Systematic Review Comparing Internal Fixation Versus Hemiarthroplasty in Management of 4-Parts Fracture of Proximal Humerus in Elderly Population

A Systematic Review of Literature

Essay

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INTRODUCTION

Proximal humeral fractures account for approximately 5% of all fractures[1]. More than 70% of patients with these fractures are older than 60 years of age, 75% are women, and the fractures are often related to osteoporosis, for this elderly population the goal of treatment of proximal humeral fractures is to maintain independence of daily living by achieving a painless shoulder with an adequate function[2,3].

The most frequently used classification for proximal humeral fractures is Neer classification, The displaced 4-part fracture of proximal humerus is defined as a fracture with at least 10 mm of displacement and/or 45° or more of angulation between the head and shaft fragments and a fracture of the greater or lesser tubercle with at least 10 mm of displacement[4,5].

The majority of proximal humeral fractures are non or minimally displaced, and are well treated nonoperatively[6,7]. In displaced three-and four-part proximal humeral fractures surgical treatment is recommended[8,9].

However, the optimal surgical management remains controversial. A wide variety of treatment modalities, varying from minimal percutaneous Osteosynthesis to prosthetic replacement of the humeral head, has been described.[10, 11]

Open reduction and internal fixation (ORIF) with locking plates has the potential to restore the anatomy; however, a risk of complications exists related to the implant[12] and to the surgery itself. [13] Shoulder hemiarthroplasty is indicated in patients with displaced and comminuted fractures, where avascular necrosis of the humeral head seems inevitable. According to Hertel et al, [14] the predictors of humeral head ischemia are the integrity of the medial hinge, the length of the dorsomedial metaphyseal extension of the head fracture (calcar length), and the fracture type[14].

In elderly patients, most displaced 3-and 4-part fractures, fracture-dislocations, and fractures with a split or impacted humeral head with a loss of more than 40%of the articular surface can be managed by hemiarthroplasty. [15, 16, 17, 18]

Aim of the Work

A Systematic Review of literature to compare the results of open reduction internal fixation versus hemiarthroplasty in the management of 4- parts fracture of the proximal humerus in elderly patients.

Chapter 1

ANATOMY

The glenohumeral joint is the most mobile joint in the body, resulting from a series of complex interactions among bone, muscle, and soft tissue forces. An appreciation for this anatomy enables the surgeon to effectively restore function in the setting of fracture, the proximal humerus includes the humeral head, greater tuberosity, lesser tuberosity, and the humeral shaft. In the sagittal plane, the humeral head is retroverted an average of 20 degrees relative to the humeral shaft [(19)]. In the coronal plane, it is angled 130 to 150 degrees cephalad relative to the diaphysis. Fractures through the anatomic neck can result in significant vascular compromise to humeral head leading to avascular necrosis[(20)].

In neutral rotation, the greater tuberosity forms the lateral border of the proximal humerus. The lesser tuberosity, which sits directly anterior in this position, becomes profiled medially when the humerus is internally rotated this creates a rounded silhouette "lightbulb sign" on radiograph. The long head of biceps passes between the two tuberosities in the intertubercular groove, approximately 1 cm lateral to the midline of the humerus, and its relationship is an important landmark during fracture reduction [(20)]. The long biceps tendon arises from the supraglenoid tubercle and partly from the superior glenoid labrum, the tendon is intra-articular but extra

synovial, with a surrounding synovial-lined sheath that communicates with the glenohumeral joint and extends into the bicipital groove. As it passes anteriorly and laterally to the bicipital groove, the intra-articular portion of the LHBT is cradled and stabilized by the superior glenohumeral ligament (SGHL) and coracohumeral ligament (CHL), which fuse along the lateral half of the rotator interval with fibers from the subscapularis and supraspinatus to form the biceps pulley, The LHBT undergoes a rather abrupt angulation of 30 to 40 degrees as it passes through the pulley and into the bicipital groove[21]

The supraspinatus muscle, innervated by the suprascapular nerve, attaches to the superior facet of the greater tuberosity with a force vector that pulls predominantly in a medial direction, The infraspinatus muscle, also innervated by the suprascapular nerve, inserts on the middle facet of the greater tuberosity, The teres minor muscle, innervated by the axillary nerve, attaches to the inferior facet. Together, these three externally rotate and yield a posteromedially directed deforming force. Therefore, if the greater tuberosity is fractured, it is displaced posteromedially. If it remains intact, and there is a surgical neck fracture, the resulting deformity is typically varus and external rotation, Anteriorly, the subscapularis gets innervated by the upper and lower subscapular nerves, attaches to the lesser tuberosity, resulting in anteromedial displacement of this osseous fragment if fractured [20,22].

When fractured, the greater and lesser tuberosities are deformed by their musculotendinous rotator cuff attachments (Figure 1) [23].

Figure (1): The deforming forces on the proximal humerus in the setting of fracture. The supraspinatus (A) exerts a force posteromedially. The infraspinatus and teres minor (B) pull posteromedially and externally rotate. The subscapularis (C) exerts an anteromedially directed force on the lesser tuberosity. The pectoralis major (D) internally rotates and adducts, while the deltoid (E) pulls superiorly on the metadiaphysis of the humerus[23].

The pectoralis major tendon insertion into the lateral lip of the bicipital groove of the humerus is an important landmark, especially during hemiarthroplasty. Murachovsky et al. showed that the average distance from the pectoralis major tendon insertion to the tangent to the humeral head was 5.6 cm [24].

Torrens and colleagues confirmed this relationship and added that hemiarthroplasty rotation could also be estimated based on the insertion of this tendon, specifically, it had been found that the anatomy of the proximal humerus can be restored by placing the prosthesis 5.6 cm above the upper insertion of the pectoralis major [25].

Additionally, it had been that found the distance from the upper margin of the pectoralis major insertion to be 17.55% of the total humeral length. Thus, for a more anatomic reconstruction, it had been found that acquiring a preoperative radiograph of the contralateral humerus and calculating the patient specific length based on measurements made of the unaffected side [25]. Humeral head vascularity comes from the anterior and posterior humeral circumflex arteries. The anterior humeral circumflex artery (AHCA) runs with its two venae comunicantes as the "three sisters" before anastomosing with the posterior humeral circumflex artery (PHCA). The AHCA gives off an anterolateral ascending branch that crosses the subscapularis tendon anteriorly and runs superiorly along the lateral border of the intertubercular groove before terminating as the arcuate artery [20, 22].

The PHCA runs posteriorly along with the axillary nerve through the quadrangular space, defined by the subscapularis and teres minor muscles superiorly, the teres major inferiorly, the long head of the triceps medially, and the humeral surgical neck laterally, Within the quadrangular space, the PHCA splits into posterior and anterior branches, which run in concert with the branches of the axillary nerve to supply the proximal humerus and deltoid muscle[20].

Classically, the AHCA has been considered the most important blood supply to the proximal humerus, with secondary contributions from the PHCA and muscular attachments of the proximal humerus [22, 26- 28]. More recently,