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SHOULDER

# Assessment of painful total shoulder arthroplasty using computed tomography arthrography



Gregory C. Mallo, MD<sup>a,\*</sup>, Lauren Burton, BA<sup>a</sup>, Margaret Coats-Thomas, BS<sup>a</sup>, S. David Daniels, BS<sup>b</sup>, Nathan J. Sinz, BA<sup>b</sup>, Jon J.P. Warner, MD<sup>a</sup>

<sup>a</sup>*Boston Shoulder Institute, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA*

<sup>b</sup>*Boston Shoulder Institute, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA*

**Background:** This study assessed the accuracy of computed tomography (CT) arthrography when evaluating glenoid component stability in the setting of postarthroplasty shoulder pain.

**Methods:** We retrospectively reviewed all patients presenting to the clinic during a 5.5-year period to identify those with a painful shoulder arthroplasty more than 1 year after the index procedure. We excluded reverse and hemiarthroplasty procedures, patients with a clearly identifiable cause for pain, such as rotator cuff insufficiency or gross component loosening as seen on plain radiographs, and those with culture-positive aspiration. There were 14 patients with suspected glenoid component loosening but inconclusive plain radiographs. Each of the 14 patients underwent a CT arthrogram that was evaluated by the senior author (J.J.P.W.) for the presence or absence of contrast material underneath the polyethylene component. Operative reports and surgical videos from subsequent arthroscopy were reviewed to assess glenoid component stability as determined by direct arthroscopic visualization.

**Results:** CT arthrography suggested glenoid component loosening in 8 of 14 patients (57.1%), and arthroscopic inspection identified loosening in 10 of 14 patients (71.4%). In 3 of 10 patients (30%), CTA suggested a well-fixed glenoid component, but gross loosening was identified during arthroscopy. In this study, CTA yielded a sensitivity of 70%, a specificity of 75%, a positive predictive value of 87.5%, and a negative predictive value of 50.0%.

**Conclusion:** CTA had a low negative predictive value (50%), and therefore, the prediction of component stability based on the absence of contrast between the glenoid component and the bone-cement interface does not always reflect true stability.

**Level of evidence:** Level I, Diagnostic Study.

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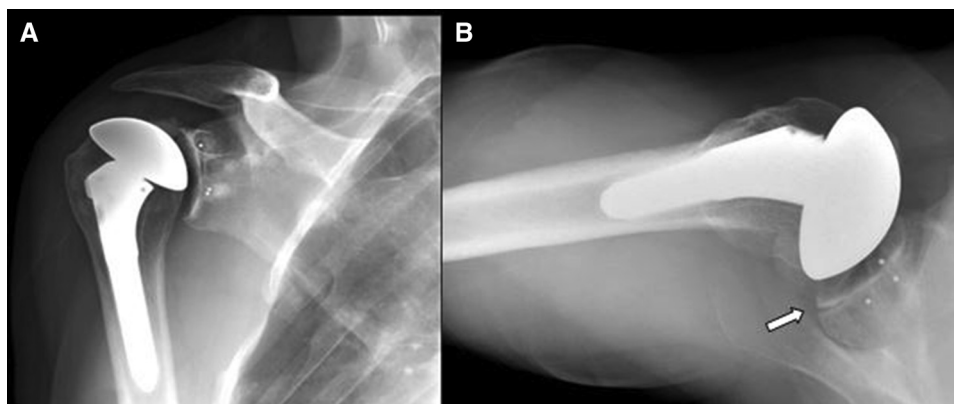
**Keywords:** Shoulder; CT arthrography; arthroplasty; total shoulder arthroplasty; glenoid loosening; component loosening

The Partners HealthCare Brigham and Women's Investigational Review Board approved the study (Protocol #2012P000568).

\*Reprint requests: Gregory C. Mallo, MD, Boston Shoulder Institute, Massachusetts General Hospital, 55 Fruit St, Ste 3200, 3G, Boston, MA 02114, USA.

E-mail address: [gregorymallo@gmail.com](mailto:gregorymallo@gmail.com) (G.C. Mallo).

Although total shoulder arthroplasty is generally successful in providing durable pain relief, aseptic loosening of the glenoid may be a source of pain in a minority of patients.<sup>1,3,4,7</sup> Diagnosis of this condition can be difficult using conventional radiographs and computed tomography



**Figure 1** (A) Anteroposterior and (B) axillary X-ray views of a painful total shoulder arthroplasty show no definitive evidence of loosening. Subtle lucency is detected on the axillary lateral view (*arrow*).

(CT) scans. Lucent lines may be an indication of loosening, but these may occur without symptoms as well. Component shift only occurs after gross loosening, which is a late event in glenoid failure. Radiographic projections make detection of glenoid loosening unreliable, and although a CT scan with contrast increases the detection rate, it may not always be reliable.<sup>13</sup>

To our knowledge, there has been only 1 report in the literature involving the use of arthroscopy in the evaluation of glenoid loosening and no reports on the accuracy of diagnosing glenoid loosening with CT arthrogram (CTA). In 1993, Bonutti et al<sup>2</sup> showed that X-ray arthrography accurately predicted glenoid loosening in only 1 of 3 cases. They concluded that arthroscopy was the most sensitive indicator of glenoid loosening compared with X-ray imaging or X-ray arthrography, but a systematic analysis is lacking.

Currently, to our knowledge, no studies have evaluated the accuracy of CTA in the identification of gross glenoid component loosening. In addition, the utility and indications for arthroscopic evaluation of a painful shoulder arthroplasty remain unclear. The purpose of our study was to determine whether CTA is accurate in assessing glenoid component stability in the setting of a painful total shoulder arthroplasty. We compared the direct assessment of glenoid component stability documented at the time of arthroscopy with the prearthroscopic assessment of glenoid component stability based on CTA. Our hypothesis was that the CTA does not always readily identify glenoid component loosening, and therefore, this clinical entity can be overlooked in the painful postarthroplasty patient. This observation expands the indications for arthroscopy of the painful total shoulder arthroplasty, because we believe that a painful shoulder arthroplasty in the absence of a clinical or radiographic explanation warrants arthroscopic inspection of the glenoid component as well as a concomitant soft tissue biopsy specimen to rule out infection.

## Methods

A retrospective review of the medical records spanning a 5½-year period (May 2009 to August 2014) was conducted to identify patients with a chief complaint of painful shoulder arthroplasty at our institution at a minimum follow-up of 1 year after the index procedure.

All patients with reverse arthroplasty, hemiarthroplasty, or revision arthroplasty were excluded. We also excluded patients with a clear identifiable cause for pain such as rotator cuff insufficiency or gross component loosening as seen on plain radiographs. Shoulders with culture-positive aspiration were also excluded. There were 14 patients, all with pegged glenoid components, in which glenoid loosening was expected despite inconclusive plain radiographs (Fig. 1).

In such cases, our practice is to perform a CTA to assess for bone quality and glenoid loosening, followed by arthroscopy to obtain soft tissue biopsy specimens (held for 21 days) to rule out infection. Therefore, this protocol was carried out in these 14 patients with a single surgeon performing all arthrogram interpretations and arthroscopies.

All CTAs were evaluated by the senior author (J.J.P.W.) and the presence or absence of contrast material medial to the polyethylene or around the pegs was recorded (Fig. 2). Operative reports and arthroscopic imaging were reviewed to assess component stability (Fig. 3), and all videotapes routinely recorded for each patient were reviewed as well.

A statistical analysis was performed to determine the sensitivity, specificity, positive predictive value, and negative predictive value of CTA in identifying glenoid component loosening.

## Results

CTA suggested loosening of the glenoid component in 8 of the 14 patients (57.1%), whereas direct arthroscopic inspection identified loosening in 10 patients (71.4%). The CTA in 1 patient (7%) suggested loosening, but direct arthroscopic inspection showed the glenoid was stable. In 3 of 10 patients (30%), the CTA suggested a well-fixed

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