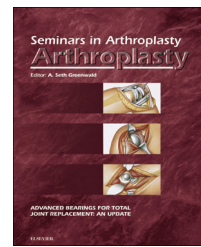


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Reverse shoulder arthroplasty for proximal humerus fractures



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ABSTRACT

A reverse shoulder arthroplasty is a consideration for the treatment of comminuted four-part proximal humerus fractures in elderly patients. While a reverse TSA should not replace other treatment modalities, it is indicated in elderly patients with fractures that are not amenable to fixation. Immediate stability and relative independence from tuberosity healing are clear advantages, but the complication rate is substantially higher. Larger studies are necessary to clarify appropriate indications.

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1. Introduction

Proximal humerus fractures result in substantial disability, especially in the elderly population. Proximal humerus fractures account for nearly 10% of all fractures in the elderly [1,2]. Many nondisplaced or minimally displaced fractures can be treated non-operatively with a brief period of sling immobilization followed by early mobilization. However, more complex fracture patterns, including those with articular incongruity or articular fragment displacement, may require surgical intervention.

Options for surgical treatment include open reduction and internal fixation (ORIF) with periarticular locking plates, hemiarthroplasty, or, more recently, reverse total shoulder arthroplasty [1,3–5]. In general, ORIF is the preferred option if an anatomic reduction is obtained and fixation strength is adequate to provide appropriate support. Indications for fixation include two-part surgical neck fractures, selected three-part fractures, and valgus-impacted four-part fractures. Four-part fractures in younger patients require special consideration. Although many of these fractures are at risk for

avascular necrosis, fixation is preferred over an arthroplasty given longevity concerns in the younger population.

Complex three-part and four-part fractures, fracture-dislocations, and humeral head-splitting fractures may be contraindicated for ORIF due to high risk of nonunion, malunion, or osteonecrosis (Fig. 1) [3,4,6]. In these cases, arthroplasty options are considered. Hemiarthroplasty for treatment of proximal humeral fractures was originally described by Neer [4,7] and is intended to address the concerns arising from ORIF in elderly patients. Historically, studies have reported inconsistent results for ROM and function. Results depend on the healing of the greater and lesser tuberosities to the implant [8–11]. Complications following hemiarthroplasty stem from displacement and osteolysis of the tuberosities, which subsequently lead to loss of function [12,13]. Fracture-specific stems, which have design components to promote tuberosity healing, have been utilized more recently to address some of these concerns [5,14,15] but have not resulted in major improvements in the ultimate outcome.

Reverse total shoulder arthroplasty has been traditionally indicated in low-demand, elderly patients with rotator cuff

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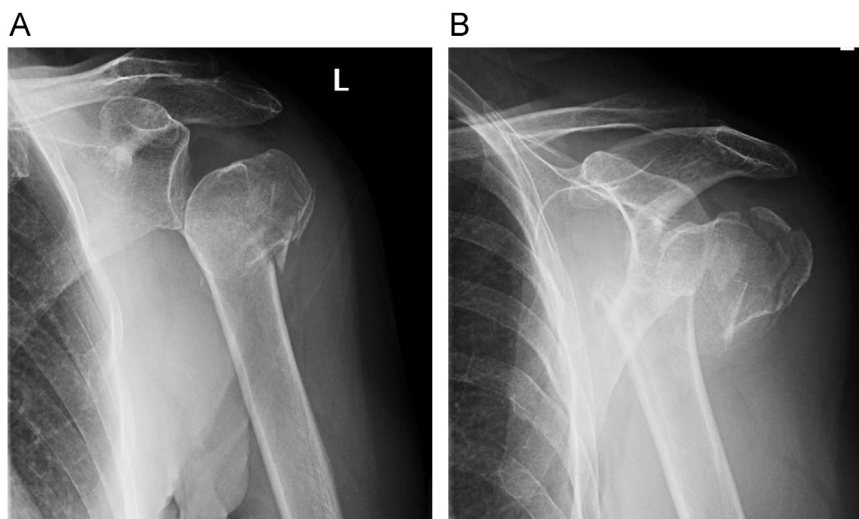


Figure 1 – (A) True AP and (B) AP radiographs demonstrating a three-part proximal humerus fracture with significant tuberosity comminution, which is an example of the type of fracture that is amenable for reverse total shoulder arthroplasty.

arthropathy [16,17]. This design is intended to function relatively independent of an intact rotator cuff. Therefore, it has become a consideration in the treatment of fractures, especially in elderly and lower-demand patients. Theoretically, outcome after a fracture does not rely as much on tuberosity healing or a functioning rotator cuff compared to hemiarthroplasty [18–24]. Original indications include elderly patients over 75 years of age, significant osteoporosis, significant medical comorbidities, tuberosity comminution, and pre-injury rotator cuff lesions [13,15]. Several case reports have shown promising early results of reverse shoulder arthroplasty with pain relief and functional gains [18–24], and this has led some to broaden the indications. However, a substantial complication rate has been reported [15]. The purpose of this review article is to review the surgical technique, outcomes, complications, and future directions for reverse total shoulder arthroplasty in the setting of proximal humeral fractures.

2. Technique

Surgical technique for a reverse total shoulder arthroplasty in the setting of proximal humerus fractures utilizes either the standard deltopectoral approach or the superolateral approach [15]. The fracture fragments, humeral head, and tuberosities are identified once the shoulder has been exposed. The humeral head is removed, and the tuberosities are retracted to facilitate glenoid exposure [25]. Heavy sutures are passed through the bone-tendon junction of the tuberosities for control and later fixation. Glenoid baseplate and glenosphere implantation follow standard techniques [16,25].

After glenoid implantation, the humerus is prepared. Sequential reamers are used until cortical contact is obtained. Humeral stem height is adjusted depending on the amount of proximal metaphyseal bone loss, with the goal being to restore appropriate tension of the deltoid and conjoint tendons [25]. The tension can also be adjusted by variable sizes of polyethylene spacers.

Reverse humeral stem implantation can be either cemented or non-cemented [15,18–20,22–26]. However, in the setting of a fracture, stems are usually cemented because of the proximal shaft and metaphyseal bone loss (Figs. 2 and 3). Either a suture or a wire should be placed through the bone-tendon junction of the tuberosities before implanting and reducing the humeral component because access to the tuberosities is limited once the prosthesis is implanted. There are no formal recommendations for tuberosity fixation [15,25], and the material used is based on the surgeon's preference. Our preference is to use an 18-gauge wire, which is passed around the neck of the prosthesis. The wire provides stable fixation, and the circumferential pattern brings the tuberosities into close approximation to the prosthesis [25].

Post-operatively, patients are immobilized in a sling for 4 weeks. Immobilization allows for healing and resolution of swelling and may prevent tuberosity migration [25]. Most studies describe a self-directed progressive range-of-motion protocol after the immobilization period and rarely utilize a formal physical therapy program [13]. The authors' preference is to initiate pulley exercises at 4 weeks and progressive participation in daily activities.

3. Outcomes

Outcomes of reverse total shoulder arthroplasty for proximal humeral fractures are generally described in small-patient-number case reviews or cohort studies [18–20,26]. Retrospective studies of reverse shoulder arthroplasty for fracture describe good to excellent results in terms of forward elevation, pain relief, and patient outcome scores. Follow-up in these studies was variable, but it generally averaged 20–40 months. The rate of clinical complications reported is variable, and the most common complications are post-operative hematoma and neurologic injury [18,19,22,26]. The most common radiographic complication is scapular notching. The frequency is variable and grading is inconsistent [15,26].

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