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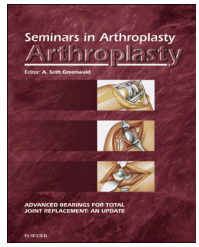

Periprosthetic humeral fractures in shoulder arthroplasty

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ABSTRACT

Periprosthetic fractures associated with shoulder arthroplasty are uncommon but can be very difficult to treat. Treatment options depend on the timing of the fracture, the type of fracture, and the stability of the implant. Understanding these characteristics of periprosthetic fractures helps the practicing surgeon to avoid them and also to determine how best to manage them when they do occur.

Despite the success of shoulder arthroplasty, periprosthetic fractures are a recognized complication. Based on large case series, they have been estimated to occur in anatomic total shoulder arthroplasty with an incidence between 1.5% and 2.4% [1–3]. Rates of fracture associated with reverse shoulder arthroplasty have not been as well described. Although multiple classification systems have been developed [4,5], all are based on relatively small series, and are either of limited clinical relevance or are insufficient to help guide treatment decisions. Instead, the three most essential characteristics that one needs to consider are the location of the fracture, the timing of the fracture, and the stability of the components. By understanding these characteristics, surgeons can be aware of the types of periprosthetic fractures associated with shoulder arthroplasty, how to avoid them, and how to manage them when they do occur.

Risk factors for periprosthetic fractures include age, rheumatoid arthritis, female sex, osteopenia, and excessive surgical manipulation [2,6]. Essentially, anything that decreases bone quality is a risk factor for fracture. They can occur either intra-operatively or as a late complication. Intra-operative fractures are primarily the result of poor surgical exposure or overzealous manipulation of the arm. A key to preventing these fractures is appropriate surgical positioning. Ensuring that the shoulder is off the edge of the bed allows extension and external rotation of the arm without undo force (Fig. 1). Additionally, inadequate soft tissue releases or humeral head resection limit exposure may cause errors in humeral preparation. Care must be taken to release the entire inferior capsule, the capsule on the undersurface of the subscapularis, and the rotator interval to allow appropriate retraction of these tissues. The entry point into the humeral canal may vary slightly but typically is lateral to the center of rotation of the humeral head and posterior to the biceps groove (Fig. 2). Failure to find an appropriate starting point or inadequate exposure may lead to reaming in a more varus position, which risks lateral cortex perforation. Finally, when placing the humeral stem, care must be taken to avoid oversizing. Stems and trials in reverse shoulder arthroplasty, in particular, have a proximal flare that may cause a fracture, if they are aggressively impacted without appropriate reaming.

For post-operative fractures, the same patient-specific risks apply. In addition, creation of a stress riser substantially increases fracture risk. This may result from cortical perforation, endosteal notching, or even ipsilateral shoulder and

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Figure 1 – Appropriate patient positioning includes ensuring that shoulder is positioned off the bed so that the arm is free to extend and externally rotate. In this case, the shoulder pad on the operating table is removable (black arrow). (Color illustration of figure appears online.)

elbow arthroplasties. Stem loosening or osteolysis creates cortical defects that may predispose to fracture as well.

Two major classification systems have been described for periprosthetic fractures. The classification by Iannotti and Williams [4] is primarily based on location (Table 1). Wright and Cofield [5] developed a classification system that is also based on location in relation to the tip of the humeral implant (Table 2). However, these systems have not been validated and do not take into account the stability of prosthesis, which is clearly important for decision making. The inter-observer reliability of the Wright and Cofield classification was recently evaluated and found to be poor [7]. Therefore, decision making cannot be based entirely on classification and instead must rely on critical evaluation of the timing of the fracture, the location of the fracture, and the stability of the stem.

For those fractures that occur intra-operatively, the key principle is ensuring that the arm is stable at the completion of the case. Management should not be delayed until a later

Table 1 – Iannotti and Williams Classification of Periprosthetic Fractures

Region	Location of Fracture
1	Tuberosity
2	Metaphyseal fracture
3	Proximal diaphysis
4	Diaphysis distal to the tip of stem

Table 2 – Wright and Cofield Classification of Periprosthetic Fractures

Type	Location of Fracture
A	Begins at the tip of humeral stem and extends proximally
B	Begins at the tip of humeral stem and extends distally
C	Completely distal to the tip of humeral stem

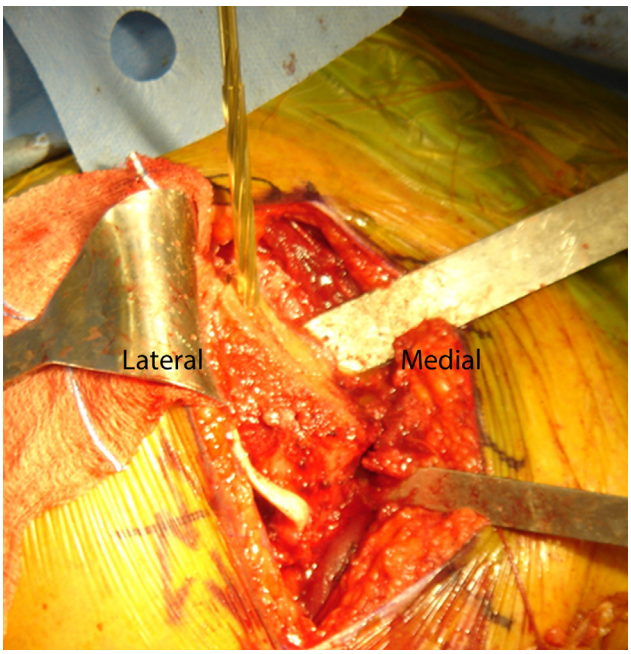

Figure 2 – When reaming, care is taken to identify a start point on the lateral aspect of the humeral head to ensure that the reamer is not introduced in a varus position. (Color illustration of figure appears online.)

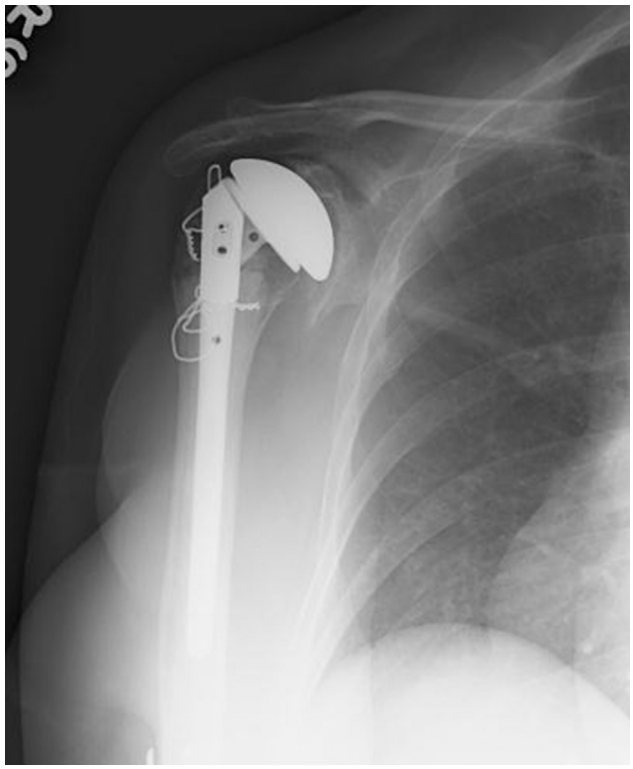

Figure 3 – Anteroposterior radiograph of the right shoulder demonstrates an intra-operative tuberosity fracture that was secured with cerclage wires.