J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Radiographic results of augmented all-polyethylene glenoids in the presence of posterior glenoid bone loss during total shoulder arthroplasty

Scott P. Stephens, MD[a,*], Edwin E. Spencer, MD[b], Michael A. Wirth, MD[c]

[a]*Fondren Orthopedic Group, Houston, TX, USA*
[b]*Knoxville Orthopaedic Clinic, Knoxville, TN, USA*
[c]*Department of Orthopaedics, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA*

Background: Chronic osteoarthritis can result in glenohumeral subluxation and loss of posterior glenoid bone. This can alter normal glenohumeral biomechanics and affect the stress placed on the glenoid implant after total shoulder arthroplasty. This study evaluated the clinical and radiographic results of an augmented all-polyethylene glenoid for the treatment of glenoid osteoarthritis in the presence of posterior glenoid bone loss and determined whether any failures or complications occurred with short-term follow-up.

Methods: During a 2-year period, 21 patients were treated with an augmented glenoid for an index diagnosis of osteoarthritis with a biconcave glenoid and average posterior glenoid bone loss of 4.7 mm. Clinical outcomes were recorded for the American Shoulder and Elbow Surgeons Shoulder Assessment, Simple Shoulder Test, and active motion. Radiographic analysis included glenoid version, humeral head subluxation, component seating, ingrowth, and loosening.

Results: Significant improvements were demonstrated for American Shoulder and Elbow Surgeons Shoulder Assessment (52.3), Simple Shoulder Test (8.1), forward flexion (50°), external rotation (32°), and pain. Radiographic improvements were found for glenoid version (12°), humeral scapular alignment (23%), and humeral glenoid alignment (8%). Central peg ingrowth was demonstrated in all patients, and complete component seating was achieved in 19 patients. No complications were encountered, and no clinical or radiographic failures were identified.

Conclusion: Augmented polyethylene glenoid components demonstrated improved clinical outcome, without implant failure or complications, during short-term follow-up.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Augmented glenoid; posterior glenoid bone loss; glenoid retroversion; shoulder osteoarthritis; total shoulder arthroplasty; biconcave glenoid; glenoid loosening; anchor peg glenoid

Shoulder arthroplasty has demonstrated successful long-term clinical outcomes, but glenoid component loosening remains the most common cause of implant failure.[23,38] Chronic glenohumeral osteoarthritis can alter glenoid morphology,

The University of Texas Health Science Center Institutional Review Board Review Committee approved this study (#HSC20010109H).

*Reprint requests: Scott P. Stephens, MD, Fondren Orthopedic Group, 3100 Post Oak Blvd #551, Houston, TX 77056, USA.

E-mail address: Scott.stephens31@gmail.com (S.P. Stephens).

1058-2746/$ - see front matter © 2016 Journal of Shoulder and Elbow Surgery Board of Trustees. All rights reserved.
http://dx.doi.org/10.1016/j.jse.2016.09.053

resulting in humeral head subluxation, posterior glenoid erosion, and increased glenoid retroversion.[17,18] This can have a dramatic effect on shoulder biomechanics by altering the joint reactive forces and resulting in humeral head instability, polyethylene edge loading, and component loosening.[2,6,7,28] Farron et al[7] performed 3-dimensional finite-element analysis and found that placing a glenoid implant in 20° of retroversion created a posterior contact point on the glenoid, increasing stresses within the cement mantle by 326%. Even just 10° of retroversion resulted in an increase in micromotion at the bone-to-cement interface of more than 700%.

The effect of altered shoulder biomechanics on implant longevity has also been demonstrated in clinical studies. Ho et al[14] reported that placing a glenoid in greater than 15° of retroversion increased the odds of developing osteolysis around the central peg, which correlated with early signs of radiographic component loosening. Walch et al[34] reviewed the results of 92 patients undergoing total shoulder arthroplasty with posterior glenoid bone loss and biconcave glenoids and reported glenoid loosening in 20.6% and revision rates as high as 16.3%. Posterior humeral subluxation has also been found to result in lower functional scores, more pain, and decreased active motion after shoulder arthroplasty.[22]

A variety of surgical techniques have been described to treat posterior glenoid bone loss, including eccentric reaming and bone grafting, but are limited by the amount of glenoid bone stock available and the concern of bone graft failure.[5,10,11,13,26] Reverse total shoulder arthroplasty has also been reported as a potential alternative with its improved glenoid fixation but historically has had a high reported rate of complications.[25] An alternative option to restore glenoid version and offset posterior glenoid bone loss is an augmented glenoid. Previous studies involving glenoid augmentation have used wedge-shaped polyethylene or metal composite augments, but clinical outcomes have been unreliable.[4,29] This study investigated the short-term clinical and radiographic results of an augmented all-polyethylene step-cut glenoid and determined whether any implant failure or complications were identified.

Materials and methods

This was a retrospective study of 22 patients during a 2-year period who underwent total shoulder arthroplasty with implantation of an all-polyethylene augmented glenoid (Global StepTech; DePuy, Warsaw, IN, USA) by 2 surgeons (12 patients and 10 patients) at 2 independent tertiary referral shoulder centers. Twenty-one patients with a mean age of 66 years (range, 58-81 years) were available for 2-year follow-up.

Inclusion criteria included any patient undergoing total shoulder arthroplasty for a diagnosis of glenohumeral osteoarthritis with a Walch B2 or C type glenoid morphology, glenoid retroversion of a minimum of 12°, presence of humeral head subluxation greater than 10%, posterior glenoid bone loss, intact rotator cuff and implantation of an augmented glenoid with minimum of 2-year follow- up. No patient during this interval was treated with standard polyethylene implant that met these criteria. Exclusion criteria included any patient with less than 2-year radiographic or clinical follow-up, inflammatory arthritis, revision shoulder arthroplasty, prior or current infection, or use of bone graft. One patient was lost to follow-up before the 2-year follow-up and was excluded.

The diagnosis was glenohumeral osteoarthritis in all 21 patients, with a mean follow-up of 35 months (range, 24-41 months). Four patients had prior surgical procedures on the operative shoulder, including 2 patients with open capsulorrhaphies for anterior instability, an arthroscopic decompression, and an acromioclavicular joint stabilization procedure.

Patients were evaluated preoperatively and postoperatively with plain radiographs or computed tomography (CT). Optimal axillary radiographs were defined by a visible center peg with an identifiable scapular body, a neutral lateral position of the acromion, and no overlap of the coracoid, as described by Ho et al.[14] Preoperative imaging consisted of CT in 17 patients and plain radiographs in 4. Glenoid version was measured preoperatively using the technique described by Friedman et al[8] and postoperatively with the method described by Ho et al.[14] Preoperative glenoid bone loss was determined by an estimation of the predeformity joint line as described by Scalise et al.[33] Glenohumeral subluxation was determined by using the plane of the scapula and the plane of the glenoid.[8,32] Periprosthetic glenoid radiolucency was determined by the method described by Lazarus et al.[21] Central peg flange bone density was measured with the technique described by Wirth et al.[37] The grade of glenoid component seating was evaluated by method described by Lazarus et al.[21]

Surgical technique

All surgical procedures were performed through the deltopectoral interval. Glenoid bone loss was evaluated with preoperative imaging and intraoperative trials to determine the amount of augmentation necessary to provide the desired correction. The correct sizer pin guide was then placed, and reaming was performed to remove the remaining glenoid cartilage. Careful attention was paid to maintain the anterior glenoid subchondral bone to maximize implant support. Posterior preparation began by removing sclerotic bone with a high-speed bur and then placing a corresponding sized rasp guide. An oscillating rasp was used to finalize preparation of the posterior glenoid surface (Fig. 1). Trials were used to ensure that congruent contact was made between the implant and glenoid surface, and steps were repeated as necessary to ensure complete congruency was visualized through the bone preparation assessor. Implants were then trialed, and concentric contact between the implant and prepared glenoid surface was confirmed. Cancellous bone graft was applied between the flutes of the central peg and cement placed into the peripheral peg holes. Final stability was confirmed to ensure that full range of motion was achieved and that no posterior instability was encountered. Posterior capsulorrhaphy was not performed during any of these procedures. A size 3+ augment was used in 7 patients and size 5+ in 14. Glenoid diameter sizes included 40 in 1, 44 in 2, 48 in 7, 52 in 10, and 56 in 1.

Statistics

Paired-samples *t* tests were used to determine significant differences between preoperative to postoperative time points. Statistical analyses were performed using SPSS 21 software (IBM Corp., Armonk, NY, USA). Statistical significance was set at $P < .05$.