

## IS PHYSICAL EXERCISE RECOMMENDED IN DIABETIC FOOT SYNDROME?

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**Abstract:** Diabetes mellitus is a global health problem. Diabetic foot ulcer is a severe complication of diabetes and the most costly complication of the affection. The most common risk factors for ulcer in diabetic patients are peripheral diabetic neuropathy, peripheral arterial disease, structural foot deformity. Foot ulcer without specialized intervention progresses from infected ulcer, osteomyelitis to amputation. Treatment of foot ulcer is prophylactic and curative. Prophylactic treatment includes lifestyle optimization measures (nutrition therapy, smoking cessation and physical activity), pharmacologic hypoglycemic therapy and curative treatment: optimization of tissue perfusion, treatment of infection, excision of damaged or infected tissues and adequate off-loading. Regular physical activity improves glycemic control and presents health benefits; types of exercises recommended are aerobic and resistance activities. Physical activity can improve nerve conduction velocity and peripheral sensory function but patients with foot injury should be restricted to some physical activity.

**Keywords:** diabetes mellitus, diabetic foot ulcer, physical exercic

### Introduction.

Diabetes mellitus is a global health problem. The International Federation of Diabetes (IDF) estimates that in 2017 there were 425 million diabetic patients in the age segment 20-79 years world; predictions for 2040 are worrying, IDF estimates 642 million diabetic patients for the same age segment [1]. Diabetic foot syndrome is defined as ulceration of foot associated with neuropathy, ischemia and infection [2]. Diabetic foot ulcer is a severe complication of diabetes. In a review and meta-analysis published in 2017 in *Annals of Medicine* by Zhang P *et al* say that global diabetic food ulcer prevalence is 6.3%, which was higher in men than in women, higher in type 2 diabetes than in type 1 diabetes. The same authors conclude that: "The patients with diabetic foot ulcer were older, had a lower body mass index, longer diabetic duration, and had more hypertension, diabetic retinopathy, and smoking history than patients without diabetic foot ulceration" [3]. Foot ulcers are the most costly complication of diabetes; IDF estimates in 2017 that compared with diabetic patients without foot ulcer the cost for treating of patients with foot ulcers is 5.4 times higher in the year of the first episode and 2.6 higher in the year of the second episode [1]. Driver VR and collaborators mention that "Costs for the treatment of the highest-grade ulcers are 8 times higher than for treating low-grade ulcers". The authors recommend early recognition and treatment of diabetic food

diseases for reductions in food complications and amputation rates [4].

### Causal pathways for diabetic food ulcer

Elevated glycaemic levels are associated with increased risk of microvascular and macrovascular complications. The most common risk factor for ulcer food in diabetic patients are peripheral diabetic neuropathy, peripheral arterial disease, structural foot deformity [5, 6, 7].

Peripheral diabetic neuropathy is a chronic complications characteristic of diabetes; Diabetic neuropathy is characterized by affection of sensory, motor and autonomic nerves of the peripheral nervous system [1]. The pathology includes nerve fiber and axonal degeneration, alteration of endoneurial microvessels [8, 9]. The most common signs and symptoms of the disease include pain, inability to detect pressure, temperature, vibration or proprioception changes (sensory neuropathy), muscle atrophy (motor neuropathy), dry skin that generates fissures (autonomic neuropathy) [1].

Peripheral arterial disease secondary microvascular and macrovascular changes affect small and large vessels. The patients can present "pain of one or more lower extremity muscle groups related to activity (intermittent claudication), atypical pain, pain at rest, or with nonhealing wounds, ulceration, or gangrene" [2]. Structural foot deformity is a risk factor for the onset of diabetic foot ulcers because it generates plantar pressure. There is currently no globally

accepted definition for this condition but foot deformities could be: hallux valgus or rigidus, hammer or claw toes, bony prominences, prominent metatarsal heads, Charcot arthropathy, limited joint mobility [10, 11].

**Diabetic food ulcers**

Foot ulcer without specialized intervention progresses from infected ulcer, osteomyelitis and

amputation [1]. About 85% of all amputations in diabetic patients are preceded by foot ulceration complicated with infection or gangrene [3]. Plantar diabetic foot ulcer with necrosis and ischemic gangrene is shown in Figure 1 and Figure 2.



Figure 1. Plantar diabetic foot ulcer with necrosis.



Figure 2. Ischemic gangrene.

**Treatment of diabetic foot ulcer**

**Prophylactic treatment**

Several studies have shown that glycaemic control reduces risk of microvascular complications in diabetic patients. The Diabetes Control and Complication trial showed that intensive treatment reduced the incidence of microvascular complications in patients with type 1 diabetes but the results are not conclusive with type 2 diabetes [12]. The United Kingdom Prospective Study

provide guidelines for the management of type 2 diabetes and showed that each reduction in HbA1c by 1% was associated with a decrease in the risk of microvascular but not of macrovascular complications [1, 13, 14].

Treatment for diabetes includes lifestyle optimization measures (nutrition therapy, smoking cessation and physical activity), pharmacologic hypoglycemic therapy but also control of blood pressure and lipidic profile.

Several studies suggests that regular physical activity improves glycemic control and presents health benefits [15, 16, 17, 18]. American Diabetes Associations published the “Standards of Medical in Diabetes” in *Diabetes Care* in 2019 in which it recommends in diabetic patients “150 min or more of moderate-to-vigorous intensity aerobic activity per week” [19]. Types of exercises recommended by American Diabetes Associations are aerobic and resistance activities. The physical activity should progress in intensity and duration. A prospective study performed by Lemaster JW *et al* in which they included 400 diabetic patients with prior history of foot ulcer has highlighted that daily walking activity not increase the risk of food re-ulceration [20].

Matos M and collaborators after the analysis of 6 studies involving 418 diabetic patients who followed aerobic exercise, resistance and balance exercise including through Tai Chin Chuan methods concluded that physical activity improve nerve velocity conduction and peripheral sensory function [21]. Diabetic patients with peripheral arterial disease after 6-month walking intervention have improved walking speed [22]. Several studies suggests that specific physical activity improves muscular strenght [23, 24]. There is no resarch on the positive effect of physical activity on foot deformity. The American Diabetes Associations recommends that patients with foot injury should be restricted to some physical activity [19].

#### Curative treatment

The management of diabetic foot ulcer includes optimization of tissue perfusion, treatment of infection, excision of damaged or infected tissues and adequate off-loading. Studies have show that revascularization in diabetic patients with peripheral arterial disease and recurent food ulcers reduces amputation. Treatment of infection requires that antibiotic therapy; in non-severe infections in the absence of risk factors from anaerobes or gram-negative pathogen antistaphylococcal therapy recommended because in Europe the most common pathogen involved in diabetic foot ulcer infection is *Staphylococcus aureus*. For severe infections systemic antibiotics are recommrnded but currently standardised criteria to define outcome measures do not exist. Debridement is the excision of damaged tissues and it can be mechanical, enzymatic, autolytic, biologic or surgical. Boulton AJ *et al* mentions that “off-loading refers to the use of devices or surgeries that remove pressure or reduce the

“load” at the site of ulceration to improve healing” [25].

#### Conclusion

Regular physical activity improves glycemic control and presents health benefits; types of exercises recommended are aerobic and resistance activities. Physical activity can improve nerve velocity conduction and peripheral sensory function but patients with food injury should be restricted to some physical activity.

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