Novel, vacuum-assisted method for harvesting autogenous cancellous bone graft and bone marrow from the proximal tibial metaphysis.

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Introduction

Autogenous cancellous bone graft and bone marrow aspirate are commonly used in lower extremity foot and ankle surgery. Autologous bone graft is considered the gold standard for fusion procedures as it is osteogenic, osteoinductive, and osteoconductive. Further, autologous graft is without the potential risks of allograft-associated infection and immunologic reaction[1].

Disadvantages include graft harvest time and donor site morbidity due to the surgical incision, approach and bone corticotomy. Traditionally, autologous bone has been harvested from the anterior iliac crest; however, there are a number of disadvantages to using this site during foot and ankle procedures. There are high rates of complications from anterior iliac crest bone graft including nerve injury, hematoma formation, and postoperative pain[2]. In addition, obtaining anterior iliac crest graft requires the preparation of a second surgical field.

The proximal tibia has been shown to be viable alternative donor site with easy access, the ability to provide sufficient graft volume[3] and low associated complication rates[4].

This study evaluated the safety and efficacy of a novel vacuum-assisted bone graft harvesting device. This device was able to obtain both cancellous bone and bone marrow for insertion into arthrodesis sites of patients undergoing complex primary and revision lower extremity arthrodesis procedures.

Materials and Methods

Between March and November 2017, nine patients underwent a foot and/or ankle complex primary or revision arthrodesis procedure at a single tertiary academic center.

One patient underwent a lapidus arthrodesis, one patient underwent a revision tibiotalar arthrodesis, one patient underwent a primary tibiotalar arthrodesis, one patient underwent a revision arthrodesis for a calcaneal malunion, one patient underwent a revision arthrodesis of a talonavicular nonunion, one patient underwent a primary subtalar arthrodesis, two patients underwent tibio-talar-calcaneal arthrodesis and one patient underwent revision arthrodesis for subtalar nonunion.

During these procedures, autogenous cancellous graft and bone marrow were harvested from the ipsilateral proximal tibia. All patients were 18 years or older with no prior history of knee pain, knee injury, or surgery at the proximal tibia.

A 2 centimeter vertical skin incision was made over the anterior proximal tibia (Figure 1) and blunt dissection was carried down to the periosteum. A circular corticotomy was performed through the anterior cortex of the proximal tibia. Subsequently, cancellous bone was harvested using a novel suction-powered, hand-driven bone curettage system (Avitus Orthopaedics, Farmington, CT) (Figures 2A and 3). The donor site was backfilled with bone graft substitute (Figure 4B). Incision length was recorded as well as surgical time from donor site incision to completion of graft acquisition. The volume of cancellous graft and bone marrow were recorded separately. All patients were non-weight bearing on the involved extremity for a minimum of 6 weeks post-operatively and all were evaluated at 2 and 6 weeks post-operatively for donor site pain and associated complications.

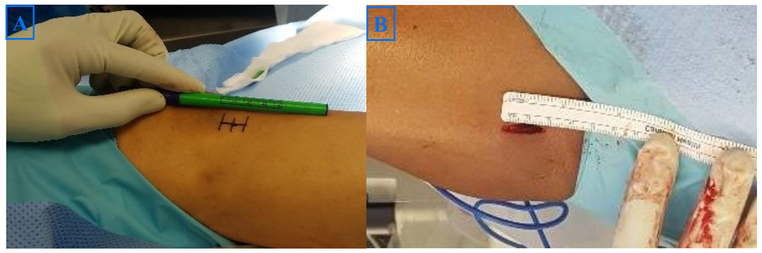

Figure 1. A) Two centimeter incision site marked over the anterior proximal tibia. B) Incision made sharply through skin and dissection carried bluntly through subcutaneous tissue to periosteum.

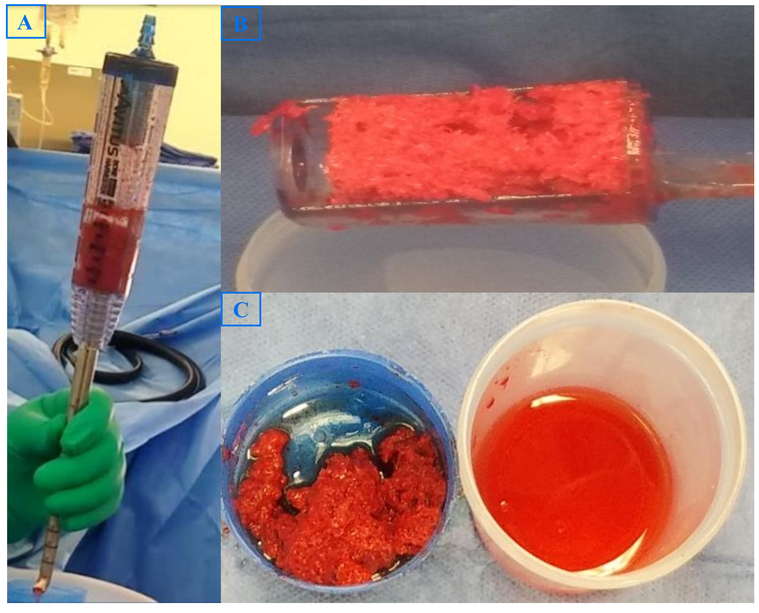

Figure 2. A) Suction-powered, hand-driven bone harvesting device. B) Filter insert retrieving cancellous bone graft. C) Collected autologous bone graft (left) and bone marrow aspirate (right).

Figure 3. Intraoperative fluoroscopic images demonstrating the curved, beveled tip of the bone aspirator in the metaphysis of the proximal tibia.

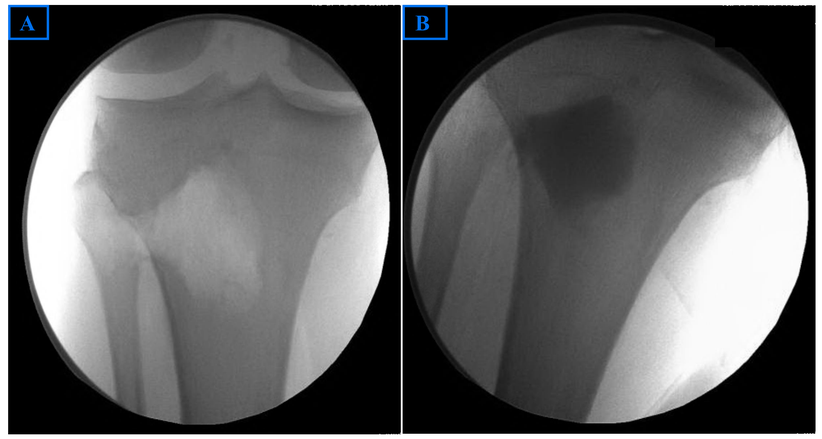

Figure 4. A) AP radiograph of the proximal tibia post-bone graft harvest. B) Radiograph of the proximal tibia bone graft harvest site backfilled with bone substitute.

Results

The series included a total of nine patients, five male and four female, with an average age of 51 years and 8 months (range 29 to 71 years). Procedures included six complex primary fusions and three revision tibiotalar, talonavicular or subtalar fusions for nonunion or malunion.

Mean incision length was 2 cm (range 1.80-2.75 cm). Mean volume of obtained graft material included 25 cm^3 of cancellous bone (range 9-30 cm^3) and 21 cm^3 of bone marrow aspirate (range 10-40 cm^3) (Figure 2C). Mean procedure time was 5 minutes (range 4-8 minutes). Average blood loss was 2 mL. Two patients had mild pain at 2 week follow-up; however, no patients reported donor site pain at 6 week follow-up. There were no major or minor complications such as fracture, infection, hematoma formation, sensory changes, or wound healing issues at 6 week follow-up.

Conclusion

The use of an innovative, vacuum-assisted bone harvesting device allows large volumes of autogenous cancellous bone graft and marrow to be rapidly and readily obtained from the ipsilateral proximal tibia with minimal donor site morbidity.

References

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