The Journal of Foot & Ankle Surgery 54 (2015) 254–257

Contents lists available at ScienceDirect

The Journal of Foot & Ankle Surgery

journal homepage: www.jfas.org

Use of a Spinal Cage for Creating Stable Constructs in Ankle and Subtalar Fusion

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A R T I C L E   I N F O

Level of Clinical Evidence: 4

Keywords:
bone grafting
compression distraction
hindfoot fusion
nonunion

A B S T R A C T

In complicated foot surgery with reconstruction of the hindfoot, a gap will sometimes be present between the bones that must be filled and stabilized. Bone grafting with structural bone graft is 1 alternative; however, it can collapse and must be stabilized with screws or a nail. A locking intramedullary nail can be used but could lead to nonunion owing to distraction. Newer nails include a compression device but that can result in shortening. We developed a technique that includes distraction of the fusion area with a spinal cage and then compression of the construct by inserting a compression screw through the cage. We present our experience with this technique.We reviewed the data from 7 patients who had undergone surgery using this technique. The technique included distraction of the fusion area and insertion of a titanium cylindrical spinal cage filled with autologous cancellous bone graft. A cannulated compression screw was then inserted through the cage, creating compression of the fusion area against the cage and achieving stabilization of the fusion area. Postoperatively, a non-weightbearing cast was applied for 3 months, followed by a full weightbearing cast until radiographic fusion was apparent. Complete radiographic union was observed in all 7 patients within 6 to 12 months postoperatively. At the latest follow-up visit, the mean American Orthopaedic Foot and Ankle Society scale score was 54 ± 16 (range 30 to 71) points. The use of a cylindrical titanium cage with a local bone graft and stabilization by distraction and compression provided a stable construct, avoided shortening, and led to good fusion. In addition, donor site complications and unpredictable strength loss and lysis of bone allograft were avoided.

Fusion procedures of the foot and ankle articulations have been traditionally performed to address situations such as Charcot deformities, paralytic disorders, and complex residual clubfoot deformities and as the ultimate surgical solution for severe post-traumatic arthritis (1,2) or end-stage inflammatory arthropathy (3,4). Loosening of a total ankle prosthesis is another indication in recent years (4–6). Although these interventions are aimed at obtaining a plantigrade foot, reducing pain, and improving the ambulatory function, they can be associated with variable limitations. When fusion is planned as a salvage procedure to address failed ankle prosthesis, the presence of limited talar and tibial bone stock, segmental shortening after prosthesis removal, difficulty in stabilizing the fusion, and the occasional need for a massive bone graft can all pose substantial technical challenges (7,8). In the subtalar joint, lag screws can be used for both compressing and stabilizing the construct, with good outcomes occasionally (9). However, when the bone stock is inadequate at the area of desired fusion, stabilizing the hindfoot will be less predictable, and the risk of nonunion with subsequent malalignment will increase (10). To address these challenges, several alternatives have been described with the aim of obtaining stable fusion and a well-aligned foot. These have included the use of a spherical femoral head allograft (11,12), poly ether ether ketone filled with cancellous bone from the fusion site (13), and structural autogenous bone graft struts harvested from the iliac crest (9–11,14–17) or fibula (6). A locking intramedullary nail has also been suggested to obtain fusion during hindfoot reconstruction, although nonunion can result from distraction forces between the fragments (5,18–20). Compression nails have been suggested to overcome the drawback of nonunion resulting from distraction; however, in such cases, shortening and, consequently, deformity can result (3,7).

The objective of the present study was to present a technique that uses a spinal cage (21) to obtain a stable, well-aligned ankle and hindfoot fusion and to provide our clinical outcomes of a series of

Financial Disclosure: None reported.
Conflict of Interest: None reported.
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1067-2516/$ - see front matter
http://dx.doi.org/10.1053/j.jfas.2014.12.010

patients who had undergone this procedure. We hypothesized that with the use of the cage and compression screws, a stable construct could be obtained, resulting in well-aligned fusion and good outcomes at the final follow-up visit.

Surgical Technique

The indications to perform the procedure were as follows:

1. End-stage arthritic changes at the ankle or hindfoot joint with daily pain despite nonoperative measures (i.e., intra-articular injections, shoe wear modifications)
2. Mechanical support with bone graft struts was needed to create a stable construct
3. Substantial deformity mandating alignment correction

The surgical steps were as follows. First, the fusion site was prepared with all cartilaginous and fibrous tissue between the articulating parts at the area of desired fusion thoroughly debrided to a bleeding bone. Second, the spinal cage device (titanium mesh spinal cage) (22) was packed with morselized cancellous bone autograft from the operative site. In cases in which not enough bone is available, more cancellous bone can be obtained from the proximal tibia metaphysis or from the calcaneal body (Fig. 1). Third, a laminar spreader was used to distract the adjacent sides of the desired area of fusion and prepare an adequate void for cage insertion (Fig. 2). Fourth, the bone graft-packed cage was inserted into the prepared fusion area, maintaining the distraction and joint alignment (Fig. 3). Fifth, the titanium screws were inserted to create compression of the fusion site against the cage device. Next, the hardware location and joint alignment were confirmed using an image intensifier (Fig. 4). Finally, the operative wounds were closed. A short leg non-weightbearing cast was applied with for 12 weeks until fusion was observed on the follow-up radiographs (Fig. 5). If fusion was not complete (i.e., 3 to 4 solid cortices on 2 radiographic views), a full weightbearing cast was continued until fusion had been achieved.

Patients and Methods

A review was performed to identify those patients who had undergone this fusion technique at our department from January 2002 to December 2009. The data retrieved from the patients' medical records included age at surgery, sex, medical background, preoperative diagnosis, area of fusion, and postoperative complications. The American Orthopaedic Foot and Ankle Society (AOFAS) score (23) was completed at the latest follow-up visit. The criteria for union included 3 to 4 solid cortices observed on 2 radiographic views. The institutional review board approved the present study.

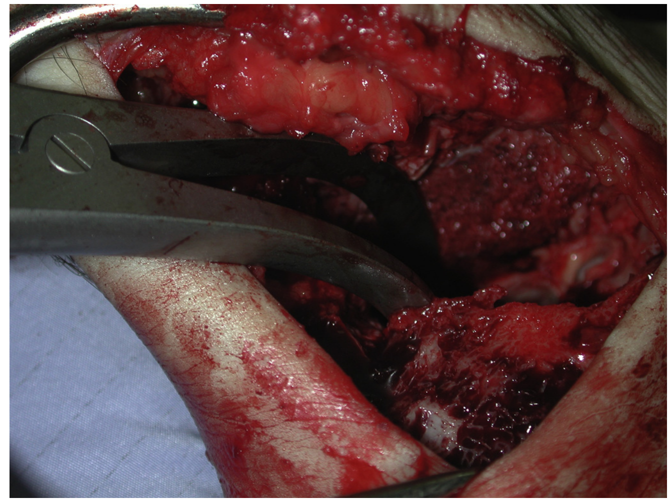

Fig. 2. Distraction produced by laminar spreader.

Results

The present study included 5 males and 2 females (Table). The median patient age at surgery was 55 (range 31 to 83) years. The median follow-up period was 5 (range 1 to 7) years. Two patients had systemic illnesses not associated with their arthritic disease. One had diabetes mellitus, and one had ischemic heart disease, chronic obstructive pulmonary disease, and liver cirrhosis. The latter patient had died 1 year postoperatively of complications related to his systemic illnesses. The postoperative complications included 1 case of tarsal tunnel syndrome that was decompressed surgically with symptom resolution and 1 case of deep operative wound infection in the 83-year-old male with chronic obstructive pulmonary disease, ischemic heart disease, and liver cirrhosis that resolved with antibiotics. Complete radiographic union was observed in all 7 patients

Fig. 1. Titanium spinal cage packed with bone graft.

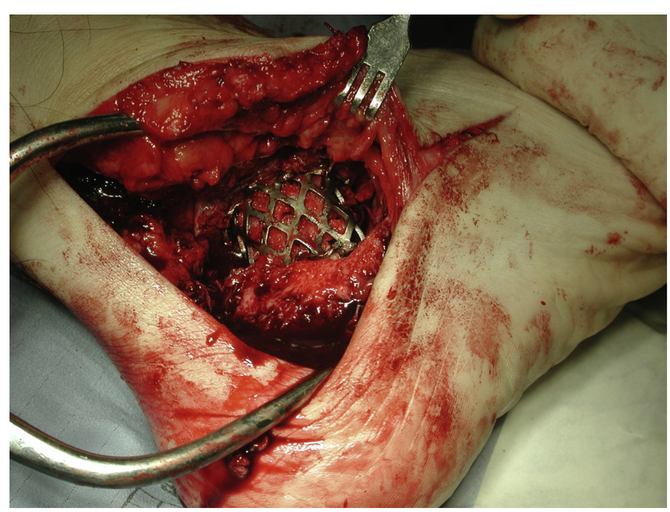

Fig. 3. Insertion of the cage.