Superconstructs in the Treatment of Charcot Foot Deformity: Plantar Plating, Locked Plating, and Axial Screw Fixation

Article by VJ Sammarco. Foot Ankle Clin N Am. 2009;14:393-407.
Commentary by **John F. Grady, DPM**

CONDENSATION

Purpose of Study

To review the surgical treatment of Charcot neuroarthropathy in diabetic patients with an emphasis on plating and screw fixation techniques involving stabilizing areas beyond the affected joints

Review

The goal of both non-operative and operative treatment of Charcot neuroarthropathy is to achieve a stable, plantigrade functional foot that is free of ulcers and compatible with nonprescription footwear. Non-operative techniques include the use of total-contact cast immobilization until bony consolidation, followed by bracing and special shoes. Operative treatment has evolved from the simple resection of bony prominences in patients with gross deformity and ulceration to an earlier and more aggressive surgical intervention to restore alignment. Diabetic patients have delayed healing because of poor bone quality, neuropathy, poor vascularity, and impaired nutrition of glycosylated tissue. These factors must be considered when planning surgery.

Pre-operative Management

A pre-operative assessment is essential and should include all medical comorbidities such as diabetes and cardiac function. If a palpable pulse cannot be found, the patients should be sent for noninvasive vascular studies. Patients with inadequate vascular status who cannot be revascularized are not candidates for either reconstructive surgery or limb salvage. The presence of osteomyelitis requires the aggressive debridement of infected bone and treatment with organism-specific antibiotics. Both the arthrodesis and any internal fixation require a sterile field.

"Superconstructs"

Neuropathic midfoot disease is difficult to treat because of the dissolution of bone, dislocation, fragmentation, and osteoporosis and healing is delayed

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because of poor bone quality, neuropathy, poor vascularity, and impaired nutrition of glycosylated tissue. Many of these patients are overweight and inflexible and compliance with the non-weightbearing restriction needed to achieve arthrodesis may be poor. The term "superconstruct" is used to describe the use of larger and stronger fixation devices that "bridge" the area of poor bone and achieve fixation proximally and distally to the affected bone, even though motion in some normal joints is sacrificed. During the planning phase, the soft tissue envelope should be evaluated for tolerance and the superconstruct should be chosen to maximize strength and mechanical function.

Plantar Plating Techniques

Plantar plates can be used to span the area of Charcot dissolution. They can be fixed into cortical bone at the metatarsals and they can add compression to the fusion site. Although plates may not improve union rates in neuropathic feet, plates that are placed in a plantar location are more stable and can support greater loads than crossed screws. The plantar location means the plate is on the tension side of the fusion mass and is in tension during weightbearing.

Locked Plating

Locked plates should provide similar fixation to plantar plates and may significantly improve fixation in osteoporotic bone. Although locked plates may not necessitate as much plantar exposure when used, the sustentaculum tali of the calcaneus will interfere with any plate that must be placed across the talonavicular joint.

Axial Screw Fixation

Multiple long axial screws can be placed from the calcaneus or from the metatarsophalangeal joints and the arthrodesis sites can be compressed by tightening the screws. Use of axial screws eliminates stress risers in the cortical bone of the metatarsals seen after transcortical screws are used to secure plates. The use of screws requires smaller incisions than the use of plates and extensive stripping of bone is not needed. Since screw position is intraosseous, the chance for exposed hardware in cases of wound complications is reduced. Patients are at higher risk for complications if the fusion crosses the talonavicular joint.

Investigators' Observations

The management of Charcot deformity of the foot and ankle is complicated by medical comorbidity, peripheral neuropathy, vascular disease, and immune impairment. Early results indicate superconstructs can be used to extend the fusion site beyond the zone of bone deformity and resorption, but large clinical trials are needed to evaluate the techniques.

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COMMENTARY

The necessity of reconstructive procedures for Charcot foot deformity after conservative care has failed is inarguable today. The goal is achieving a stable, plantigrade functional foot that is free of ulcers and compatible with non-prescription footwear. It is well known and accepted in literature that diabetic patients have delayed healing and are at higher risk of complications than non-diabetics. For these and other reasons, history has not been kind with reconstruction of the Charcot foot until recently. It is important to understand numerous options when evaluating these reconstructive procedures. The author here takes on the question of whether it is better to consider superconstructs in the treatment of Charcot deformity, which he defines as those larger, and fixation devices that bridge the area of poor bone as well as achieve fixation proximally and distally to the affected bone or superiorly and inferiorly affected bone, even though motion in those joints that are unaffected is sacrificed.

This article is a literature review of currently available techniques and studies as well as a description of the options available in employing these procedures. This article also considers current technological improvements that lead to more successful outcomes. This article promotes extension of internal fixation beyond regions of injury to provide greater construct stability. Consistent with the need for improved construct stability, the author advocates using the device available that can be tolerated by the soft tissues. This can most commonly be interpreted as the thickest and most robust plate and screws that do not impinge surrounding soft tissue structures. The author believes that success with the treatment is a byproduct of enhanced construct stability and improved foot mechanics related to shortening the lever arm effect with surgery. As the author says, while larger clinical trials are lacking, early sources of these techniques are promising.