Triquetral autograft for distal radius lunate fossa reconstruction.

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Introduction

Distal radius fractures are one of the most common orthopaedic injuries, accounting for approximately 12 – 17% of all fractures [1,2].Fractures can range from simple patterns such as extra-articular nondisplaced to highly comminuted displaced intra-articular fractures depending on the energy sustained at the site of injury, or the susceptibility to injury such as is seen in individuals with osteoporosis. Treatment options can range from casting to percutaneous fixation with k-wires to volar and dorsal fragment specific fixation, dorsal bridge plating and external fixation or combination thereof [3]. Intra-articular distal radius fractures that heal with articular step-off or gapping have been shown to have worse outcomes and result in arthritis [4,5]. Additionally, there may be cartilage loss of the distal radius, rendering the carpal fossa arthritic immediately at the time of the injury.

We present a case of a patient with a highly comminuted intra-articular displaced distal radius fracture with an unrepairable lunate fossa secondary to cartilage loss that was reconstructed with triquetral autograft.

Materials and Methods

The patient is a 67 year-old left-hand dominant female who initially presented after suffering a fall down one flight of stairs. Initial examination and X-rays demonstrated open highly comminuted fractures of the distal radius and ulna, ipsilateral nondisplaced trans-scaphoid waist fracture perilunate dislocation and closed ipsilateral intra-articular distal humerus fracture. She underwent debridement of the open fracture with closed reduction and external fixation of the distal radius and ulna, followed by open repair of the perilunate dislocation, carpal tunnel release and acute bone allografting to the distal radius to restore bone stock to the metaphyseal defect. The patient returned to the OR six days after presentation and underwent surgical fixation of the distal humerus fracture. The patient was followed over the next few months and failed union of the distal radius metaphysis and malunion of the distal radius articular surface were observed. The patient was recommended for repair of nonunion and osteotomies of the malunited articular surface and ORIF. A tagged white blood cell bone scan and infection labs were negative. The patient sought a second opinion from an outside institution for her wrist injuries and was offered total wrist arthrodesis with repair of the nonunion were recommended. However, she adamantly opposed having the arthrodesis and our Orthopedic Hand Surgery service was consulted for evaluation of reconstructive options that might accommodate her goal of returning to as many activities as possible, including yoga and playing with her grandchildren. Following a discussion of reconstructive options, she elected bone marrow aspirate concentrate for bone grafting of the nonunion over alternative tricortical iliac crest autograft (Figure 1).

Five months after the initial injury, the patient was taken back for definitive reconstruction of the distal radius articular surface and repair of the distal radius nonunion. Bone marrow aspirate was obtained from the iliac crest. The external fixator and k-wires were removed and a dorsal approach to the wrist was utilized. Upon dissection to the extensor retinaculum, a significant amount of callus was noted around the extensor tendons. The first through fourth dorsal compartments were elevated and the callus excised. The posterior interosseous nerve was noted to be intact, and subsequently underwent neurectomy to relieve postoperative pain. The proximal scaphoid had healed as an arthrodesis to the lunate from the pinning of the perilunate dislocation, but the scaphoid was still noted to have incomplete healing of the fracture. A headless compression screw was placed into the scaphoid for definitive fixation. There was a nonunion at the distal metaphysis of the radius secondary to incarcerated periosteum. This was removed, debrided, and sent for culture and biopsy. Preliminary results intra-operatively were negative for bacteria, and ultimately, cultures and pathology were negative for infection. At the lunate fossa, there was a large defect of bone. The defect was debrided of any fibrinous callus and tissue. The triquetrum was harvested and the cortical contact sides were cut to good bone using a microsagittal saw to allow for healing and integration. The triquetrum filled the void well and without articular step-off. It was temporarily held with a K-wire. A fibular cortical allograft was cut to size at the distal metaphysis nonunion site and placed with the concentrated bone marrow aspirate. A volar variable angle distal radius plate, contoured to fit the dorsal surface of the distal radius, and screws were then placed to hold the final construct. The wrist capsule was closed followed by extensor retinaculum in a lengthened fashion. The skin was then closed using nylon sutures (Figure 2).

9 months postoperatively, patient had occasional soreness at the wrist of about 1/10 on the visual analogue scale but otherwise reported that she was doing well and happy to be able to be able to perform activities of daily living well. On physical exam, her distal radius was non-tender and range of motion and strength were relatively good (Table 1 - 2).

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Discussion

Distal radius fractures remain one of the most common orthopaedic injuries, both in the younger and older populations. The aging population is remaining active as there is a drive for more weight bearing activities to stay healthy and combat age related osteopenia and osteoporosis. However, some activities predispose individuals to a risk of injury. (Figure 3). In the event of a high energy traumatic injury or relative high energy injury in an osteoporotic patient, the distal radius can sustain significant injury with high comminution and displacement. This includes any articulating surfaces with resultant step-offs and gaps as well as denuding of articular cartilage, which may lead to arthritis and the potential for pain and disability.

In osteopenic and osteoporotic bone, there is already a diminished amount of bone. The cancellous bone undergoes compression during the course of injury, amplifying the amount of bone loss present. In addition, areas of bone void may result from debridement of contaminated or devitalized bone. Many distal radius fractures undergoing surgical treatment are therefore supplemented with bone allograft, either as cortical or cancellous chips or demineralized matrix paste. These aid to account for these areas of bone loss and to provide some structural support. There are no real options for reconstruction of the distal radius articular surface other than a limited radiocarpal arthrodesis, total wrist arthrodesis, and total wrist arthroplasty (Figure 4).

In regards to reconstructing the distal radius articular surface, there has been a case report utilizing a triquetral autograft for the reconstruction of the lunate fossa in Kienbock's disease combined with a proximal row carpectomy. Additionally, there is a case report in the setting of a traumatic comminuted distal radius fracture secondary to a gunshot injury with the use of triquetral autograft to supplement the loss of the lunate fossa combined with an midcarpal arthrodesis [6,7]. The triquetrum has been noted to have several similar surface dimensions to the lunate, which support its use for reconstructing the distal radius articular lunate fossa [8]. Here we present a case of a previously active older individual who sustained a highly comminuted displaced distal radius fracture, who underwent lunate fossa reconstruction with triquetral autograft while retaining the rest of the proximal carpal row of the scaphoid and lunate (Figure 5). The patient continued to make gains of wrist range of motion and strength at her most recent follow up of 9 months (Table 1 - 2). The patient went on to heal and has returned to a more active lifestyle.

Figure 1. *X-rays of initial presentation prior to treatment.*

Figure 2. *X-rays after external fixation of the distal radius and ulna with pin fixation of the lunate dislocation.*

Table 1: *Range of motion 9 months postoperatively.*

	Left (Affected)	Right (Dominant)
Wrist Flexion	45	75
Wrist Extension	32	75
Radial Deviation	2	25
Ulnar Deviation	28	45
Wrist Pronation	85	85
Wrist Supination	64	85

Table 2: *Strength 9 months postoperatively.*

Muscle Strength	Left (Affected)	Right (Dominant)	% Deficit
Grip at #2	19 lbs	60 lbs	68%
2 point Pinch	3 lbs	10 lbs	70%
3 point Pinch	4 lbs	13 lbs	69%
Lateral Pinch	10 lbs	12 lbs	17%

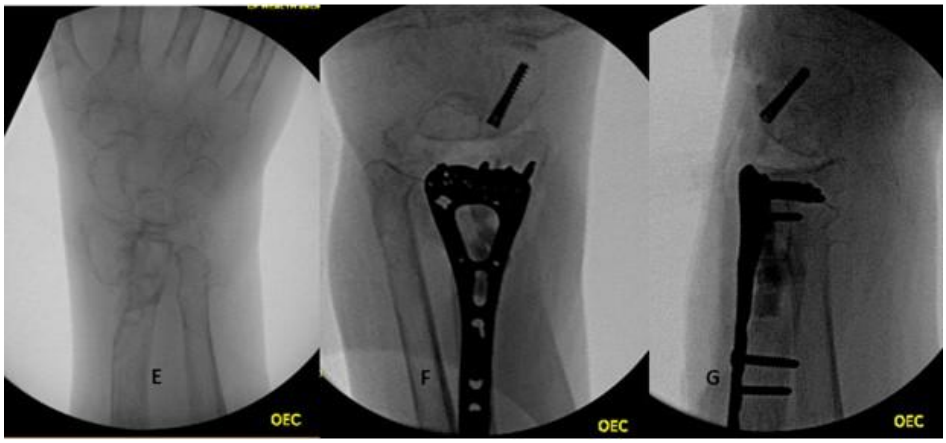

Figure 3. *Intra-operative fluoroscopic images after repair of nonunion and bone grafting of the distal radius and scaphoid.*

Figure 4. *X-rays 9 months postoperatively.*

Figure 5. *Clinical presentation 9 months postoperatively.*

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Conflict of Interest

The author(s) certify that there is no conflict(s) of interest to declare.

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