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Glenoid perforation does not affect the short-term outcomes of pegged all-polyethylene implants in total shoulder arthroplasty

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Background: The glenoid vault can be perforated during pegged glenoid preparation in total shoulder arthroplasty. The clinical implications of glenoid vault perforation, however, are unknown. The purpose of this study was to determine the effects of perforation of the glenoid during total shoulder arthroplasty on clinical and radiographic outcomes.

Materials and methods: Eighteen patients with known intraoperative glenoid perforations were prospectively identified and compared with 34 patients matched by age, gender, diagnosis, and arm dominance during the same period. Patients were evaluated with multiple outcome scores. Radiographs were evaluated for glenoid lucency immediately postoperatively and at final follow-up.

Results: Average follow-up was 28.1 months for the perforated group and 31.2 months for the matched controls. Both groups had significant improvements in outcome scores postoperatively. American Shoulder and Elbow Surgeons scores increased from 39.8 to 91.0 ($P < .001$) in the perforated group and from 36.9 to 82.6 ($P < .001$) in the control group. Constant scores increased from 24.4 to 77.4 ($P < .001$) in the perforated group and from 36.9 to 75.6 ($P < .001$) in the control group. Ninety-four percent of the perforated group and 80% of the matched controls were satisfied or very satisfied with their result ($P = .896$). The presence and number of perforations were not related to the American Shoulder and Elbow Surgeons score ($P = .549$), Constant score ($P = .154$), or radiographic lucency grade ($P = .584$).

Conclusions: Glenoid perforation during pegged glenoid preparation in total shoulder arthroplasty does not seem to have an adverse effect on clinical or radiographic outcomes at an average of 2 years of follow-up.

Level of evidence: Level III, Case Control Design, Treatment Study.

Keywords: Glenoid perforation; total shoulder arthroplasty; pegged implants; outcomes

Hemiarthroplasty has been used to treat many shoulder conditions with success, but patient satisfaction has been shown to decrease over time.[8] Several studies have suggested that total shoulder arthroplasty (TSA) yields better patient satisfaction and improved pain scores compared

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with hemiarthroplasty alone in patients with osteoarthritis.[2,10,11] Furthermore, TSA has been shown to be more appropriate than hemiarthroplasty for inflammatory arthropathy as well.[12] The drawbacks of TSA include the time and technical skill needed to prepare and to place the glenoid implant and the long-term failure of the construct due to glenoid implant wear and loosening.[14] Achieving stable fixation of the glenoid component in TSA remains a key to long-term success.

Many studies have focused on the various factors necessary to achieve appropriate fixation. These include surgical technique, implant design, and cementing method.[3,14,16] Containment of the prosthetic implant within the glenoid vault has also been thought to play a role in prosthetic longevity. Potential vault perforation during preparation of the glenoid component has been postulated to lead to early loosening by eliminating cement containment and by decreasing the cementing pressure necessary to achieve stable fixation.[6,16] Clinical investigation has been undertaken in this area in an attempt to determine glenoid components that decrease the likelihood of perforation.[13] Unfortunately, many glenoid perforations may go undetected at the time of surgery, which limits the ability to identify this as a definitive cause of early glenoid loosening. This study is the first of its kind and aims to demonstrate prospective outcomes of patients with known intraoperative glenoid vault perforations with comparisons to a cohort without perforations and presents data at 2 years' follow-up.

Materials and methods

Between 2004 and 2007, a consecutive series of primary, anatomic TSAs by use of a single system were collected with documentation of any glenoid vault perforations. All glenoid components used in the study consisted of 4 peg holes in an inverse-T configuration. Intraoperatively, all glenoid peg holes were tested with a sounder to ensure that the drill hole was contained. All perforations were documented and detailed as to their location on the glenoid (anterior, posterior, superior, central). All glenoid morphology was also documented as described by Walch.[15]

These perforation patients were observed prospectively with Constant and American Shoulder and Elbow Surgeons (ASES) scores and with serial radiographs.[1,9] Our practice's research database was searched for a cohort of patients who matched as closely as possible the perforation cohort for the following set of variables: age, sex, diagnosis, and arm dominance. This multiple-variable matching process provided for multiple comparison points per perforation patient, with the nearest match on the entire set of variables rather than on any single variable. Consequently, the groups differed slightly with respect to some of the specific matching variables but were similar on the multivariate aggregate. Use of several comparison cases for each perforation case, when available, improved the consistency and precision of the statistical estimates. Ultimately, the 18 patients with known glenoid perforations were matched with 34 patients without perforation and observed for an average of more than 2 years.

Patient characteristics

Women represented 12 of 18 (67%) patients in the perforation group and 14 of 34 (41%) in the control group. Ages were nearly identical (69.3 $\pm$ 8.6 years for the perforation group and 69.0 $\pm$ 8.3 years for the control group). Difference in body mass index was not significant between groups (30.7 $\pm$ 6.3 vs 29.4 $\pm$ 5.8; $P = .527$). Osteoarthritis represented the majority of cases (10 of 18 in the perforation group; 30 of 34 in the control group), followed by revision arthroplasty and rheumatoid arthritis.

Patient evaluation

All patients underwent a comprehensive history and physical examination, including range of motion, and standard shoulder radiographs (anterior-posterior, axillary lateral, and scapular lateral). Secondary imaging was also employed to better determine glenoid morphology by either computed tomographic arthrography or magnetic resonance imaging.

Surgical technique

All patients underwent a conventional TSA with a single system (Tornier, Bloomington, MN, USA) through a standard deltopectoral approach. The subscapularis was managed with a tenotomy, leaving a stump of tissue laterally to allow an end-to-end repair, and the glenohumeral ligaments and capsule surrounding the tendon were released to increase excursion. The humeral head was osteotomized at the level of the anatomic neck and the humerus was prepared for implantation of a press-fit prosthesis. An inferior capsular release was performed along the anterior and inferior portions of the glenoid neck to provide adequate visualization. Once the correct glenoid size was chosen, a central peg hole was drilled and then reamed with the aim to remove only articular cartilage and to provide a concentric backing for the glenoid component. Eccentric reaming was performed whenever appropriate (on the basis of preoperative imaging) to correct for the increased retroversion seen in some cases of osteoarthritis. A peripheral drill hole guide was used to place the holes for the pegged glenoid component. On completion of these drill holes, all 4 (superior, anterior, posterior, central) were carefully probed to ensure that there was bone containment throughout. The location of any breach was recorded. The glenoid was then irrigated, and the 4 peg holes were filled with methyl methacrylate under pressure by use of a tipped syringe and modern cementing techniques.[16] No cement was placed on the back of the glenoid component. The glenoid was then impacted into place and held under pressure until the cement polymerized. The humeral component was then implanted, and glenohumeral mismatch was calculated on the basis of the size of the implants. The subscapularis was closed with multiple high-tensile, nonabsorbable sutures with both transtendinous and transosseous purchase, and a running, absorbable suture was placed over the top for reinforcement. The wound was irrigated and closed in layers. Postoperatively, patients were given a simple sling; at their 1-week follow-up appointment, aquatic physical therapy was prescribed with primary limitations aimed at protecting the subscapularis repair.