

# Ten years of a multidisciplinary diabetic foot team approach in Sao Paulo, Brazil

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Diabetes mellitus can cause devastating foot problems including loss of protective sensation with subsequent ulcerations and amputations. The natural history and pathophysiology of diabetic foot ulcers is best understood and managed by a multiprofessional team approach. The main factors for prevention and treatment of these devastating diabetic foot conditions are shown, with special attention to education of the patient. This approach decreases the morbidity of the disease, besides its economical and social feasibility.

Keywords: *diabetic foot ulceration; diabetic foot surgery; diabetic neuropathy; diabetes education; diabetic wound care*

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**D**iabetes mellitus (DM) is a chronic and debilitating disease that occurs globally with a reported prevalence of 4–6.5% and an exponential increase in the last decade (1–3). Owing to its manifestations, as well as systemic involvement and high morbidity rates, DM has a negative social, personal, and economic impact around the world (2). About 40% of patients with DM will have significant renal disease with subsequent dialysis; these patients are two to six times more susceptible to heart disease, two to four times predisposed to a cardiovascular incident, and are more prone to blindness in adults (3).

Diabetic foot problems are very common, especially in those individuals with diabetic autonomic and sensory neuropathy. Rigid pedal deformities and poor foot care are important risk factors for subsequent amputation in this population. Diabetic foot infections are the cause of about 25% of total hospital admissions in diabetic patients (4). DM is also the main cause of non-traumatic amputations in the United States (3), and increases the risk of amputation from 15 to 40 times, compared to the non-diabetic population. Due to the impact in the public health, in 1992 the Action Program of the Declaration of St. Vincent was accomplished, with the engagement of decreasing the number of amputations by half, in five years (5, 6, 7).

Some of the most common factors leading to a diabetic foot amputation include, but are not limited to, the existence of an ulceration, untreated infection, dense peripheral neuropathy, peripheral vascular disease, and pedal deformities. Eighty-five percent of diabetic lower extremity amputations are preceded by a previous ulceration and diabetic foot infection (3). The risk of ulceration in the diabetic foot is around 15% at any age (4), and one in five ulcers result from treatment failures (8). Essential guidelines and patient care education through a multidisciplinary team approach can decrease the risk of diabetic foot amputations (9, 7, 10).

A multidisciplinary team approach has been established in our institution in Sao Paulo, Brazil, where healthcare providers from each discipline in the management of the diabetic patient plays a vital role in diabetic limb salvage. The purpose of this paper is to report on the multidisciplinary experience of our institution with the Brazilian public healthcare system that is linked to the Department of Orthopedics and Traumatology at Universidade Federal de São Paulo, Brazil.

## Team approach to diabetic limb salvage

In 2000, a multidisciplinary healthcare team with emphasis on diabetic limb salvage was established in our institution and, currently, more than 1,000 patients per

year with a diabetic foot problem visit our clinical setting. The team consists of orthopedic surgeons specializing in diabetic foot and ankle surgery, nurses, orthotists and/or prosthetists, physiotherapists, cardiologists, nephrologists, infectious disease specialists, and internists. This team works closely with the diabetic foot protocols and guidelines and collaborates in the management of the diabetic foot.

The patient is initially evaluated and examined by the orthopedic team, which establishes the clinical pathway and eventual treatment of the diabetic patient. Pertinent history and physical examination, including the patient's musculoskeletal, neurological, vascular, and dermatological status, are obtained during the patient's first visit with a diabetic foot problem. In addition, a biomechanical examination and/or pertinent laboratory and medical imaging tests are also obtained. At that point, the necessary referrals are established for the overall medical management of diabetes in this patient population. These referrals may include an internist, cardiologist, nephrologist, and/or ophthalmologist. Patient education on proper foot care through an intensive nursing program is also established early in the patient's visit.

In addition, the patient has the opportunity to be assessed by an orthotist and/or prosthetist, who defines with the orthopedic team the conservative functional or post-reconstructive treatment plan for the diabetic patient. The final treatment is decided upon our plan that is being facilitated by multiple healthcare members, clinical settings, teaching and patient education.

Several classification systems have been used for the treatment of the diabetic foot and Table 1 represents our generic classification that guides the patient's treatment and clinical investigation protocols (11).

### Clinical strategies

Our main strategies include appropriate patient education and prevention, advanced wound care modalities and treatment, appropriate offloading with a total contact cast and/or custom-made orthopedic shoes, curative and reconstructive surgery, post-operative management, and amputee rehabilitation program when needed (10, 12–15).

All diabetic patients in our clinical setting present from the public healthcare system, and almost all have attended this system on other occasions. We have to

**Table 1.** Diabetic foot generic classification

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- I. Diabetic foot without a wound and/or infection
  - II. Diabetic foot with a wound and/or infection
  - III. Septic diabetic foot
  - IV. Charcot's foot
  - V. Combined conditions of any of the above
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highlight that most of these patients come to our clinic without minimum parameters of glycemic control, such as glycosylated hemoglobin A1C or self-monitoring blood glucose levels. The majority of these patients have minimal knowledge about the care of their diabetic feet and are not aware of the complications of diabetic neuropathy. In addition, many patients also present with other inabilities that complicate the care of their feet, for example, a decrease of visual acuity (16).

Education is a strong tool in the patient's overall treatment of diabetic foot pathology (17). It has been documented that objective education actually decreases the incidence of ulcers and amputations (8, 17, 18). The first step is to warn the patient and the patient's family of the potential limb and/or life-threatening case scenarios that can arise from a diabetic foot ulceration. The second step is to educate the patient about proper foot self-inspection and seek medical care when necessary. The final step is the consideration of prophylactic and elective diabetic foot surgery in the presence of pedal deformities that cannot be accommodated in custom-made diabetic shoes (8).

Urgent and emergent diabetic foot cases are performed immediately by surgeons who specialize in diabetic foot and ankle surgery. This will further prevent the patient's morbidity and mortality rate (19). Post-operatively, the reconstructed or amputee patients are referred to an orthotist and/or prosthetist for the prescription of custom foot orthosis and/or shoes (16, 19). This type of multidisciplinary team approach has been very beneficial to our institution and the overall public healthcare system in Sao Paulo, Brazil. It has decreased the number of amputations, ulcerations, and prolonged hospitalizations similar to other diabetic foot units around the world (9, 20–22, 23).

### Conclusion

In this paper, we report our success in the management of the diabetic foot in a university hospital in collaboration with the public healthcare system in Sao Paulo, Brazil. Through extensive patient education, prevention, reconstructive surgery, and rehabilitation, we are able to provide excellent patient care and decrease the amount of yearly amputations and re-ulcerations due to DM. Our diabetic foot treatment program has been effective in providing a dialogue with public healthcare personnel and solving major problems within our system. We hope to continue this multidisciplinary program and provide an excellent model to many other diabetic clinical settings around the world.

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