Distal Femoral Locking Plates for Tibiotalocalcaneal Fusions in Charcot Ankle

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Introduction
Charcot neuroarthropathy when left untreated can progress to combined deformity of the ankle and subtalar joints (Figures 1 and 2). The treatment goal in these cases is to produce a stable, plantigrade foot that is functionable. When this is not possible, as is the case with some patients with bilateral or severe Charcot’s arthropathy (Figure 3), the surgeon would have several options to consider, including amputation, total ankle arthroplasty, or ankle arthrodesis.

Surgical Technique
A linear incision was made adjacent to the course of the tendons. The operative field was then accessed and resected from the soft tissues (Figure 4). The oblique incision was then made on the plantar aspect of the foot and was temporarily fixated with a Steinman pin placed through the plantar aspect of the foot, crossing both joints (Figure 5). The distal fragment was then removed from the plantar foot (Figure 6). On the lateral aspect of the tibia, talus, and calcaneus, the circular fixator frame was than applied to the lower extremity with wires and half pins using standard technique and verified using imaging. All four patients underwent tibiotalocalcaneal arthrodesis using a distal femoral locking plate combined with external ring fixation for rigid axial compression. Follow-up was obtained up to 12 months. Frames were removed after approximately three months, after which patients began progressive weight bearing in a postoperative boot.

Methods
This is a retrospective chart and radiographic review of four patients with Charcot neuroarthropathy with associated ankle-valgus. All patients failed conservative treatments, including bracing and shoe gear modifications, and required surgical treatment. All four patients underwent tibiotalocalcaneal arthrodesis using a distal femoral locking plate combined with external ring fixation for rigid axial compression. Follow-up was obtained up to 12 months. Frames were removed after approximately three months, after which patients began progressive weight bearing in a postoperative boot.

Results
Three patients had a successful outcome with only minor complications. Two patients required blood transfusion following surgery, and one had mild pin tract infections which responded quickly to oral antibiotics. One patient had failure of the procedure with development of osteomyelitis and ultimately had a below knee amputation. On average, ccesaeous consolidation was appreciated in 77 days for those patients that had successful outcomes.

Discussion
Attaining rigid fixation in tibiotalocalcaneal arthrodesis can be difficult in patients with Charcot neuroarthropathy. Coide et al (2003) compared the biomechanical properties of blade-plates and intermedullary rod fixation for TTC arthrodesis, and found that the blade-plate was more rigid construct. In patients with Charcot neuroarthropathy, greater rigidity is ideal to maintain the correction through the arthrodesis.

The use of distal femoral locking plates for tibiotalocalcaneal arthrodesis is a viable rigid internal form of fixation. The locking plate technology allows for a stable construct in patients with questionable bone quality. In comparison to other forms of arthrodeses, it has a more rigid construct with better boney apposition. In summary, the use of distal femoral locking plates and external fixation is an acceptable option to create a plantigrade fusible foot as a limb salvage procedure in Charcot neuropathy patients.

<table>
<thead>
<tr>
<th>Patient #1</th>
<th>Patient #2</th>
<th>Patient #3</th>
<th>Patient #4</th>
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</thead>
<tbody>
<tr>
<td>Frame Removal (days)</td>
<td>70</td>
<td>71</td>
<td>83</td>
</tr>
<tr>
<td>Full Weight bearing (days)</td>
<td>82</td>
<td>121</td>
<td>152</td>
</tr>
<tr>
<td>Time to Return to Work (days)</td>
<td>82</td>
<td>89</td>
<td>none</td>
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<tr>
<td>Complications</td>
<td>Required blood transfusion</td>
<td>Satisfactory</td>
<td>Wound dehiscence, osteomyelitis</td>
</tr>
<tr>
<td>Outcome</td>
<td>Satisfactory</td>
<td></td>
<td>Failure</td>
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</table>

References

Outcomes
All four patients remained non-weightbearing for roughly three months in the external fixator. The fixation was then removed and patients remained non weightbearing for an additional two weeks. Patients began progressive weightbearing in a post-operative boot to full weightbearing for 3 additional months. Once radiographic consolidation was seen, patients were progressed to full weightbearing in a CROW walker or similar device.