

Radiographic and Clinical Outcomes After Reverse Total Shoulder Arthroplasty with Hybrid Humeral Stem Fixation

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INTRODUCTION: Humeral implant fixation for reverse total shoulder arthroplasty (rTSA) has been achieved primarily via either cementation or press-fit approaches. In 2015, Formaini et al.¹ described the “black-and-tan” technique, a hybrid cementation-impaction grafting approach to humeral stem fixation that utilizes cement distally in the diaphysis and bone-graft proximally to improve tuberosity healing in rTSA for proximal humeral fracture. As a medium between the more traditional press-fit and cemented approaches, hybrid humeral implant fixation presents as a potential means of achieving better time-zero fixation while preserving the potential for bone ingrowth (Figure 1). Currently, the only studies that describe outcomes following hybrid stem fixation in primary rTSA are for cases of proximal humeral fracture. The purpose of this study is to evaluate the clinical and radiological outcomes of hybrid humeral stem fixation for indications other than fracture.

METHODS: A retrospective cohort study was conducted using data from our institutional shoulder arthroplasty clinical registry. The study included consecutive patients who underwent primary rTSA with hybrid humeral stem fixation between February 1, 2016, and July 31, 2022. Data collected included patient demographics, operative details, and clinical outcomes. Patient-reported outcome measures (PROMs)—including ASES, SANE, VAS—and range of motion (ROM) were assessed preoperatively and at final follow-up. Descriptive statistics were used for analysis.

RESULTS: A total of 11 patients underwent rTSA with hybrid humeral stem fixation. Average time to final PROM and radiographic follow-up was 38.7 ± 17.1 months (14.8 - 50.1 months) and 21.1 ± 11.9 months (3.8 - 38.7 months), respectively. The average age of the cohort was 72.6 ± 5.0 years, and average BMI was 28.7 ± 7.2. Primary diagnoses included rotator cuff tear arthropathy (45.5%), osteoarthritis (45.5%), and avascular necrosis (9.1%). Intraoperative rotator cuff status was reported as torn (63.6%), intact (27.3%), and attenuated (9.1%) and all patients underwent biceps tenodesis. The mean ASES score improved from 46.32 ± 15.60 to 91.91 ± 9.31 (p < 0.0001). Forward elevation increased from 86.36° ± 28.05° to 142.27° ± 20.15° (p < 0.0001), and external rotation improved from 27.73° ± 15.13° to 55° ± 11.08° (p < 0.0005). VAS pain scores decreased from 6.82 ± 1.59 to 0.18 ± 0.39 (p < 0.0001). SANE scores (available for 72.7% of patients) improved from 20.63 ± 18.87 to 77.25 ± 30.86 (p < 0.0001) (**Table 1**).

DISCUSSION: While initial generations of rTSA employed a cemented humeral stem, cementation has been associated with increased intraoperative complications, longer operative times, higher operative costs, and increased difficulty during revision surgery.² While short-stem press-fit implants may mitigate some of these risks through bone ingrowth, this technique may risk humeral stem subsidence or loosening in patients with poor proximal humeral bone density. In patients with compromised proximal humeral bone density, hybrid humeral stem fixation employing both distal cementation and proximal press-fit fixation may offer the advantages of both fixation techniques. In this series involving non-fracture related rTSA, hybrid humeral stem fixation provided satisfactory clinical outcomes—measured via ASES, VAS, SANE scores and ROM—comparable to that of press fit and cemented humeral stem fixation. Radiographic complications were rare and only one patient required revision due to periprosthetic fracture secondary to a traumatic injury. These findings support a novel indication for hybrid fixation as a promising alternative to fully cemented or press-fit techniques, particularly in patients with poor humeral bone quality even in the absence of fracture. Further investigation with larger cohorts and longer follow-up periods is warranted.

SIGNIFICANCE/CLINICAL RELEVANCE: Hybrid “black-and-tan” humeral stem fixation in primary rTSA for non-fracture indications produced large, clinically meaningful gains in ASES, SANE, pain, and ROM with rare radiographic issues and just one traumatic revision at ~3 years. These early-to-midterm results support hybrid fixation as a practical alternative to fully cemented or press-fit stems—particularly when proximal humeral bone quality is compromised—by combining distal cemented stability with the potential for proximal ingrowth; larger comparative studies with longer follow-up are warranted to confirm durability and refine indications.

Figure 1. Postoperative radiographs of a patient with rTSA, black and tan technique, (a) internally rotated, (b) externally rotated, (c) outlet, and (d) axillary view. The red arrow is directed towards the cemented portion of the implant, the blue arrow is directed towards the uncemented portion, and the orange dashed line approximates where the cemented portion ends.

