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Partial allograft replacement of the radial head in the management of complex fracture-dislocations of the elbow

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Background: There have been reports of total radial head allografts showing variable outcomes. This case series reports the novel use of an allograft for partial radial head replacement in the treatment of elbow fracture-dislocation.

Methods: Eight patients underwent partial radial head allograft reconstruction to restore stability for complex fracture-dislocations involving fractures of the coronoid and radial head, with collateral ligament disruption. Two patients were treated acutely. Six were referred from other centers 2 to 48 weeks after injury following failure of primary treatment. In each case, it was not possible to perform stable open reduction—internal reduction of the radial head fracture, or the fracture fragment had already been excised. A fresh-frozen partial radial head allograft was used to replace the defect and restore the joint surface. The coronoid fracture and injury to collateral ligaments were also managed surgically. Patient charts, surgical records, and radiographs were reviewed. Patients were contacted at a mean of 79 months after treatment to answer questions to determine the Mayo Elbow Performance Score and the score on the shortened version of the Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire.

Results: Clinical and radiologic reviews confirmed union of graft in all cases. None resorbed or collapsed. Three patients had resorption of the coronoid fragment resulting in poor outcomes, with one patient ultimately undergoing total elbow arthroplasty.

Conclusion: Partial radial head allograft may be a useful alternative to radial head prosthesis in unstable fracture-dislocations in which the radial head cannot be restored fully.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Partial allograft replacement; radial head; complex fracture-dislocation; radial head allograft

Allografts are widely used for reconstructive procedures around the hip and the knee. Their use around the elbow so far has been limited.[16,31,32]

The management of fracture-dislocations of the elbow has been disappointing at times. This is especially true in the management of what has been termed the ''terrible-triad'' injury: an elbow dislocation associated with fractures

The Mayo Clinic Institutional Review Board approved this project under the protocol entitled ''Short Term Follow-up of Allograft Radial Head Replacements for the Treatment of Unreconstructable Radial Head Fractures'' (protocol No. 201-05).

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of the coronoid and radial head.[13,14,25] The coronoid and elbow ligaments are primary constraints, and although the radial head is a secondary constraint, it takes on a critical role when the structural integrity of the coronoid and/or ligaments has been compromised.[12,24] In many fracture-dislocations, the radial head fracture may be too comminuted to fix, or portions may have already been excised. In chronic cases, the displaced radial head fragments may be soft and/or deficient because of resorption. These injuries are among the most difficult to treat in the elbow, with recurrent dislocation and subluxation being commonplace. Ring et al[29] reported an unsatisfactory outcome in over 60% of terrible-triad injuries. Papandrea et al[26] showed that persistent instability predisposes patients to early arthritis following these injuries.

For fracture-dislocations, the goal of treatment is to restore all of the osseous and articular components that contribute to elbow stability. This will convert a complex fracture-dislocation into a simple dislocation (ie, a ligamentous injury only).[6,28] Achieving a stable, concentric reduction allows early mobilization, which is of paramount importance to avoid stiffness.[21] The recommended option reported in the literature for restoring stability in an unfixable fracture involving part of the radial head is radial head replacement with a prosthesis.[4-6,8,11-13,15,19,23]

In general, it is preferable to preserve the radial head when possible.[24] Whole radial head allografts have been used to replace the entire radial head with variable results.[16,31] The rationale for use of a partial radial head allograft is that the intact portion of the radial head provides a stable and correctly oriented base to which the allograft can be fixed. The allograft will therefore also be stable and properly oriented. The purpose of this study was to report on the technique and midterm results of fresh-frozen partial radial head allografts for the reconstruction of a deficient radial head in the management of complex fracture-dislocations of the elbow involving compromise of the coronoid, radial head, and collateral ligaments.

Materials and methods

After institutional review board approval was obtained, computerized records were searched to identify all elbow fracture-dislocations that had been treated in our clinic using a fresh-frozen partial radial head allograft. From September 1997 to December 2002, 9 patients, 1 of whom was lost to follow-up, underwent reconstructions of their radial heads with partial fresh-frozen allograft replacement (by the senior author [S.O.D.]).

The medical record was reviewed in detail for demographic data and for preoperative, intraoperative, and postoperative information. When possible, a recent follow-up examination was conducted in our clinic (n = 4). Nonlocal patients were contacted by phone or mail, completed a survey, underwent radiographic examination locally, and sent the films to us for review (n = 4). Objective assessment was achieved by use of the Mayo Elbow Performance Score (MEPS) and the score on the shortened version of the Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire.[1] Subjective outcome was assessed by defining the patient's satisfaction with the outcome. Radiographs were examined for subluxation or dislocation of the ulnohumeral joint and graded with regard to arthritis as none (0), mild (grade 1), moderate (grade 2), or severe (grade 3).[3] An assessment was made of the incorporation of the radial head allograft radiographically in all patients and by computed tomography in 2.

Demographics

Nine patients underwent a partial radial head allograft replacement. Of these patients, 1 was lost to follow-up, leaving 8 (6 men and 2 women, aged 32-65 years). Six patients with persistent instability were referred to our institution from other centers at 2 to 48 weeks after surgical attempts (5 patients) or closed reduction (1 patient) had failed to manage the instability. The 2 local patients underwent surgery acutely.

Three of the six patients referred from other centers were referred to our unit 8 or more weeks after injury. They had all previously undergone surgery, and the radial head fragment had been excised. Two were having problems with pain, instability, and contracture. The patient referred 8 weeks after injury had undergone a lateral collateral ligament repair and excision of bone fragments, but persistent subluxation developed.

Treatment strategy

For cases of fracture-dislocation, the treatment strategy was to restore stability so that rehabilitation would make possible a functional range of motion. This involved 3 essential components: (1) restoration of the integrity of the ulnohumeral joint, which required open reduction or reconstruction of the coronoid; (2) reconstruction of the radiohumeral joint; and (3) early active and passive range of motion as soon as possible, which in some cases was protected by a hinged external fixator. In the 6 cases performed within 2 months of injury, the lateral collateral ligament was repaired primarily. A semitendinosus tendon graft (autograft in 1 and allograft in 1) was used for lateral collateral ligament reconstruction in 2 chronic cases performed more than 6 months after injury.

In cases of chronic radial head deficiency, preoperative planning consisted of measuring the size of the fractured radial head or of the opposite, nonfractured radial head. A comparable sized radial head allograft was obtained for use in the reconstruction. In acute cases, these preoperative radial head size measurements were not done because the consideration of an allograft was first made intraoperatively. (Our hospital's bone bank has sufficient resources to permit this.)

The radial head was exposed through the interval created by splitting the extensor digitorum communis. If the coronoid required reconstruction or fixation of its anteromedial facet, an additional incision was made on the medial side, elevating part or all of the flexor-pronator mass. After mobilization of the ulnar nerve for anterior transposition, the coronoid was fixed with threaded K-wires and a precontoured plate or by multiple screws. In 1 patient, in whom the coronoid was absent because of prior fragment excision, the coronoid was reconstructed with the remaining portion of the radial head allograft by a technique that has been previously described by van Riet et al.[32]