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ORIGINAL ARTICLE

Radiographic and clinical comparison of pegged and keeled glenoid components using modern cementing techniques: midterm results of a prospective randomized study

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Background: Glenoid component loosening remains a significant issue after anatomic shoulder arthroplasty. Pegged glenoid components have shown better lucency rates than keeled components in the short term; however, midterm to long-term results have not fully been determined. We previously reported early outcomes of the current randomized controlled group of patients, with higher glenoid lucency rates in those with a keeled glenoid. The purpose of this study was to evaluate the radiographic and clinical outcomes of these components at minimum 5-year follow-up.

Methods: Fifty-nine total shoulder arthroplasties were performed in patients with primary glenohumeral osteoarthritis. Patients were randomized to receive either a pegged or keeled glenoid component. Three raters graded radiographic glenoid lucencies. Clinical outcome scores and active mobility outcomes were collected preoperatively and at yearly postoperative appointments.

Results: Of the 46 shoulders meeting the inclusion criteria, 38 (82.6%) were available for minimum 5-year radiographic follow-up. After an average of 7.9 years, radiographic lucency was present in 100% of pegged and 91% of keeled components ($P = .617$). Grade 4 or 5 lucency was present in 44% of pegged and 36% of keeled components ($P = .743$). There were no differences in clinical outcome scores or active mobility outcomes between shoulders with pegged and keeled components at last follow-up. Within the initial cohort, 20% of the keeled shoulders (6 of 30) and 7% of the pegged shoulders (2 of 29) underwent revision surgery ($P = .263$). Kaplan-Meier analysis showed no significant difference in survival rates between groups ($P = .560$).

Conclusion: At an average 7.9-year follow-up, non-ingrowth, all-polyethylene pegged glenoid implants are equivalent to keeled implants with respect to radiolucency, clinical outcomes, and need for revision surgery.

This study was approved by the Texas Orthopedic Hospital Institutional Review Board (protocol TOH 040).

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Management of end-stage glenohumeral arthritis with anatomic total shoulder arthroplasty continues to increase.[16] The most frequent indication for revision total shoulder arthroplasty is loosening of the glenoid component,[13-15,18,24,27,31,35,41,43] which has been correlated radiographically with the appearance of lucencies around the glenoid component.[1-3,23,27,34,38]

Early radiolucent lines around the glenoid component have been shown to occur at significantly higher rates in shoulders in which radiographic loosening eventually develops.[34] After ways to improve cementing techniques were examined,[6,17,23,25,32] the focus transitioned toward glenoid component design. Early biomechanical and animal studies showed the superiority of pegged components over keeled components.[18,29,41] Subsequently, outcomes comparing retrospective and prospective early and midterm radiographic results of pegged versus keeled glenoid components have also favored pegged components.[5,9,17,19] This observation was found in the early results of the current cohort of patients: the rate of glenoid lucency was significantly higher in patients with keeled components (46%) compared with patients with pegged components (15%) ($P = .003$) at an average of 26 months.[5]

Perhaps the true test of superiority does not lie in radiographic assessment but rather in clinical outcomes. Furthermore, these qualities are not readily apparent in the short term and may require longer follow-up to delineate subtle differences. The purpose of this study was to follow up a previous randomized controlled population that received a non-ingrowth, all-polyethylene pegged component or keeled implant using modern cementing techniques[5] and attempt to determine both radiographic and clinical outcomes at a minimum of 5 years postoperatively. On the basis of the findings from the previous randomized study, our working hypothesis was that both radiographic and clinical outcomes at the midterm would prove to be superior in pegged implants.

Materials and methods

Subjects

Participating patients signed informed consent forms. The study consisted of the same 50 patients who were enrolled in our prospective randomized trial previously.[5] Patients undergoing total shoulder arthroplasty were included if they had a diagnosis of primary glenohumeral osteoarthritis and a glenoid that did not require bone grafting. Patients with a history of shoulder trauma (fracture or soft-tissue injury), instability (surgically or nonsurgically treated), or shoulder surgery were excluded. In addition, we excluded patients with marked rotator cuff disorders of the shoulder, as indicated by acromiohumeral arthritis, a massive rotator cuff tear, or a rotator cuff tear involving the infraspinatus or subscapularis, because the cause of their shoulder disease may not have been primary glenohumeral osteoarthritis.

All patients underwent complete preoperative radiographic assessment, including an anteroposterior radiograph and computed tomographic arthrography, for evaluation of the rotator cuff and morphologic features of the glenoid. Glenoid morphology was described according to the classification of Walch et al.[37] Shoulder function scores and active mobility outcomes were evaluated preoperatively and at yearly postoperative appointments. The clinical information was retained in a secure password-protected server. Additional surgery or revision procedures were recorded.

A simple randomization technique using a number table with glenoid component type placed in sealed envelopes (with odd numbers indicating pegged and even numbers indicating keeled) was used. The design of the glenoid component, pegged versus keeled, was determined by opening a randomly selected envelope immediately preoperatively without any specific indication.

The initial study's power analysis showed that 18 patients in each group were needed to identify a radiographic difference of 1 level.[5] In the initial study, 50 patients (53 shoulders) with an average age of 69 ± 11 years were enrolled. Surgical procedures were performed between December 2004 and December 2005. Six patients later underwent contralateral total shoulder arthroplasty as late as November 2008 and were included in the randomization. Therefore, 59 shoulders in 50 patients were enrolled, with 29 pegged and 30 keeled components implanted. Patients who had undergone revision surgery or died before evaluation were excluded. Minimum 5-year follow-up was required for inclusion of radiographic and clinical evaluation.

Surgical procedure

Fifty-nine total shoulder arthroplasties were performed in patients with primary glenohumeral osteoarthritis who agreed to participate in the initial study.[5] All cases were performed at a single, high-volume shoulder arthroplasty center by a single surgeon (T.B.E.) using a uniform implant system (Wright Medical, Memphis, TN, USA). A deltopectoral surgical approach was used, with management of the subscapularis through a tenotomy at the anatomic neck of the humerus. Subscapularis mobilization was achieved through releases of the glenohumeral ligaments and capsule. On dislocation and removal of osteophytes, the humerus was prepared to accept a press-fit prosthesis with a corresponding humeral head size (39-50 mm).

Glenoid visualization and preparation were carried out through a release of the capsule at the inferior portion of the glenoid and drilling of a center hole. After assessment of the native radius of curvature of the glenoid surface, a concentric reamer was used with care taken to avoid excessive subchondral bone removal. Either the non-ingrowth, all-polyethylene pegged (Fig. 1, *A*) or keeled (Fig. 1,