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CLINICAL

Identifying the Best Treatment for Charcot Foot and Ankle Is Critical

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EDITOR'S NOTE: This article is the first in a two-part series on the treatment of Charcot foot and ankle. Part 1 focuses on understanding the pathology, medical considerations, and "red flags" in surgical planning. Part 2 will discuss the best surgical options with the difficult clinical problems of Charcot neuroarthropathy and failure of the bones to heal.

► Charcot neuroarthropathy can result from any condition that causes peripheral neuropathy, such as chemotherapeutic drug toxicity, hereditary conditions, vitamin deficiency, traumatic peripheral nerve injuries, and diabetes mellitus. Charcot arthropathy can have devastating and debilitating effects on the patient, including inability to ambulate, ulceration, infection, amputation, sepsis, and death.

The incidence of diabetes is increasing in the general population, so Charcot foot and ankle arthropathy and the devastating sequelae of the disorders have become more important clinical challenges for orthopaedic surgeons.

Limb salvage is often the main goal, yet choosing between salvage and amputation—often below- or above-knee amputation—greatly affects patients' potential quality of life. Painless fracture and failure of the normal architecture with collapse of the bony structures are pathognomonic of a Charcot foot (Fig. 1A and B).

There are several factors to consider when planning Charcot limb salvage. It is imperative to explain to the patient the entire course of postoperative treatment and any complications that may arise so that the person can have realistic expectations regarding surgical outcomes. Limb-salvage surgery can be considered once in the consolidation phase of a Charcot flare, after nonoperative treatment modalities have been employed, such as offloading with knee scooter or wheelchair and total contact casting.



Fig. 1 Charcot foot lateral view (A) and anteroposterior view (B) of a failure at the Lisfranc joint with collapse of the arch and loss of midfoot stability. The radiograph shows lateral translation of the metatarsals and dislocation of the naviculo-cuneiform joint.

COURTESY OF NICOLA CORBETT, MD, FAAOS

Preoperative evaluation

Several preoperative considerations should be addressed when a surgeon is choosing limb salvage versus amputation. One of the most important considerations for Charcot limb salvage is HbA1c level; the risk of amputation with an HbA1c level greater than 8.0 is approximately 35 percent higher than with an HbA1c level lower than 8.0.

It is also essential to obtain non-invasive vascular studies with ankle brachial index (ABI). The tolerances for Charcot limb salvage are ABI below 0.9 and greater than 1.4, which are typically regarded as significantly compromised vascularity, thereby indicating that the patient is not a candidate for limb salvage. Vascular consultation and CT angiogram with runoff may be needed to determine adequate vascularity because ABIs may not be obtainable in the diabetic patient with extensive atherosclerosis that renders the arteries incompressible.

Obesity and nutritional status

BMI of 30 or above, signifying obesity, is another factor that can negatively affect the outcome of Charcot limb salvage surgery. Patients with BMI greater than 45 are considered

ineligible for limb-salvage surgery and instead are counseled on weight loss and offered referral to a nutritionist and a bariatric surgeon.

Vitamin D level has emerged as an important factor influencing bone healing. Vitamin D level is obtained prior to any arthrodesis surgery in the foot and ankle, as well as Charcot limb-salvage procedures. Vitamin D level lower than 40 ng/mL should be supplemented with 50,000 units of ergocalciferol once a week for one month, whereas vitamin D level lower than 20 ng/mL should be supplemented with 50,000 units of ergocalciferol once a week for three months. Surgery should not be undertaken if a patient's vitamin D level is lower than 20 ng/mL, as a vitamin D deficiency poses

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QUALITY & RESEARCH

Shorter Intervals between Knee Arthroscopy and TKA May Increase Risk of Complications

REBECCA ARAUJO

► In a study of timing from knee arthroscopy to total knee arthroplasty (TKA), researchers found a relationship between surgery timing and risk of postoperative complications.

The findings were presented at the AAOS 2021 Annual Meeting by Safa C. Fassihi, MD. "In recent years, there has been ample research performed on modifiable risk factors that can be optimized prior to TKA to mitigate postoperative complications," Dr. Fassihi told AAOS Now.

Several studies have looked at the effects of preoperative corticosteroid or hyaluronic acid injections on subsequent revision risk for TKA, he added. "However, research on the effect of knee arthroscopy timing on subsequent TKA is sparse. While this topic has been examined previously, the time points chosen were typically arbitrary."

The investigators analyzed insurance data between 2006 and 2017 for patients who underwent TKA with or without previous knee arthroscopy.

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a notably higher risk of nonunion. If the patient's vitamin D level does not respond appropriately to supplementation, endocrinology consultation prior to surgery is indicated.

Smoking

A patient's smoking status must be considered prior to surgical intervention, as nicotine of any kind prevents bone healing and wound healing. Smoking cigarettes, in particular, compromises the microvascular circulation, specifically in diabetic patients with Charcot arthropathy in which the microvascular circulation is already significantly compromised. The patient must be counseled to quit all nicotine use, including cigarettes, cigars, Nicorette gum, nicotine patches, nicotine lozenges, and vaping with nicotine for at least 30 days before surgery and after surgery. Patients should be offered counseling, smoking-cessation classes, and medications such as varenicline (Chantix) or bupropion (Wellbutrin) as tobacco-cessation aids. They can then call the office when they have been nicotine-free for 30 days. If a nicotine blood test is negative, the patient can proceed to surgery. The patient should be instructed on the importance of refraining from nicotine use after surgery to allow for optimal bone healing.

Bone health

Prior to Charcot limb-salvage surgery, a CT scan of the affected extremity should be obtained for preoperative surgical planning, as well as to determine whether there is adequate bone stock to support limb-salvage surgery.

Due to poorer bone quality and arthrodesis of multiple joints, particularly

in the midfoot, "super-constructs" such as multiple plates or beaming screws have been used with success. However, patients and their family members should be counseled extensively on the risk of amputation. Even if surgery and postoperative care go according to plan, infection, wound-healing complications, and amputations are common after limb-salvage surgery, as these procedures are extensive in an already-compromised foot.

Wounds

The severity and location of open wounds and current infection status must also be considered. If open wounds will interfere with surgical implantation of hardware, have a large degree of necrosis, or are extensive in size, then amputation may be the treatment of choice. The skin conditions are never ideal and post-operative infections are also a consideration, even when fusions heal. Many times, these represent significant problems and require additional surgery to resolve the secondary infection (Fig. 2).

Social issues

Patient age and social issues such as access to family support or home health services should also be addressed pre-operatively.

The problem of Charcot neuroarthropathy is an increasing cause for alarm for orthopaedic surgeons and society at large. The underlying causes are often based on treatable diseases such as poorly controlled diabetes compounded by obesity, malnutrition, weak bones, smoking, and vascular compromise. In approaching these patients, it is important to unwind the puzzle



Fig. 2 Left foot Charcot neuroarthropathy, Schon midfoot Charcot arthropathy classification 2C, with a postoperative wound infection after midfoot fusion (A). Operative debridement for wound infection (B). COURTESY OF LANCE M. SILVERMAN, MD, FAAOS

associated with the present case and mitigate as many modifiable factors as possible (such as smoking and high HbA1c) to obtain the most successful outcomes. Naturally, patient compliance is the key to success—and the most difficult factor to influence. The next article in this series will discuss surgical options in these difficult-to-treat patients.

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and ankle specialist in private practice at Connecticut Orthopaedics, with an interest in complex foot and ankle deformity correction.

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Quick pearls for surgical decision-making

- **Diabetic control:** HbA1c <8.0
- **Circulation status:** ankle brachial index >0.9 and <1.4
- **Obesity:** BMI <45
- **Skin condition:** no chronic open wounds/ulcerations that will interfere with internal fixation
- **Smoking:** non-smoker
- **Bone quality:** adequate bone stock on CT

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2 percent but include failure of fixation with subsequent deformity, continued pain, musculocutaneous neuropathy, reflex sympathetic dystrophy (RSD), and infection.

Causalgia (RSD and complex regional pain syndrome) with injury to the musculocutaneous nerve is a risk with subpectoral tenodesis. Neuropathia during an open procedure may be due to retraction given the proximity to the brachial plexus. The senior author has reported one case of nerve entrapment secondary to an error in technique. The patient developed causalgia, most likely due to the short head of the biceps becoming entrapped within the tenodesed tendon. The

patient subsequently underwent a tenotomy and nerve decompression with resolution of symptoms.

A bone tunnel or bone window for fixation can be a stress riser, and torsional fractures can occur. Studies have demonstrated that less-than-ideal positioning (eccentric-lateral) of the bone window increases torsional stress on the humeral shaft, predisposing the patient to postoperative humeral shaft fracture. A recent review cited a 1.4 percent rate of postoperative humeral shaft fracture (Fig. 5, page 9).

Stiffness, over-tightening, and re-rupture after repair are additional complications of tenodesis. The senior author recounted one case of re-rupture

following a mechanical fall in a thin patient (BMI, 18). Implant failure occurred just below the subpectoral tenodesis site using an interference screw method. A revision with soft-tissue anchors yielded a good outcome. Low BMI, often associated with delayed healing and osteoporosis, and overtightening are risk factors in these types of cases. Studies have demonstrated that the most common site of failure is at the tendon-bone interface.

For biceps pain, patient selection, underlying pathology, and operative technique play a role in clinical outcomes. Although still controversial, the choice between tenotomy and tenodesis is coming into focus. Functional

outcomes vary with technique. When orthopaedic surgeons consider risks and expectations, they can improve patient satisfaction.

References for the information cited can be found in the online version of the article, available at www.aaosnow.org.

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