Seminars in
Arthroplasty

The Delta Experience . . . "Does It Fly"?

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Cuff tear arthropathy remains a challenging clinical problem, quite debilitating for the patient and a significant management challenge for the shoulder surgeon. Recent reports have suggested early success in using a reverse shoulder prosthesis to provide longitudinal stability while utilizing the power of an intact deltoid muscle to restore motion and function and alleviate pain in shoulders with cuff tear arthropathy. Concerns remain however regarding the longevity of these prostheses, given the disappointing history of previous attempts at constrained or semiconstrained devices and the biomechanical forces generated through the glenoid neck by the prosthetic design. Experience in 12 cases using the reverse "Delta" prosthesis for failed primary surgery in cuff tear arthropathy is reported. Short-term results in 12 patients have demonstrated satisfactory outcomes as a salvage procedure with improved function and a substantial decrease in the level of pain. One revision for dislocation in the 12 cases was performed and in that case significant erosion of the polyethylene cup was noted. The reverse prosthesis shows promise as a salvage procedure when more standard and conservative techniques of treating cuff tear arthropathy have failed, but long term follow-up is needed to evaluate outcomes and develop strategies for design improvement.
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Since its description by Neer,[1] cuff tear arthropathy has become a well recognized and clinically challenging entity. No single management technique has been shown to be totally effective, but many authors have demonstrated reasonable success using forms of hemi-arthroplasty.[2-9] The goal of treatment is primarily pain relief, with some degree of anticipated improved mobility and function below the horizontal.

In the face of an arthritic glenohumeral joint with a superiorly subluxed humeral head that is still captured within the coracoacromial (C-A) arch, we have reported success using a resurfacing procedure with a cup arthroplasty placed in a "hyper valgus" configuration allowing seamless articulation of the upper humerus within the altered mechanical confines of the C-A arch allowing a more cephalad center of rotation.[10,11] This technique burns few bridges and allows relatively straight forward revision if unsuccessful. Past experiences with constrained shoulder prostheses for any reason have proven to be unsuccessful because of high stresses at the glenoid/implant interval resulting in ultimate failure at this interface.[12-15]

The concept of a reverse prosthesis is not new. Prior attempts at such a prosthesis using the Kessel design demonstrated ultimate failure at the level of the glenoid because of high vertical shear forces resulting from lateral offset.[13,16] The European experience using the Grammont (Delta) prosthesis over the past 10 years has demonstrated moderate success in maintaining glenoid fixation but has been associated with significant "notching" of the inferior glenoid and wear of the polyethylene stem liner raising concerns for the possibility of particulate debris wear in the long term.[17-27] More recently, Frankel has recommended a more laterally offset design to avoid the problem of notching, and has demonstrated increased shear stresses because of the lateral offset through biomechanical studies but has stated that these stresses are within the limits of "acceptable."[28] Nonetheless, his clinical reports have demonstrated a relatively high rate of glenoid component failure and screw breakage.[29] However, faced with a patient who has failed a more standard, more conservative reconstructive approach, in whom "capture" of the humeral head within the coracoacromial arch has been

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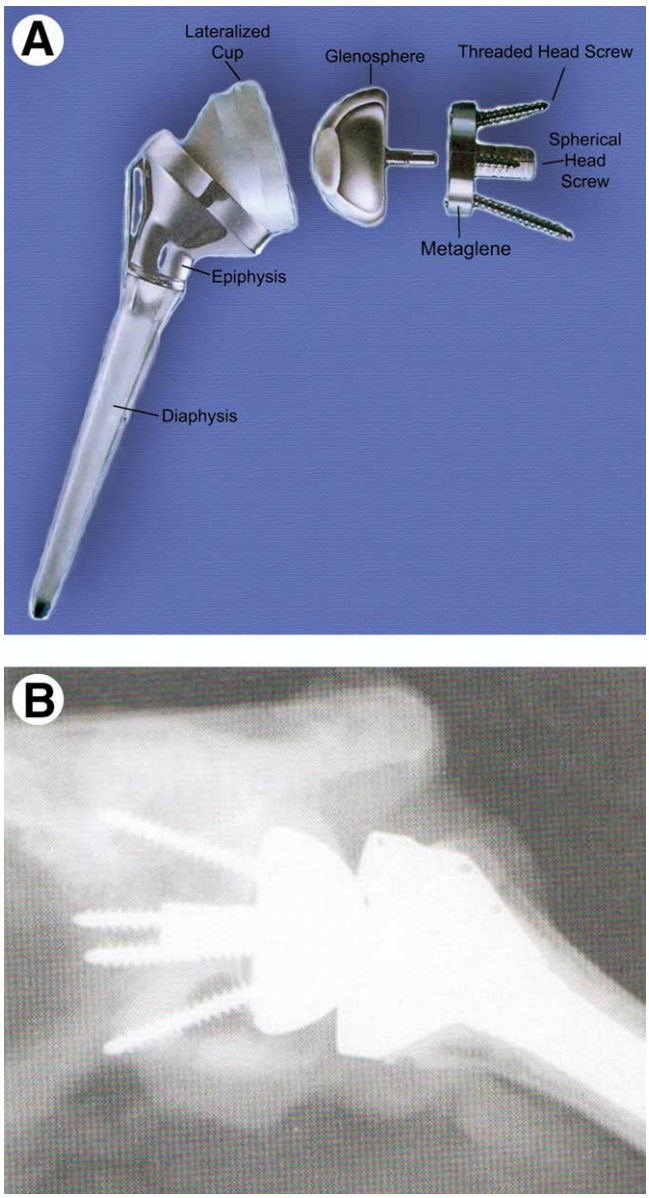

Figure 1 (A) Individual components of the reverse "delta" prosthesis include the metaglen base plate with central fixation peg, a superior and inferior locking screw and an anterior and posterior lag screw. The glenosphere locks into the metaglen with a locking screw. The metallic humeral stem is cemented in place with a snap fit polyethylene cup liner. (B) An X-ray of the reverse prosthesis securely anchored in the glenoid and cemented in the humerus. (Color version of figure is available online.)

lost with antero-superior dislocation and resultant pain and dysfunction there has been no real treatment option that can restore significant function and alleviate pain. In this group of patients with no other resource for management, the reverse prosthetic components may provide a solution to a previously unsolvable problem.[21] We have restricted our use of the reverse prosthesis to this group of patients, with failed primary surgery and report here our short-term results (Fig. 1).

Materials and Methods

Twelve patients have undergone revision shoulder reconstruction utilizing a reverse, fixed fulcrum prosthetic design. In all cases, patients have had at least one prior surgical procedure. There was an average of 2.67 prior procedures in the group. Four patients were wheelchair bound, all were severely disabled because of their arthropathy. All patients had lost capture of the humeral head by the coracoacromial arch and demonstrated a humeral head subluxating anteriorly and superiorly. Nine of the 12 patients had undergone some form of hemiarthroplasty replacement whereas 3 patients had undergone multiple failed attempts at soft tissue reconstruction. As noted, all patients were severely disabled by their shoulder pathology and presented with a condition for which no other viable alternative existed.

Surgical Technique

The surgery was performed through a superolateral deltoid split incision without detachment of the deltoid. Through this incision existing prosthetic implants in the humerus could be removed, access to the glenoid was relatively straightforward utilizing inferior, anterior and posterior retractors. Because of concerns with reports of inferior glenoid "notching" the planing of the glenoid was performed in a slightly (10 degrees) cephalad direction allowing the metaglen base plate to be applied in a slightly downwardly tilted orientation when possible.[24,30] The central drill hole was placed for the metaglen base plate and superior and inferior locking screws and anterior and posterior grasping lag screws were then inserted to "lock in" the base plate. A trial humeral stem was then inserted after very gentle reaming of the humeral intramedullary canal and appropriately sized trial glenosphere and humeral cups were then tested until a securely tensioned fit was obtained relying on an intact deltoid to power the new joint in forward, lateral, and posterior elevation.[22]

Once the appropriate combination of implant components was determined, the humeral canal was prepared and cemented with antibiotic cement and the humeral implant inserted and its polyethylene cup liner affixed. Finally, the glenosphere was secured to the metaglen with its locking screw and the prosthetic components were articulated and taken through a full arc of motion insuring that adequate deltoid tension prevailed and no subluxation or dislocation occurred at any point through the arc of motion. Once this was completed, if there was any remnant of anterior or posterior rotator cuff that appeared viable, it was secured down to bone anatomically (Fig. 2A, B)

Postoperative rehabilitation began the day after surgery with passive mobility exercises performed for the first 6 weeks. Active elevation and functional activities commenced at the sixth week and gradually proceeded into strengthening and endurance exercises over the ensuing 3 to 6 months (Fig. 3).