, 35 to 65% in 3 years, and 39 to 80% in 5 years, which is worse than most malignancies.

Epidemiology of diabetic foot complication

- A meta-analysis study published recently showed that the worldwide prevalence rate of DFU was 6.3%.
- North America showed the highest prevalence rate of 13.0% compared with Oceania with prevalence rate of 3.0%.
- Africa showed a prevalence rate of 7.2% which is higher than Asia (5.5 %). Europe showed a prevalence rate of 5.1%
- *Australia has prevalence rate of 1.5% and Belgium with 16.6% followed by Canada (14.8%) and USA at 13.0%.*
- *India showed a prevalence rate of 11.6%.*

Footwear

- Diabetic foot ulcers are typically caused by repetitive stresses (shear and pressure) on the foot in the presence of the diabetes-related complications of peripheral neuropathy or peripheral artery disease, and their healing is often complicated by the development of infection
- Use of inappropriate footwear or walking barefoot typically increases the magnitude of the local mechanical repetitive stresses on the foot that are leading causes of the development of diabetic foot ulceration
- Thus, it is recommended that people with diabetes wear appropriate footwear designed to reduce repetitive stresses at all times, to help prevent diabetic foot ulceration

Footwear features



Specific footwear requirements for people with diabetes and a foot deformity

	Height	Outsole	Uppers (quarter) ^b	Tongue
Limited joint mobility	Low ^a	Toughened	Supple	Supple
Pes cavus	Ankle-high	Toughened	Toughened	Toughened ^c
Flexible flat foot with hallux valgus	High	Toughened	Toughened	Toughened ^c
Rigid flat foot with hallux valgus	Ankle-high	Toughened	Strong medial support	Toughened ^c
Charcot foot	High	Stiff	Toughened	Toughened ^c
Hallux or toe amputation	High	Stiff	Toughened	Toughened ^c
Forefoot amputation	High	Stiff	Stiff	Stiff

Footwear for people with diabetes

For all people at-risk of foot ulceration

- 1 Advise people with diabetes to wear footwear that fits, protects and accommodates the shape of their feet
- 2 Advise people with diabetes to always wear socks within their footwear, in order to reduce shear and friction
- 3 Educate people with diabetes, their relatives and caregivers on the importance of wearing appropriate footwear to prevent foot ulceration

For people at intermediate- or high-risk of foot ulceration

- 4 Instruct people with diabetes at intermediate-or high-risk of foot ulceration to obtain footwear from an appropriately trained professional to ensure it fits, protects and accommodates the shape of their feet
- 5 Motivate people with diabetes at intermediate- or high-risk of foot ulceration to wear their footwear at all times, both indoors and outdoors
- 6 Motivate people with diabetes at intermediate- or high-risk of foot ulceration (or their relatives and caregivers) to check their:
 - a. footwear, each time before wearing, to ensure that there are no foreign objects in the footwear, or penetrating, the soles
 - b. feet, each time their footwear is removed, to ensure that there are no signs of abnormal pressure, trauma or ulceration
- 7 For people with a foot deformity or pre-ulcerative lesion, consider prescribing medical grade footwear, which may include custom-made in-shoe orthoses or insoles
- 8 For people with a healed plantar foot ulcer, prescribe medical grade footwear with custom-made in-shoe orthoses or insoles with a demonstrated plantar pressure reducing effect at the high-risk areas
- 9 Review prescribed footwear every three months to ensure it still fits, protects, and supports the foot

For people with diabetic foot ulceration

- 10 For people with a plantar diabetic foot ulcer, footwear is not specifically recommended for treatment; prescribe appropriate offloading devices to heal these ulcers

Requirements for footwear for people with diabetes

Feature	Requirements
Length	Inner length of the footwear should be 1–2 cm longer than the foot length as measured from heel to the longest toe when a person is standing. Adequate length needs to be confirmed when people are weight-bearing while wearing the footwear.
Depth	Depth should accommodate the toes to move freely without causing pressure at either the medial, lateral or the dorsal side.
Width	Width should equal the width of all parts of the foot. Width is good when the upper can be slightly bunched. The relation between forefoot and hindfoot is important, as accommodating a wide forefoot may result in the heel being too wide.
Height	Footwear height can be low, ankle-high, or high. High footwear provides more firmness, stability and reduces joint motion. The shaft of high footwear also contributes to forefoot pressure reduction. See further Table 3 for specific height requirements for people with a foot deformity.
Insole	The removable moulded insole can be pre-fabricated, adjusted or custom-made. The primary function of the insole is pressure redistribution. This is achieved via the principle of increasing the contact area between the foot and the insole, and the addition of corrective elements in the insole. Shock-absorbing, soft but sufficiently resilient and non-slippery materials should be used. See further Table 4 for the offloading effects of specific insole modifications.
Outsole	Rubber, plastic, and leather can all be used in construction of footwear outsoles, but rubber outsoles are thought to be superior. Outsoles can be supple, toughened or stiff. The shoe should not be more supple than the foot, or friction between foot and shoe will develop during push-off. See further Table 3 for specific outsole requirements for people with a foot deformity and Table 4 for the offloading effects of specific modifications.

Requirements for footwear for people with diabetes... contd..

Rocker profile	Rocker profiles have proven effectiveness in reducing plantar pressures, especially the forefoot. The rocker profile chosen depends on the affected joints and is determined by the apex position (pivot point) and the angle from the pivot point to the tip of the toe. For plantar pressure reduction of the metatarsophalangeal joints, the pivot point needs to be proximal to these joints. The rocker profile also impacts balance; the more proximally placed, the greater the balance disturbance. A person's balance should therefore always be taken into account when deciding on the rocker profile.
Heel enclosure	An adequately fitting and enclosed heel is recommended, as open backed footwear or a heel enclosure that is too wide can result in injury and usually requires a person to claw their toes in order to keep them on. The heel counter needs to be free of edges protruding into the footwear.
Heel lift	The heel lift (or heel-forefoot difference, or pitch) should be generally 1.5–2 cm, and should not exceed 3 cm.
Closure	Adequate closure (or fixation) is needed to keep the foot from sliding forward. Closure should allow secure longer-term fastening and individual adjustment. Laces have long been considered the optimal choice; however, alternatives that are easier to use while still meeting these criteria are available as well, and innovative closures continue to be developed.
Uppers	The uppers consist of the 'quarter'(hind- and midfoot) and 'vamp' (forefoot and toes). Uppers should be made from leather or a combination of materials (similar to sports shoes), with smooth inner lining made from a material that does not harden over time, with limited seams and preferably no seams in the vamp area as they reduce the ability of the leather to give. Uppers should be breathable and durable and have the ability to mould to deformities of the foot without resulting in pressure areas. Uppers can be supple, toughened or stiff. The vamp area should generally remain supple to accommodate the toes. See further Table 3 for specific requirements for the uppers (quarter) for people with a foot deformity.
Toe box	The part of the shoe that covers and protects the toes. This should be supple (unless specific requirements (e.g. for building professionals) require otherwise), and should accommodate the shape of the toes, to avoid any rubbing on the toes.

International Guidelines

IWGDF Guidance on footwear and offloading interventions to prevent and heal foot ulcers in patients with diabetes

Casting and prefabricated healing devices

- 1. To heal a neuropathic plantar forefoot ulcer without ischemia or uncontrolled infection in a patient with diabetes, offload with a non-removable knee-high device with an appropriate foot-device interface.
- 2. When a non-removable knee-high device is contraindicated or not tolerated by the patient, consider offloading with a removable knee-high walker with an appropriate foot-device interface to heal a neuropathic plantar forefoot ulcer in a patient with diabetes, but only when the patient can be expected to be adherent to wearing the device.
- 3. When a knee-high device is contraindicated or cannot be tolerated by the patient, consider offloading with a forefoot offloading shoe, cast shoe, or custom-made temporary shoe to heal a neuropathic plantar forefoot ulcer in a patient with diabetes, but only and when the patient can be expected to be adherent to wearing the shoes.

Therapeutic footwear

- 4. To protect their feet, instruct an at-risk patient with diabetes not to walk barefoot, in socks, or in thin-soled standard slippers, whether at home or when outside.
- 5. Instruct an at-risk patient with diabetes to wear properly fitting footwear to prevent a first foot ulcer, either plantar or non-plantar, or a recurrent non-plantar ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing therapeutic shoes, custom-made insoles, or toe orthosis.
- 6. To prevent a recurrent plantar foot ulcer in an at-risk patient with diabetes, prescribe therapeutic footwear that has a demonstrated plantar pressure relieving effect during walking (i.e. 30% relief compared to plantar pressure in standard of care)

Therapeutic footwear

- 7. Do not prescribe, and instruct a patient with diabetes not to use, conventional or standard therapeutic shoes to heal a plantar foot ulcer.
- 8. Consider using shoe modifications, temporary footwear, toe spacers or orthoses to offload and heal a non-plantar foot ulcer without ischemia or uncontrolled infection in a patient with diabetes. The specific modality will depend on the type and location of the foot ulcer.

Surgical offloading interventions

- 9. Consider Achilles tendon lengthening, joint arthroplasty, single or pan metatarsal head resection, or osteotomy to prevent a recurrent foot ulcer when conservative treatment fails in a high-risk patient with diabetes and a plantar foot ulcer.
- 10. Consider digital flexor tenotomy to prevent a toe ulcer when conservative treatment fails in a high-risk patient with diabetes, hammertoes and either a pre-ulcerative sign or an ulcer on the toe.
- 11. To heal a neuropathic plantar foot ulcer without ischemia or uncontrolled infection in a patient with diabetes, consider Achilles tendon lengthening, single or pan metatarsal head resection, or joint arthroplasty when conservative treatment fails.
- 12. To heal a toe ulcer without ischemia or uncontrolled infection in a patient with diabetes

Other offloading interventions

- 13. If other forms of biomechanical relief are not available, consider using felted foam in combination with appropriate footwear to offload and heal a neuropathic foot ulcer without ischemia or uncontrolled infection in a patient with diabetes.

Conclusion

- Diabetes and its associated complications, including foot diseases, are increasing at an alarming pace in India and adding an enormous burden on our limited health care resources.
- Early recognition, classification, diagnosis, and treatment of foot complications are needed to optimize outcomes in patients with diabetes
- A comprehensive approach by all the stakeholders is essential to overcome this burden.