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Acute proximal humeral fractures in adults

Véronique Lowry PT, MSc [a], Nathalie J. Bureau MD, MSc, FRCPC [b,c], François Desmeules PT, PhD [a,d], Jean-Sébastien Roy PT, PhD [e,f], Dominique M. Rouleau MD, MSc, FRSCS [g,h,*]

[a] Department of Research, Maisonneuve-Rosemont Hospital Research Center, University of Montreal Affiliated Research Center, Montreal, Quebec, Canada
[b] Radiology Department, University of Montreal, Montreal, Quebec, Canada
[c] Department of Research, Research Center, Centre Hospitalier de l'Université de Montréal, Montreal, Quebec, Canada
[d] Department of Rehabilitation, School of Rehabilitation, Faculty of Medicine, University of Montreal, Montreal, Quebec, Canada
[e] Department of Rehabilitation, Faculty of Medicine, Laval University, Quebec City, Quebec, Canada
[f] Center for Interdisciplinary Research in Rehabilitation and Social Integration, Quebec, Canada
[g] Department of Surgery, Hôpital du Sacré-Cœur de Montréal, Montréal PQ, Canada
[h] Department of Surgery, Université de Montréal, Montréal PQ, Canada

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ABSTRACT

Study Design: Clinical commentary.
Introduction: Proximal humeral fractures (PHF) are the third most common fracture in the elderly with an increased incidence expected in the coming years with the aging population, causing an important burden to the healthcare system. The management of PHF is challenging due to its complexity and the wide variety of fractures and treatment options.
Purpose: The objective of this clinical commentary is to update the available evidence on clinical presentation, classification, imaging, medical treatment, and rehabilitation of acute PHF.
Methods/Results/Discussion: N/A for clinical commentary.
Conclusions: The first step to a successful management of PHF is the clinical and radiographic examination of the shoulder, which enables the physician to classify the fracture and choose the appropriate treatment option. The Neer and OA classifications are commonly used and are based on the identification of the fractured parts of the humerus, as well as the displacement of the fragments. In case of non-displaced or minimally displaced fractures, a conservative treatment, consisting of initial immobilization and a rehabilitation program will be chosen. Displaced or unstable fractures will be managed operatively. Different surgical options exist and will vary according to the fracture type, patient's age, and functional needs, followed by rehabilitation.
Level of Evidence: 5.

Introduction

Proximal humerus fractures (PHFs) are the third most common fracture in the elderly, after proximal femur and distal radius fractures,[1] and represent 10% of all fractures.[2] Their incidence is expected to increase in upcoming years with the aging population, leading to greater costs to the health care system. When a proximal humerus fracture occurs, the individuals suffering from this injury are usually still active,[3,4] and the injury leads to important disability and loss of health-related quality of life that often becomes permanent.[5] The risk of PHF increases with age and is most prevalent in osteoporotic elderly women.[6] Apart from bone fragility, caused by osteopenia or osteoporosis, commonly reported risk factors include those related to increased risk of falls, such as low level of physical activity, impaired balance, or lower limb pain or injury.[4,5] It is also more prevalent in elderly populations with a history of previous falls.[4,5]

PHF includes all fractures to the anatomical neck, surgical neck, greater tuberosity (GT), or lesser tuberosity, either isolated or in combination.[3] The management of PHF, both in terms of diagnostic

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* Corresponding author. Hopital du Sacré-Coeur de Montréal C2095-5400 Boul, Gouin Ouest, Montreal, Quebec, Canada, H4J 1C5. Tel.: 1-514-338-2222 #3427; fax: 514 338-2694.
E-mail address: dominique.rouleau@umontreal.ca (D.M. Rouleau).

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and treatment, remains a challenge and varies according to the clinical presentation.[7] Severity and displacement of the fracture will be assessed with a clinical history, examination findings, and radiographic investigations to determine prognostic and treatment options.[8] However, because of the complexity of the clinical presentations, and various fracture patterns, the most beneficial approach often remains unclear[1] and high-quality evidence regarding the management of PFH remains scarce. Therefore, the purpose of this review was to update the available evidence on clinical presentation, classification, imaging, medical treatment, and rehabilitation of acute PHF.

Clinical presentation and classification

The 2 most common clinical presentations for PHF are (1) high-level energy trauma such as sports injuries and motor vehicle accidents, usually observed in patients aged between 20 and 45 years and (2) low-energy trauma, such as a fall from a standing position or a direct blow to the shoulder, usually observed in the elderly. There is a steep rise in the incidence of PHF beyond 45 years of age and more so in women than in men.[9]

There are 2 main classifications used for PHF (Neer and AO classifications) and one specific to GT fractures. In 1970, Neer proposed a classification, which divides the proximal humerus in 4 functional parts: the head (articular segment), lesser tuberosity, GT, and humeral shaft. Anatomically, the head is almost hemispherical and is set between 130° and 150° cephalad to the long axis of the humeral diaphysis in the coronal plane, whereas the GT footprint projects 5-7 mm distally to the most cranial point of the humeral head convexity. Neer's classification takes into consideration whether the fracture is associated with a dislocation, the presence of a head split, and the extent of fragment displacement. A displaced fracture is classified as 2-part, 3-part, or 4-part fractures, according to the number of fragments, with more than 45° of angulation or more than 1 cm of displacement. However, different criteria apply to the GT, which is considered to be displaced beyond 5 mm of displacement. A Neer I (1-part) fracture is considered undisplaced and represents most fractures of the proximal humerus, although recent data suggest that displaced fractures are more prevalent than originally stated by Neer.[10]

The 1987 AO classification uses a 3-category division of A, B and C. Type A fractures are simple fractures, type B fractures involve the surgical neck, and type C involve the anatomical neck.[11] In these 2 classifications, the GT is categorized as displaced or not displaced.

In 2014, Mutch et al.[12] proposed a 3-category classification of fractures involving the GT based on the fracture's morphology. Each fracture category is associated with a specific treatment approach. The first type, representing 40% of cases, is the split fracture. It is defined by a large fragment with a vertical fracture line. The second type is the avulsion fracture (40%), which consists of a very small fragment with a horizontal fracture line. The last type, representing 20% of cases, is an impacted GT fracture.

These 3 classification systems have been studied for their reliability. Data on reliability can be found in Table 1.

Imaging

When a PHF is suspected, a conventional radiography is the first examination to be performed. Most PHF may be diagnosed on anteroposterior (AP) radiographs of the shoulder, but characterizing the fracture displacement and classifying the fracture type on radiographic studies are very difficult, especially for more complex fractures.[16] The radiographic trauma series for the shoulder may also vary between centers. At our institution, the initial radiographic evaluation consists of an AP view of the shoulder with the arm in internal or neutral rotation, depending on the patient's tolerance to pain, of a 45° posterior oblique projection (known as the Grashey view) and of a scapula Y view, also referred to as the tangential view of the scapula or Neer's view (Fig. 1). These views are generally obtained with the patient standing but alternatively can be performed with the patient supine. The AP view, with the arm in internal or neutral rotation, allows an evaluation of the displacement of fragments in the frontal plane. The Grashey view allows visualization of the glenohumeral joint in profile and delineates the contours of the GT. The scapula Y view is a lateral projection of the humeral head and is helpful to assess the displacement of fracture fragments in the sagittal plane (AP direction), as well as the relationship of the humeral head to the glenoid. These views provide complementary information regarding the spatial configuration of a PHF and can be performed with minimal mobilization of the injured arm.

Another view that can be performed in the context of trauma to the shoulder is the axillary view (Fig. 2) to assess whether there is any associated dislocation with the PHF. This view allows the evaluation of the glenohumeral joint and acromion and coracoid process and, similarly to the scapula Y view, provides an evaluation of the displacement of the fracture fragments in the AP direction in relation to the glenoid. The patient is in the supine position with the arm abducted and supported. The x-ray beam is oriented horizontally and directed toward the axilla. Alternatively, in patients who are unable to tolerate the abducted position of the arm because of pain, a Velpeau view may be substituted. To obtain this view, the patient's arm is held in internal rotation and the x-ray beam is directed superior to inferior relative to the shoulder while the patient is standing and leaning backward at an angle of approximately 45°. The axillary view is very helpful to exclude a glenohumeral dislocation associated with a PHF, but it is technically challenging, especially in the elderly population, and is often more painful for the patient. Consequently, it is often omitted in the shoulder trauma series, even when specifically ordered, and its value in treatment management planning has been recently challenged.[17] Computed tomography (CT) with 2-dimensional (2D) reconstructions in the sagittal oblique and coronal oblique

Table 1
Reliability of the 3 common classification systems for acute proximal humeral fractures in adults according to selected validity studies

Study	Neer	AO	GT morphology
Brorson 2012,[13] $n = 193$	Kappa interobserver, 0.33		
Carrerra 2012,[14] $n = 56$	Kappa interobserver, 0.063 and intraobserver, 0.362	Kappa interobserver, 0.028 and intraobserver, 0.460	
Sukthankar 2013,[15] $n = 47$	Kappa interobserver, 0.44 and intraobserver, 0.42-0.77	Kappa interobserver, 0.47 and intraobserver, 0.61-0.71	
Mutch 2014,[12] $n = 139$ GT fracture	Kappa interobserver, 0.31-0.35 and intraobserver 0.54-0.63	Kappa interobserver, 0.30-0.32 and intraobserver 0.59-0.65	Kappa interobserver, 0.73-0.77 and intraobserver 0.69-0.86

GT = greater tuberosity.