

Distal Tibial Lengthening and Resultant Regenerate

Complication- A Case Study

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Statement of Purpose

To highlight the potential complications associated with distal tibial lengthening, we present a case of regenerate failure and subsequent malunion revision with bone graft to address symptomatic limb length discrepancy (LLD) as well as our recommendations for future complication prevention.

Introduction & Literature Review

It has been well accepted that a LLD greater than 2-2.5 cm is poorly tolerated (1). As little as 3 mm discrepancy has been shown to cause postural changes, leading to degenerative changes and adaptations of the kinetic chain (2). Deficient limb lengths not amenable to, or that have failed conservative management, may require surgical intervention. One manner in which to achieve this is distraction osteogenesis of one of the long bones in the lower extremity.

Studies have shown that lengthening over an intramedullary nail for proximal corticotomies may allow for earlier weightbearing and prevent regenerate fracture; however, this technique presents possible complications due to violation of the knee joint (i.e. increased knee joint pain and development of knee osteoarthritis). Furthermore, a future knee arthroplasty is more difficult for retained nail cases because there is not enough space for the tibial implant stem. For these reasons, distal tibial corticotomies for distraction osteogenesis have gained interest.

Unlike proximal tibial corticotomies for distraction osteogenesis, distal corticotomies are a relatively novel concept and there is paucity in the literature regarding standard protocol, efficacy and utilization of this technique.

Case Report

A 28-year-old female presented due to symptomatic limb length discrepancy of 19 mm (right greater than left) [Figure 1]. Past medical history included depression, anxiety, migraines and hypertension.

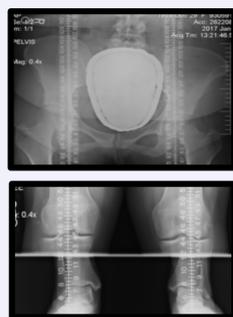


Figure 1. Preoperative radiographs of pelvis. Right pelvic length measures 4 mm longer than left. 2.1 cm right iliac tilt. Preoperative radiographs of ankles. Right ankle height is 5 mm higher than left. The right leg measures 1.2 cm longer than the left. Total leg length of femur and foreleg 16 mm greater on the right than left. Total leg length to include ankle height 19 mm greater on the right than the left.

Procedure

After failing conservative measures, she underwent a distal tibial corticotomy at the distal tibial meta-diaphyseal junction with distraction osteogenesis of the left lower extremity. She began lengthening at POD #8 at a distraction rate of 0.25 mm 4 x/day. After completing 20 days of lengthening, a 2 cm regenerate length was achieved [Figure 2].



Figure 2. AP and lateral ankle radiographs after 20 days lengthening demonstrating 2 cm of regenerate achieved

Consolidation

The consolidation phase was 11 weeks. Radiographs were taken, revealing consolidation about three cortices. Additionally, no edema was noted and the patient denied any pain to the surgical site. The external fixator was removed and the regenerate was stressed via intraoperative fluoroscopy, which was found to be stable. A bone stimulator was dispensed. The patient transitioned to a CAM boot and began to gradually increase weightbearing.

Complication

Four weeks after frame removal, patient endorsed increased pain and noticed gross deformity of her lower leg. Radiographs revealed a 14 degree distal recurvatum tibial deformity from anterior regenerate fracture [Figure 3]. The degree of deformity was not conducive to ambulation due to significant anterior tibiotalar impingement. It was decided to perform a tibial malunion revision with wedge bone graft and anterior tibial plate augmented with bone marrow aspirate.



Figure 3. 4 weeks post external fixator removal. Regenerate fracture anteriorly and approximately 14 degrees of tibial recurvatum noted.

Revision

After 10 weeks non-weightbearing, the patient began loading the left lower extremity. At 14 weeks post frame removal she transitioned to full weight-bearing in a CAM boot and at 16 weeks transitioned to full weightbearing in normal shoe gear. Final radiographs were taken [Figure 4].

Results

At the end of the treatment course, the malunion revision consolidated without incident and limb lengthening was achieved. The patient is now able to ambulate pain free without the use of DME. Her pre-operative hip and knee discomfort have also resolved.



Figure 4. 16 weeks post tibial malunion revision with wedge bone graft and anterior tibial plate augmented with bone marrow aspirate. Adequate bony callous and consolidation is noted.

Analysis & Discussion

There is no current accepted regimen for distal tibial lengthening for distraction osteogenesis to address limb length discrepancy. Our suggested protocol is noted in Table 1. Our experience indicates a latency period of 7-10 days with a distraction rate of 0.5-1.0 mm/day. Slower rates are recommended for: patients greater than 60 years old, those with metabolic comorbidities and/or vascular compromise and revisional cases. A bone stimulator should be used routinely during the consolidation phase in order to decrease regenerate healing time as recommended by Fredericks and colleagues [3].

We recommend a consolidation phase three times the amount of time needed for lengthening. In this case, the patient completed a week longer of consolidation than required. Some have advocated for CT scans to assess regenerate consolidation; however, we felt this was unnecessary as consolidation was evident at three cortices radiographically and clinically there was no edema or tenderness noted with palpation to regenerate site.

After the regenerate fracture occurred, a full metabolic bone profile was completed to ensure that no underlying causes for poor bone healing went unnoticed. Although the patient had no metabolic deficiencies, she still failed after protected weight-bearing in CAM boot for four weeks. There is no obvious explanation for this failure, which indicates how poorly regenerate bone understood. Preoperative counseling is crucial and patients undergoing this procedure must be made aware that revisional surgery may be necessary.

As a result of this case, it is our new recommendation that after frame removal, a patellar offloading brace should be utilized to prevent regenerate fracture, while still allowing for normal ambulation, axial loading, and dynamization through the regenerate site for four to six weeks. Patellar offloading braces allow for a more well-controlled loading protocol as compared to CAM boot.

In conclusion, distal tibial osteotomies for distraction osteogenesis is a novel and promising procedure; however, the possibility for complications exist, one being regenerate failure. This case has illustrated the need for modifications to our current treatment protocol, which may prevent regenerate failure in future cases.

Table 1: Distal Tibial Corticotomy for Distraction Osteogenesis Protocol

Obtain long leg radiographs to determine precise LLD

Order metabolic bone profile

- Bun, CA, Creatinine, Alk Phosphate, Potassium, SGPT, SGOT, TSH, PTH, Vit D
- Other: 24 hr urine calcium, DEXA Scan, bone biopsy

Perform corticotomy at tibial meta-diaphyseal junction

7-10 day latency period

Lengthen at 0.5-1.0 mm/day

- Slower speeds for: Patients >60 years of age, those with metabolic comorbidities and/or vascular compromise and revisional cases

Consolidation phase 3x duration of lengthening period

Augment with bone stimulator

Frame removal and intraoperative regenerate stress tests

Patellar offloading brace for 4-6 weeks

- Or until no clinical or radiological signs of residual healing are evident

References

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