



The subscapularis-sparing approach in humeral head replacement



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Background: This report represents a prospective case series evaluating an open deltopectoral approach, both radiologically and clinically, without tenotomy or complete takedown of the subscapularis tendon insertion. We hypothesized that this novel technical approach would allow preservation of the upper tendon border, thus decreasing subscapularis repair failures and fatty infiltration while simultaneously allowing accelerated rehabilitation.

Methods: Fifty patients underwent humeral head replacement surgery through a subscapularis-sparing approach. In this approach, we take down only the inferior 30% to 50% of the subscapularis tendon, leaving the critical superior aspect of the tendon attached to the lesser tuberosity. Forty-three patients were included in the postoperative results (7 were lost to follow-up). Nineteen patients had a postoperative magnetic resonance imaging study, and 24 patients had ultrasound evaluation. Physical examination included belly-press and lift-off tests; follow-up included visual analog scale, American Shoulder and Elbow Surgeons, Constant, modified UCLA, Rowe, and Short Form 12 scores.

Results: All patients had a minimum 2-year follow-up. All patients had subscapularis strength equal to the opposite side as measured by lift-off, belly-press, and bear hug tests. Average postoperative scores all showed statistically significant improvement except for general health. All had an intact subscapularis tendon attachment as evaluated by either magnetic resonance imaging or ultrasound imaging. None had atrophy in the muscle belly.

Conclusions: The subscapularis-sparing, minimally invasive approach to the glenohumeral joint provides adequate exposure to allow humeral head replacement. When the upper border of the subscapularis insertion is left intact, there is a decreased risk of postoperative failure (rupture or atrophy) of the subscapularis tendon.

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

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Keywords: Humeral head replacement; deltopectoral approach; subscapularis-sparing; subscapularis; partial subscapularis takedown; minimally invasive humeral head replacement

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The deltopectoral approach with subscapularis takedown represents a standard approach to shoulder disease, and its use in shoulder arthroplasty has been well established, with mostly good or excellent outcomes reported in the literature.⁷ Failure and dysfunction of the repaired subscapularis

remain a concern after both tenotomy^{9,17,18} and lesser tuberosity osteotomy^{2,10,21} despite multiple variations in subscapularis takedown and reattachment techniques, with incidence reported as high as 40% in some studies.^{31,32} In addition to failure of the reattachment of the tendon, neurologic atrophy and fatty infiltration of the muscle belly may also be a cause of pain and functional impairment.^{8,25,26} Montgomery and Jobe described the subscapularis split and repair with suture anchors as a way to avoid taking down the subscapularis during capsulolabral repair in athletes.²⁰ We have been concerned about the propensity for subscapularis detachment for many years and have been seeking an alternative, mini-open approach that would allow shoulder replacement without taking down the entire tendon. After multiple cadaver dissections, we developed a new technique for taking down only the inferior 30% to 50% of the subscapularis tendon and preserving the more critical upper part, thus preventing well-known complications and allowing earlier rehabilitation.

This report represents a prospective case series evaluating this approach, both radiologically and clinically. We hypothesized that this novel technical approach would allow preservation of the upper tendon border, thus decreasing subscapularis repair failures and fatty infiltration while simultaneously allowing accelerated rehabilitation.

Materials and methods

Preoperative data

Fifty consecutive patients underwent humeral head replacement (Copeland Humeral Head Resurfacing [Biomet, Warsaw, IN, USA], GLOBAL CAP (Conservative Anatomic Prosthesis) [DePuy, Raynham, MA, USA], or GLOBAL ADVANTAGE humeral stem [DePuy]) surgery for arthritis of the shoulder through a subscapularis-sparing approach between May 2007 and March 2010. The present study was limited to humeral hemiarthroplasty patients. All of the patients considered for the study were being treated for glenohumeral arthritis; conservative treatment had failed, and each patient decided to schedule glenohumeral joint replacement surgery. Inclusion criteria for this study consisted of grade III degenerative changes^{3,19,22} of the shoulder and a willingness to undergo this subscapularis-sparing procedure. Exclusion criteria were glenoid asymmetry (Walch B2 or C glenoid),^{31,32} unwillingness to undergo the procedure, and unwillingness to complete the postoperative questionnaire or to participate in the examination.

The study included 29 men and 21 women, and there were 27 right shoulders and 23 left shoulders. The mean age of the patients was 63.2 years (range, 32-87 years). Of the 50 patients, 7 were withdrawn for reasons of severe physical illness unrelated to the shoulder (1), the patient's decision (4), and other reasons (2). All 7 patients had intact subscapularis function postoperatively at last clinical follow-up but were not included in the follow-up study data for reasons stated. Outcome measures included age, active and passive shoulder range of motion, visual analog scale (VAS) pain level, and the following rating scales: American Shoulder and

Elbow Surgeons (ASES), Rowe, Constant, modified University of California–Los Angeles (UCLA), and Short Form 12 (SF-12). All outcomes measures were collected by independent evaluators blinded to the procedure and not by the operative surgeons. The preoperative physical examination included the lift-off test,⁹ belly-press test,²⁹ and bear hug test.⁴

Operative technique

All patients were positioned in the beach chair position and placed under general anesthesia in combination with an interscalene block. Prophylactic antibiotics were administered before incision. A 5- to 7-cm vertical incision was made with a standard deltopectoral approach. The long head of the biceps was located at the top of the pectoralis major tendon, followed up through the rotator interval, and released off the superior labrum if a tenodesis is to be performed. The biceps was tagged and later tenodesed with suture as part of the final closure. The subscapularis tendon was identified, and a split was made in the lower muscle tendon raphe approximately one half to two thirds inferior to the superior border of the tendon (Fig. 1). An electrocautery was then used to follow a line straight down the humerus on the medial ridge of the bicipital groove down to the pectoralis major insertion. This left the tissue along the lateral groove as an anchor for future soft tissue repair. The inferior third to half of the subscapularis was elevated off the humerus from the raphe inferiorly in a subperiosteal manner (Fig. 2).

It is important to continue the release medially under and around any inferior humeral spurs. As the soft tissues are released, the arm is continually and slowly externally rotated and abducted to allow exposure of the inferior humeral head. Once the dissection reaches the posterior aspect of the humerus, a Cobb retractor is used to “flip” the upper subscapularis muscle over the superior aspect of the humeral head as the arm continues to be abducted and externally rotated. A Chandler retractor is placed medially and a Hohmann retractor superiorly to protect the soft tissues and completely expose the humeral head (Fig. 3). All inferior osteophytes are removed to allow adequate sizing of the implant. The humeral head may be either reamed for surface-type replacement or cut for humeral head replacement. In this approach, it is relatively easy to re-create the patient's normal version because of the exposure of the humeral head. The replacement is then performed in standard fashion, with symmetrical reaming for surface replacement arthroplasty (48 patients) or humeral cut in anatomic version, humeral shaft reaming, and implantation of a stemmed implant (2 patients). After replacement of the humeral head, the arm is adducted and internally rotated to allow the head to relocate into the glenoid. The preserved upper subscapularis tendon is easily visualized (Fig. 4). The lower subscapularis tendon is then repaired with either bunger #2 orthocord or by a double-loaded suture anchor and a double-row repair technique (Fig. 5) as well as interrupted polydioxanone sutures (PDS II; Ethicon Endo-Surgery, Johnson & Johnson Company, New Brunswick, NJ, USA) to reinforce the repair, both in the split raphe and at the distal tendon insertion. All patients were placed into a sling with an abduction pillow in the operating room before awakening from anesthesia.

Postoperative

Radiographs taken in the recovery room and all postoperative visits confirmed proper implant positioning, with no malposition due to

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