Tibiocalcaneal fusion utilizing nanocrystalline hydroxyapatite/amorphous silica gel matrix (NanoBone® Bone Graft) with simultaneous limb lengthening

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Introduction

A 52 year-old male with past medical history of left extremity clubfoot deformity with combined limb length discrepancy presented with intractable leg pain with severe functional abnormalities and is considering lower limb amputation. Treatment plan involves a talectomy prior to tibiocalcaneal fusion with simultaneous lengthening of the isolateral tibia.

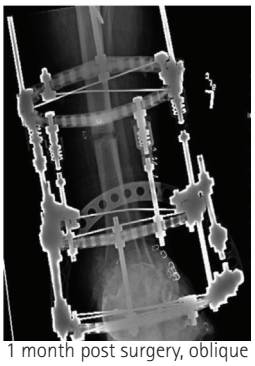
First Surgical Procedure

Surgical dissection to the lateral aspect of the ankle, where a 8 cm transverse curvilinear incision was made. A fibulectomy and talectomy were performed followed by articular curettage resection of the distal tibia, navicular and calcaneus to ensure adequate bone apposition and subchondral bleeding.[1] A 5.0 Steinmann pin was inserted from distal to proximal to secure alignment. Achilles and peroneal tenotomies were also performed. A tibial corticotomy was performed approximately 10 cm above the fusion site under fluoroscopy guidance. An Orthofix® TrueLok Circular static fixator with proximal Hexapod tibial block was utilized for limb stability and lengthening. 20 ml of NanoBone SBX Putty was placed into the fusion and lengthening site. The tibiocalcaneal fusion site was compressed acutely. The proximal tibial osteotomy was compressed for a total latency period of 12 days.

Post-Operative Course

The patient was admitted for postoperative pain management and rehabilitation. Following a brief postoperative hospital stay the patient was discharged and instructed to perform partial weight bearing no more than 20% axial loading to the affected limb assisted with a surgical walker. After a latency period of 12 days, lengthening began at a rate of 0.75 mm/day of distraction until the desired length was obtained. Pain management protocol consisted of oral Tramadol 50 mg tid, Gabapentin 100 mg tid and Tylenol 500 mg tid, taken as prescribed for 1st follow up.[2] Nutritional recommendations included: 60 grams of protein, less than 35 grams of sugar and a multivitamin each day.


1 month post surgery, AP


1 month post surgery, oblique


1 month post surgery, lateral

One month post-surgery, the patient is recovering well and has maintained 20% weight bearing. The circular fixator is stable with no motion in the ankle joint. The ankle is tender to palpation, approximately 2/10. Radiographs reveal increased bone mineralization at the tibiocalcaneal junction and tibial osteotomy.

Second Surgical Procedure

1 month following initial surgery, the patient was brought back to the OR for percutaneous injection of NanoBone SBX Putty mixed with 20 ml bone marrow aspirate concentrate (Magellan®; Isto Biologics) at the tibial osteotomy lengthening segment.

Three months post-surgery, the patient continues to make progress. Pain has decreased to 1/10. Weight bearing is continued as tolerated with surgical walker. Radiographs show increased graft incorporation compared to previous x-rays, with new bone and callus formation.

At the time of the circular fixator removal, the patient was placed in a compressive below knee brace. The patient is experiencing minimal pain with no range of motion in the ankle joint. Patient has since resumed normal activities.

6 months post-surgery

12 months post-surgery

Discussion

Autologous bone grafting is a popular treatment option as it contains osteoconductive and osteogenic properties.[3] However, associated complications arise, especially when harvesting from the iliac crest.[4]

Nanobone is a synthetic nanocrystalline hydroxyapatite impregnated into a porous silica gel matrix.[5] The nanocrystalline hydroxyapatite shares biological properties with the hydroxyapatite in human bone and binds autologous proteins.[6] These autologous proteins give Nanobone its osteoinductive properties. Additionally, the silica gel matrix lays down an osteogenic matrix, the second property of bone grafts, while also releasing SiO_2, stimulating angiogenesis during the bone healing process.

Our case study shows that a single or double application of Nanobone was effective in stimulating bone mineralization. When compared to allograft materials, Nanobone's ability to lay down a biological scaffold quickly with fewer applications results in less cost and time in the operating room. Therefore we believe Nanobone can be a valuable tool in complex bone lengthening and fusion cases.

References available upon request.

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