

# Using Nanotechnology as Stand-Alone Bone Grafting in Open Fracture Bone Defects and Nonunions



SONORAN ORTHOPAEDIC  
TRAUMA SURGEONS

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## Purpose

Review outcomes and complications of open fracture defects and nonunions treated with nanotechnology derived, stand-alone synthetic bone graft

## Methods

Retrospective review of open fracture defects and nonunions treated with the addition of a novel, advanced bone grafting material that utilizes nanocrystalline particles of hydroxyapatite (HA) that resemble the size, chemistry, and morphology of human HA particles. The HA particles are contained within an amorphous silica gel matrix. The matrix is highly nanoporous, hydrophilic and releases Silicon dioxide which triggers angiogenesis and initial bone formation. The synthetic bone grafting material is Nanobone (Artoss, Inc, Germany and USA). It was used in cases between 2017-2019 by a single surgeon at a Level 1 trauma center. The preoperative and postoperating imaging was reviewed by a fellowship-trained orthopaedic traumatologist. Patients were treated by a single surgeon using standard bone grafting techniques while utilizing the synthetic product in open fractures with bone defects and radiographically defined nonunions.

## Results

Seventeen patients underwent the application of the synthetic nano crystalline HA particles. 9 patients with open fracture defects and 8 patients with nonunions. 7/9 (78%) of the open fracture defects were within the tibia, 1/9 (11%) was within the radius, and 1/9 (11%) was within the distal humerus. The nonunions included 3/8 distal femur (38%), 4/8 tibia (50%), and 1/8 calcaneus (12%).



Figure 1a-f. Radiographs showing 21-year-old male with Type 3B open tibia; a-b injury x-rays, c-d postop x-rays at six weeks with bone defect, e-f six weeks after using Nanobone at six weeks post-op from original injury

The average age was 37 years (range 22 to 83 years). Patients were observed for an average of 13 weeks postoperatively (ranging 8 weeks to 26 months). There were no patients lost to follow-up. Union was observed in 9/9 (100%) of the open fracture defects and 8/8 of the nonunions. The average time to union was 7.5 weeks (ranging 6 to 12 weeks) when including open fracture defects and nonunions. There were no intraoperative or late complications. Early post-operative complications included a superficial infection of the radius open fracture that required oral antibiotics with resolve.

**Union rate:** 100% (9/9 fracture, 8/8 nonunions)

**Average Time to Union:** 7.5 weeks

**Complications requiring additional surgery:** 0

## Conclusion

Using Nanotechnology with nanocrystalline HA particles that are contained in a silica gel matrix is a successful treatment as stand-alone bone grafting in both open fracture defects and nonunions. Our preliminary data shows evidence of low complication rates, high union rates, and early healing. Our data suggests that using nano crystalline HA particles may be an alternative to other methods of autologous bone grafting, allografting, and/or synthetic bone grafting. Although we did not quantify the bone density healing, our clinical series show more subjective bony consolidation at much earlier stages of healing when compared to our previous gold standard when using autologous bone grafting. With our results, we have switched from using autologous bone grafting to mainly using the nanocrystalline HA particles, as we believe the preliminary findings show high and early healing rates with the reduction of risks and comorbidities associated with autologous bone graft. Nanobone® is an FDA Approved device, no financial support for study.