

# DIABETIC NEUROPATHY COMPLICATES FRACTURE MANAGEMENT

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### INTRODUCTION

Fractures in patients with documented diabetic neuropathy can be difficult to manage and may result in serious complications. There are currently no established treatment protocols for fracture management in patients with diabetic neuropathy. Unfortunately, applying standard treatment protocols for nondiabetic patients can result in less than optimal outcomes. Patients with diabetic neuropathy are at risk for various complications, including a Charcot process. There are also legal implications that should be considered when managing fractures in diabetic patients with sensory deficits.

Cavanaugh et al evaluated radiographic abnormalities in the feet of patients with diabetic neuropathy.<sup>1</sup> They compared 94 patients with peripheral neuropathy to 43 non-neuropathic patients and found traumatic fractures in 22% of the neuropathic patients. The researchers felt that early recognition of fractures is critical to preventing a Charcot process and the subsequent deformity that might ensue. They recommended that practitioners treating these types of patients should have a high index of suspicion for fracture and suggested routine foot radiographs on all patients with diabetic neuropathy.<sup>1</sup>

Reddy et al studied the biomechanical integrity of bone in rats with experimentally induced diabetes.<sup>2</sup> His group found a 37% reduction in maximum load capability (breaking strength), 25% less deformation at maximum load, and a 38% increase in bending stiffness. They concluded that the diabetic state is associated with mechanical deterioration of bone and that diabetes mellitus may predispose patients to bony problems.<sup>2</sup>

Hedlund evaluated 22 patients with type 1 diabetes mellitus and a history of calcaneal fractures. All patients had decreased bone mineralization, 15 patients were on high-dose steroids, 18 patients had

poor renal function or renal failure, 14 patients received renal or pancreas transplants, and 8 patients had restricted weight-bearing prior to fracture.<sup>3</sup>

It is clear that patients with diabetes are at risk for fracture. Ivers evaluated 3,654 patients with diabetes to determine risk factors for fracture. All patients were older than 49 years and were followed for at least two years. He found that the presence of retinopathy, diabetes mellitus of 10 years or greater duration, and insulin treatment were factors associated with statistically significant risk of fracture in patients with diabetes mellitus.<sup>4</sup>

The most troubling complication that might develop following fracture in neuropathic patients is a Charcot process. Patients with diabetic neuropathy have an inability to control their response to minor trauma. Osteopenia usually ensues, frequently as a result of the microtrauma, but some researchers suggest that neuropathy leads to increased blood flow, which triggers osteopenia,<sup>5</sup> followed by hyperemia. Osteoclastic bone resorption takes place and injured bone is resorbed with rapid destruction following shortly thereafter. Young was unable to correlate sex, age, insulin use, duration of diabetes, retinopathy, proteinuria, level of hemoglobin A1c, or history of previous foot ulcerations with development of Charcot arthropathy.<sup>6</sup> Although weight-bearing is often implicated in the development of a Charcot process, it is not a prerequisite. Nonetheless, it appears that patients with diabetes mellitus of 10 years duration, with a history of renal transplant, and with documented neuropathy are at greatest risk to develop Charcot arthropathy following fracture.

McCormack and Leith evaluated displaced fractures in 26 patients with diabetes mellitus compared to a matched group of nondiabetic patients.<sup>7</sup> They found a 42.3% incidence of complications in the diabetes mellitus group and no complications in the nondiabetic group. Six of the complications were major. They concluded that

nonoperative management might be preferable in view of the high risks in the diabetic patient population, although this study did not distinguish between diabetic patients with and without neuropathy.

Flynn et al evaluated ankle fractures in 98 patients, 25 with diabetes mellitus. The overall infection rate in the diabetic group was four times that in the nondiabetic group (32% compared with 8%); following open reduction and internal fixation (ORIF), it was twice that in the other group. Additionally, four of six diabetic patients treated with casts became infected compared with none of the five nondiabetic patients who were treated with casts. They concluded that diabetic patients with poor compliance, evidence of neuropathy, and severe edema and ecchymosis are difficult to manage and at greatest risk for infection if treated conservatively.<sup>8</sup>

### NONOPERATIVE CARE

Nonoperative care for acute fractures should take into account special considerations and circumstances surrounding diabetes mellitus. Diabetic patients should maintain a nonweight-bearing status for approximately two times longer than the nondiabetic patient. In other words, a stable, nondisplaced fracture that would normally require six weeks of nonweight-bearing might be kept nonweight-bearing for 12 weeks in the patient with diabetic neuropathy.

When immobilizing diabetic patients with a short leg cast, the practitioner should ensure that the osseous prominences are well padded. This should include the malleoli, pretibial region, retrocalcaneal region, and any deformities that may exist. Alternatively, the practitioner may consider a total contact cast to protect the extremity from iatrogenic wounds. Diabetic patients should be seen more frequently than nondiabetic patients for cast changes; we typically see these patients weekly or biweekly. This allows the limb to be inspected for any potential iatrogenic wounds or underlying infection.

In neuropathic diabetic patients with acute fracture, we have used bisphosphonate therapy prophylactically to avoid a Charcot process. Bisphosphonates are ideal during the evolutionary phase of Charcot and are directed at the pathogenesis rather than symptomatology. We have found these products actually limit bone destruction

during the acute stage of Charcot. We also use bone growth stimulation as a prophylactic measure to prevent Charcot changes.<sup>9,10</sup>

It is important to ascertain blood glucose levels at the time a fracture is diagnosed. Beam et al evaluated the effects of blood glucose control on fracture healing.<sup>11</sup> They found decreased cell proliferation and mechanical stiffness in poorly controlled diabetes mellitus, but when blood glucose levels were tightly controlled with insulin, bone healing was similar to nondiabetic controls. They concluded that insulin treatment with improved blood glucose control would ameliorate early and late complication in diabetic fracture healing.<sup>11</sup> If blood glucose levels are poorly controlled, the patient should be referred to an internist or endocrinologist.

### OPERATIVE CARE

Indications for surgery include an unstable fracture or significant deformity. Surgical options include ORIF, closed reduction with percutaneous and/or external fixation, and primary arthrodesis. Primary arthrodesis may be considered when there is gross deformity and the fracture is associated with an acute Charcot process. This is not uncommon in a Charcot process involving the tarsometatarsal joint complex.

Special consideration must be given to neuropathic diabetic patients undergoing ORIF. We recommend allowing preoperative reduction of any edema that is present. Once the skin becomes relaxed, the soft tissue envelope will be much healthier and better able to tolerate an incision. We will typically use a stiffer fixation construct than we would use for nondiabetic patients. It is also important to have a high index of suspicion for complications, as early recognition can help minimize adverse effects. As with nonoperative therapy, total contact casts, well-padded casts, and frequent cast changes are helpful in avoiding iatrogenic wounds and infection. We also consider supplemental bisphosphonate therapy in this group of patients. And again, it is important to maintain adequate blood glucose control.

Regardless of treatment, the contralateral limb must be monitored. When wearing a cast, the contralateral limb can often sustain iatrogenic wounds secondary to abrasion. We frequently recommend a dressing on the contralateral foot and

ankle. We also recommend a pillow between the legs when sleeping. Additionally, it is important to inspect the contralateral limb at postoperative visits and during cast changes.

Potential complications following ORIF of acute fractures in patients with diabetic neuropathy include wounds, infection, malunion, nonunion, and development of the Charcot process. The incidence of infection in diabetes mellitus has been well documented. Low and Tan evaluated ankle fractures in 10 patients with diabetes mellitus and neuropathy who underwent ORIF. Five developed infection and two of these patients had below-knee amputation.<sup>12</sup> Blotter et al looked at 21 patients with diabetes mellitus who received operative treatment for ankle fractures and found a 43% complication rate. Seven of the patients (33%) developed infections and two of these had below-knee amputations.<sup>13</sup>

Informed consent in a group of patients with diabetic neuropathy undergoing ORIF should include the acknowledgement of a Charcot process as a potential complication. This should be explained to the patient and his or her family so they have a thorough understanding of what might ensue. Diabetic patients with fractures who are seen in the emergency room must have a thorough evaluation, which should involve an objective assessment of sensation, even something as simple as a monofilament test. The results of this examination should be documented. Those patients who have documented neuropathy should be educated about potential hazards, including the development of a Charcot process. This discussion should also be documented.

In summary, a fracture in a patient with long-standing diabetes and neuropathy can be a calamity for the patient and for the practitioner who treats the fracture as a routine injury. However, by taking some special precautions, these outcomes can certainly be improved.

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