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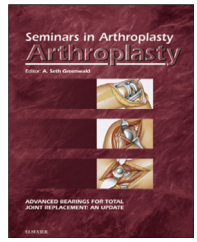

Anatomic total shoulder arthroplasty for severe glenoid bone loss: Still a viable option

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ABSTRACT

Anatomic total shoulder arthroplasty has been the gold standard for glenohumeral osteoarthritis without rotator cuff tear. There is a subset of patients with severe glenoid bone loss and glenoid retroversion that have predictably worse outcomes with component loosing and posterior instability, making reverse shoulder arthroplasty an attractive solution. Although reverse shoulder arthroplasty solves many issues with glenoid component loosing, it has concerns of higher complication rates and reduced functional outcomes. With a deeper understanding of biomechanics there are several strategies including augmented glenoid components to make anatomic total shoulder arthroplasty a more viable option for severe glenoid bone loss.

Anatomic total shoulder arthroplasty (TSA) has been used for decades for the treatment of glenohumeral joint osteoarthritis. Multiple long-term studies have shown that with modern implant systems, patient with osteoarthritis with an intact rotator cuff can have excellent outcomes including function, pain relief, and implant longevity [1,2].

Neer initially reported on posterior glenoid wear and posterior subluxation in patients with primary glenohumeral arthritis in 1974 [3]. Since then, numerous studies have shown that posterior glenoid wear and posterior subluxation is common in glenohumeral osteoarthritis. Churchill et al. has shown in their cohort of 106 consecutive patients that underwent TSA for glenohumeral arthritis that 41% of those patients had a biconcave B2 glenoid. In this cohort, the majority of the erosions were posteroinferior [4].

When anatomic TSAs are performed without addressing glenoid bone loss and retroversion, the shoulder becomes unbalanced due to the altered joint reactive forces that leads to eccentric stresses placed on the glenoid component. This places the TSA at risk for polyethylene wear, component loosening, and/or instability [5]. Ho et al. showed in their study with 66 shoulders with an average of 3.8 years follow-up that patients with post-op retroversion greater than 15. had a five times increased risk of radiolucent lines around the glenoid component [6]. Walch et al. also showed similar results in their study of 92 TSA in 75 patients with primary glenohumeral arthritis with a B2 glenoid. At an average follow-up of 77 months, 20.6% of patients had glenoid loosening and 15 shoulders underwent revision surgery for loosening, posterior instability, or soft tissue problems [7].

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2. Eccentric glenoid reaming

Multiple strategies have been used to address glenoid bone loss and retroversion in anatomic TSA. Eccentric reaming is a technique where the anterior glenoid cortex is preferentially reamed to correct the deformity. In patients with glenoid bone loss and retroversion, this is a powerful technique to restore balance in a shoulder with posterior wear and subluxation. Habermeyer et al. showed in their series of 77 patients with 2-year follow-up that with eccentric reaming, they were able to balance all shoulders with pre-operative posterior bone loss and retroversion [8]. Similarly, Gerber et al. showed in their series of 23 patients with mean 42 months follow-up with an average pre-operative retroversion of 18° and posterior subluxation of 71%, that they were able to re-balance the glenohumeral joint in 91% of patients [9].

There are limits to eccentric reaming for these patients with severe glenoid bone loss and retroversion. With over-aggressive reaming, Walch et al. has shown that this technique can reduce the subchondral support and is associated with worse outcomes [10]. Gillespie et al. [11] and Clavert et al. [12] has also shown that correction of greater than 15° of retroversion leads to glenoid implant peg perforation potential compromising glenoid component fixation.

3. Glenoid bone grafting

Another strategy to address severe glenoid bone loss and retroversion, includes bone grafting especially if the retroversion is greater than 15° or if there is insufficient glenoid bone stock for glenoid component fixation. Both autograft and allograft bone grafting have been studied and unfortunately, multiple studies have shown poor results with this technique. Hill and Norris reported on 17 TSAs that required bone grafting and had 47% of these patents with unsatisfactory results with nonunion, loss of fixation, and five patients requiring revision surgery [13]. Walch et al. found similar results in their study of 75 patients with biconcave glenoid with a minimum follow-up of 2 years. Of these 75 patients, 10 required structural bone grafting due to increased deformity. Data analysis showed that posterior bone-grafting was associated with worse outcomes and is no longer recommended by the authors [10].

4. Augmented glenoid component

A more recent strategy to address glenoid bone loss is the use of augmented glenoid components (Fig. 1). Rice et al. has shown in their study of 14 shoulders with a mean follow-up of 5 years that 12/14 patients had excellent or satisfactory results [14]. Sabesan et al. showed in their study of 29 patients with glenohumeral osteoarthritis and significant posterior glenoid bone loss and retroversion that using an augmented glenoid versus asymmetric reaming lead to the ability to correct more severe retroversion with less glenoid medialization [15]. More recently, Favorito et al. showed in their series of 22 all-polyethylene, posteriorly augmented glenoid component TSAs with an average pre-operative retroversion of 23.5°, that the results at a mean follow-up of 36 months was good with statistically significant improvements in ROM, VAS, Western Ontario Osteoarthritis of the Shoulder Score, and the SF 36 physical component summary score [16]. Although only short-term studies are available, this is a promising way to address severe glenoid bone loss.

5. Reverse shoulder replacement

Another strategy to address severe glenoid bone loss includes the placement of a reverse shoulder arthroplasty (RSA). Although initially intended for the treatment of cuff tear arthropathy (CTA), the use of RSA has expanded in the past several decades. The appeal of a RSA in patients with glenoid bone loss is the improved fixation and constraint compared to an anatomic TSA [5]. Unfortunately, this strategy is not the best option for all patients due to the limitations and increased complications with RSA when compared to anatomic TSA. Although not universally accepted, most patients with a RSA are recommended to limit weightlifting or other contact sports with their operative extremity. Multiple studies have also shown increased rate of complications, longer length of hospital stay, and worse functional outcomes with RSA compared to anatomic TSA [17–19].

Although a RSA allows adequate fixation in patients with severe bone loss and retroversion, it does not automatically negate the consequences of severe bone loss and retroversion. Favre et al. showed in their biomechanical study that with greater than 20° of glenoid retroversion in RSA, there is increased instability [20]. Permeswaran et al. [21] showed in their finite element model that increased retroversion in RSA leads to increased impingement and Keener et al. [22] recently showed in their computer ROM analysis that increased glenoid component retroversion in RSA leads to decreased external rotation and extension.

Looking specifically at patients with severe bone loss and retroversion, multiple studies have shown the high complication rate and decreased satisfaction with RSA. Mizuno et al. showed in their series of 27 RSAs with an average retroversion of 32° and 87° of posterior subluxation, that there was a 15% complication rate and 37% scapular winging rate at a mean of 4.5 years follow-up [23]. In a recent study, Alentorn-Geli et al. found in their matched cohort study between anatomic TSA and RSA in patients with biconcave glenoid that functional outcomes and satisfaction was higher in those who underwent an anatomic TSA [24].

6. Conclusion

Glenoid bone loss and retroversion is common in patients with glenohumeral arthritis. These patients have traditionally been treated with anatomic total shoulder arthroplasty with overall good results in most patients. With severe glenoid bone loss and posterior humeral subluxation, implantation of an anatomic total shoulder arthroplasty without correcting the bone loss and retroversion can lead to poor results and posterior instability due to eccentric loading of the glenoid

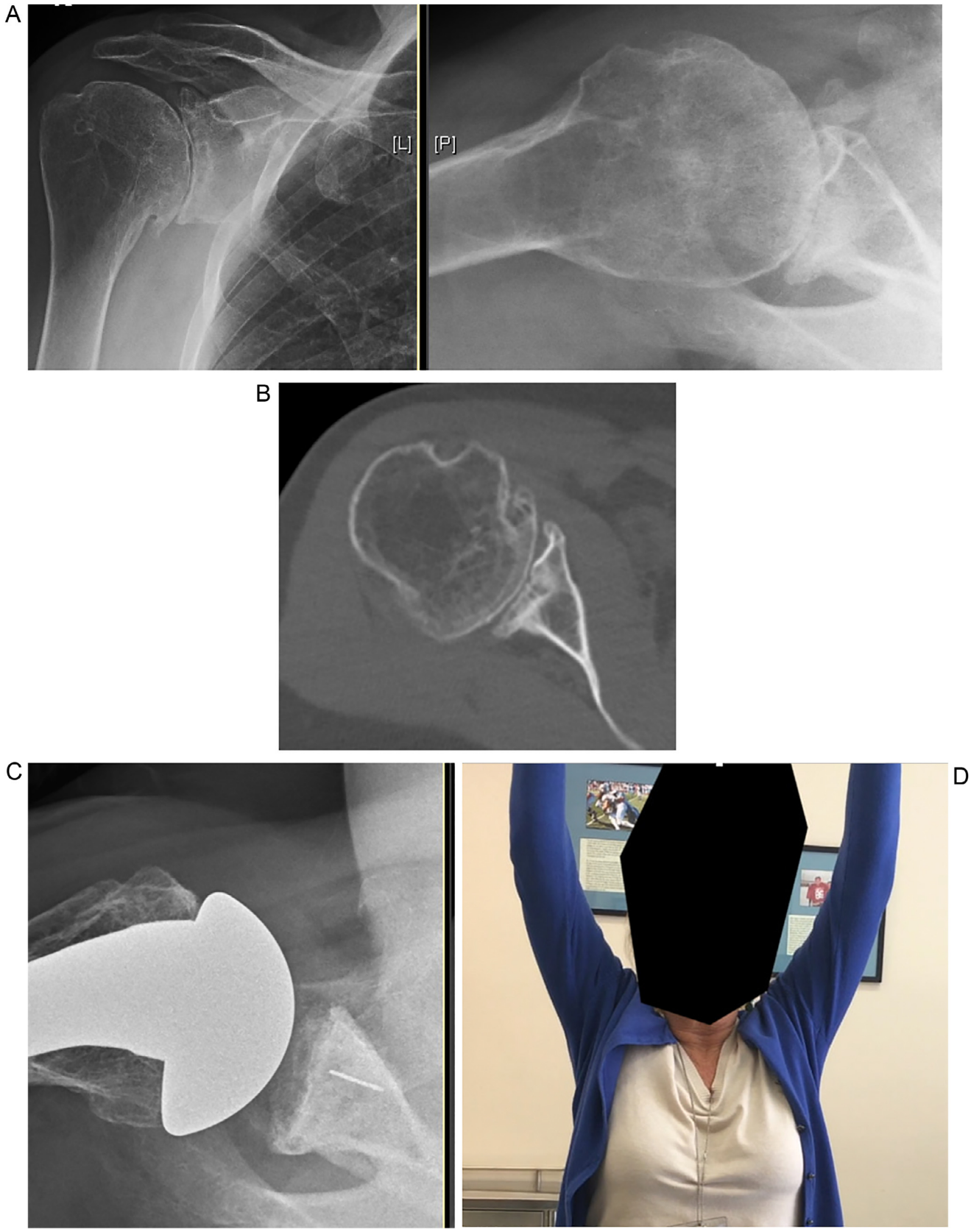

Figure 1 – Severe Posterior glenoid erosion. (A) Radiographs of right shoulder osteoarthritis with severe posterior glenoid erosion. (B) Computed tomography (CT) axial view of mid glenoid with B2 glenoid morphology with B2 glenoid morphology, posterior humeral subluxation of 75% and 25° of glenoid retroversion. (C) Axillary radiograph 2 years after anatomic total shoulder replacement with posteriorly augmented glenoid component with well centered articulation. (D) Clinical image demonstrating 155° of forward elevation of the right shoulder 2 years after anatomic total shoulder replacement.

component. Strategies to address glenoid bone loss and retroversion, including eccentric reaming, bone grafting, augmented glenoid components, have been studied and have had good but unpredictable results. An attractive alternative arthroplasty for severe glenoid bone loss and retroversion is RSA. Although some patients may have appropriate expectations for RSA, multiple studies have shown that RSA has an increased complication rates, decreased total ROM, and decreased satisfaction rate when compared to anatomic TSA. With the established strategies of addressing glenoid bone loss and retroversion along with the continual advancement in technology, anatomic TSA is still a viable option for selected patients with glenohumeral arthritis with severe bone loss and retroversion.

Disclosures

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