Foot and Ankle Surgery in the Diabetic Population

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KEYWORDS

• Diabetes • Surgery • Foot • Ankle • Orthopedic

KEY POINTS

- Foot and ankle surgery in the diabetic population has a unique set of challenges that should be considered.
- Satisfactory outcomes are possible when a surgeon recognizes these unique characteristics of diabetic patients.
- Additional surgical principles need to be applied in treating these patients.

INTRODUCTION

The incidence of obesity has been increasing worldwide over the past 3 decades. With this growth, the number of patients diagnosed with type 2 diabetes mellitus has also increased dramatically over this same period. The World Health Organization reports an estimated 422 million adults were living with diabetes in 2014, compared with 108 million in 1980. The global prevalence (age-standardized) of diabetes has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population. This reflects an increase in associated risk factors, such as being overweight or obese, and obesity is the strongest risk factor for type 2 diabetes.[1] Coincident with this surge in the number of patients who have diabetes, orthopedic surgeons have seen a greater percentage of their patients undergoing elective and posttraumatic foot and ankle surgery diagnosed with diabetes as well. It has been reported in one review of 160,000 patients with ankle fractures, 5.7% were diabetic.[2]

Diabetes also appears to dramatically increase the risk of lower extremity amputation because of infected, nonhealing foot ulcers.[3] The rates of amputation in diabetic populations are typically 10 to 20 times those of nondiabetic individuals, and over the past decade have ranged from 1.5 to 3.5 events per 1000 persons per year in populations with diagnosed diabetes.[1] Thus, orthopedic lower extremity surgeons are seeing a larger number of patients needing amputations than were encountered in previous decades.

Orthopedic surgeons who treat foot and ankle disorders must recognize the unique characteristics of diabetic patients to provide optimal care, and to ensure satisfactory outcomes. The physiologic and metabolic abnormalities seen in diabetic patients can adversely affect healing, even in the simplest of procedures. Neuropathy, vasculopathy, and altered tissue healing are very common in diabetic patients, and can negatively affect surgical treatments. Operative treatment has a higher complication rate in diabetic patients versus normoglycemic patients, especially in

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those who have common comorbidities, such as peripheral neuropathy and peripheral vascular disease.[2,4–8] This article examines some of the special considerations in the treatment of diabetic patients undergoing foot and ankle surgeries.

PHYSIOLOGIC AND METABOLIC CONSIDERATIONS

Many diabetic patients incorrectly believe that the only problem with their disease is they have "high sugar." Diabetes affects many physiologic and metabolic systems of the body, and therefore, many organ systems. As a result, there are multiple aspects of healing that can be affected by the disease.

Hemoglobin A1C levels (HgBA1C) are a well-known measure of diabetic glycemic control. Although an elevated value has not been directly linked to complications, patients with higher HgBA1C are more likely to have end-stage complications of diabetes, such as vascular disease and neuropathy, which can significantly affect surgical outcomes.[8] All patients with known diabetes should have a HgBA1C level measured before any elective surgical procedure, as should those with acute traumatic injuries. Ideally, HgBA1C levels should be less than or equal to 8 before embarking on any elective foot and ankle surgeries in diabetic patients, as levels greater than this have been associated with a higher rate of mechanical hardware failures, infection, and other morbidity.[4] Perioperative glucose levels also should be monitored, as previous research has demonstrated a higher risk of infection and healing problems in patients who remain hyperglycemic during this time.[5]

Diabetes causes multiple abnormalities in immune system function as well. Leukocyte chemotaxis, adherence, phagocytosis, and intracellular killing, all integral to infection response, are negatively affected by diabetes.[7] As a result, diabetic patients have an 80% higher risk of cellulitis, a fourfold greater risk of osteomyelitis, and twofold increased risk of sepsis and death, as compared with nondiabetic individuals.[6] In addition, a diabetic patient's physiologic response to infection is slowed compared with other patients. Diabetic patients will elicit a fever and increased white blood cell count less often than nondiabetic individuals, which is likely due to impaired immune response. One of the earliest signs of infection has been noted to be worsening glycemic control, and this has been used previously in diabetic patients to differentiate moderate from severe infection.[9] A surgeon operating on diabetic patients should keep these factors in mind, and be vigilant in recognizing and aggressively treating even the first suspected signs of infection. The judicious use of antibiotics, as well as early irrigation and debridement of suspected postoperative infections, can decrease the chance of deep infection and further morbidity.

CONTRIBUTION OF NEUROPATHY

Peripheral neuropathy has been found to be one of the most important concomitant risk factors of diabetes associated with surgical complications.[6,7,10,11] It is estimated that there is an 8% incidence of neuropathy at the time of diagnosis, but this can increase up to 50% at 25 years after diagnosis.[6] Neuropathies proceed in a stocking-glove manner from distal to proximal.

Although diabetes affects all nerve types, sensory neuropathy is the most common, and affects up to 75% of patients. Loss of protective sensation can lead to skin breakdown due to repetitive trauma, ultimately causing ulcers and infection. Diagnosis of peripheral neuropathy is initially made on physical examination, with 5.07 Semmes-Weinstein monofilament testing. This is considered to be the minimum threshold at which protective sensation is intact, and loss of sensation at this level is thought to be associated with the development of neuropathic pressure ulcers and Charcot neuroarthropathy.[7] Evaluation of a diabetic patient undergoing either elective or posttraumatic foot and ankle surgeries should include this monofilament testing of sensation. Suspected peripheral neuropathy from physical examination findings also can be confirmed with nerve conduction studies/electromyography.

Motor neuropathy can lead to foot deformities, such as claw toes and hammer toes. These deformities, especially once they become rigid, produce pressure points where shoes, casts, and braces can rub and result in ulcerations, particularly in patients who also have sensory neuropathy. Additionally, pain and temperature sensation can become diminished, as can vibratory perception. Up to 30% of patients with peripheral neuropathy also will report neuropathic pain, described as burning, shooting, cramping, "electrical," or tingling.

Autonomic disturbances have multiple effects, including skin changes, vascular dysregulation, and loss of proprioception, which contributes to the development of Charcot arthropathy. The loss of sweat production and blood vessel tone causes skin to become dry, cracked, and fissured, which contributes to the development of cellulitis and provides a portal for infection risk.

Charcot arthopathy affects fewer than 1% of all diabetic patients, but up to 13% of high-risk