Resurfacing arthroplasty of the shoulder

Thesis submitted for fulfillment

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Abstract

Shoulder arthroplasty has been a very controversial issue over time. Prosthetic designs have evolved and been altered with changes in concepts of arthroplasty. Resurfacing of the shoulder is a relatively new concept in shoulder arthroplasty that entertains the idea of minimal bone resection. This allows for preservation of bone stock and replication of anatomy.

Keywords

Cementless surface replacement arthroplasty, Glenohumeral, stemmed prosthesis, arthritis.

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Abbreviations

AC	Acromio-clavicular
AVN	Avascular necrosis
CSRA	Cementless surface replacement arthroplasty
CTA	Cuff tear arthropathy
GH	Gleno-humeral
HHR	Humeral head replacement
IGHLC	Inferior gleno-humeral ligament complex
MGHL	Midlle gleno-humeral ligament
PC	Posterior capsule
RA	Rheumatoid arthritis
ROM	Range of motion
SGHL	Superior gleno-humeral ligament
TSA	Total shoulder arthroplasty
TSR	Total shoulder replacement

Introduction

The indications and use of shoulder arthroplasty has dramatically increased over the last decade, and this trend will continue in the future. The average age of our population is increasing, yet there is a strong desire to remain active and viable. The majority of people will not accept limitation of a joint function that compromises their life styles if a reasonable surgical solution is available. Our knowledge of disease processes has broadened and improved our understanding about how best to manage these problem's clinically. Technology and innovation have provided us with options that were not possible before. However, a successful shoulder arthroplasty depends not only on knowledge and modern technology but also on sound clinical judgment, accurate surgical technique, and appropriate postoperative rehabilitation.(1)

Shoulder arthroplasty reliably relieves pain and improves function in the majority of patients with painful arthritic shoulders. However, with modern prosthetic designs, improved anatomical understanding, and continued emphasis on proper rehabilitation, our goals of restoring near-normal function are more often realized. (2)

History

Modern shoulder replacement has developed in two different sources. In Europe it has mainly evolved from massive replacement of the proximal humerus for tumour (3) .In the USA, Dr Charles Neer was developing a shoulder replacement for fractures of the proximal humerus .(4) In 1979 work was started to develop a surface replacement arthroplasty of the shoulder. Many different designs were tried on dry bones to try and determine the best method of fixation for this surface cap. From the outset it was designed as a cementless prosthesis. The prosthesis was first used clinically in 1986 . (5)

Indications

The most common pathologic condition leading to shoulder arthroplasty is osteoarthritis of the glenohumeral joint. It accounts for more than 60% of all shoulder arthroplasties performed . Rheumatoid arthritis (RA) and other inflammatory conditions account for approximately 30% of all shoulder arthroplasty (6). Avascular necrosis account for approximately 3% of patients treated with shoulder arthroplasty. In 1983, Neer et al. described rotator cuff arthropathy (CTA) as arthritis associated with a massive rotator cuff tear and superior migration of the humeral head (7) . Primary and secondary arthritis of the shoulder is the commonest indication for resurfacing arthroplasty of the shoulder. The prosthesis has been used for osteoarthritis, rheumatoid arthritis, avascular necrosis, cuff arthropathy, instability arthropathy, post trauma arthritis, post infective arthritis, arthritis secondary to glenoid dysplasia and ephiphysial dysplasia. It is not intended for use in fresh fractures. (5)

Aim of the work

To show that in patients with glenohumeral pain, resurfacing of the humeral head with a cup seems to be a good alternative to conventional stemmed prostheses. It diminishes the risk of peroperative complications involving the humeral shaft and late periprosthetic fractures. Revision or arthrodesis can be undertaken easily because the bone stock has been maintained with no loss of length. The main advantages of humeral head resurfacing are preservation of bone and the relatively simple surgical technique. (8)

Results

Over the past ten years the design of the surface replacement prosthesis has evolved, but the basic concept and design of surface replacement, minimal removal of bone and cementless fixation has remained constant .The surface replacement prosthesis has demonstrated results equal to those of conventional stemmed prostheses suggesting that the humeral component does not need a stem or cement for fixation (5).

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Anatomy and Biomechanics of the Glenohumeral joint

Anatomy and Biomechanics of the Glenohumeral Joint

The clavicle, scapula and humerus form an intercalated complex working in concert during shoulder motion. The scapula is encased in muscle and therefore has a pseudo-articulation with the chest wall. The scapula is tilted obliquely forward at an angle of 30° from the coronal plane and is tilted 3° medially from the sagittal plane [1].

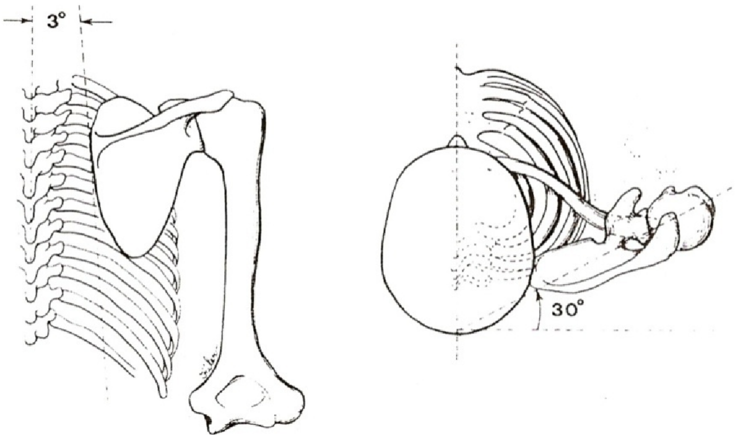

Figure 1. Orientation of the scapula with reference to the chest wall [1].

The thickened lateral aspect of the scapula forms the glenoid, which serves as the articular platform for the proximal aspect of the humerus. The glenoid is separated from the body of the scapula by the scapular neck. The glenoid has an average superior tilt of 5°, which helps control inferior stability. It is generally retroverted with respect to the body of the scapula at an average of 7° [1, 2]

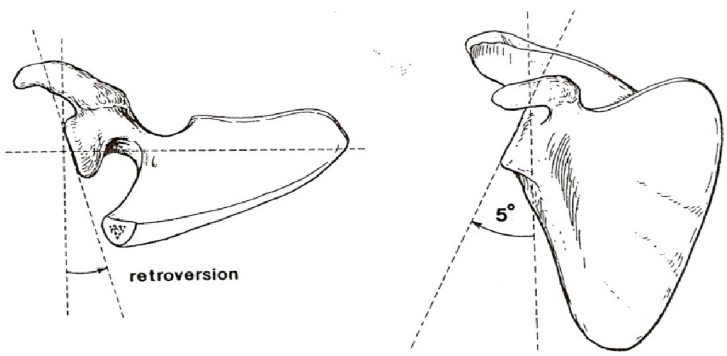

Figure 2. The glenoid version [1].

The proximal aspect of the humerus consists of the humeral head, anatomic neck and metaphysis. The humeral head has an average retroversion of 30 to 40° relative to the transcondylar axis of the distal humerus. The anatomic neck shaft angle of the proximal humerus averages 130 to 140° [1, 2].

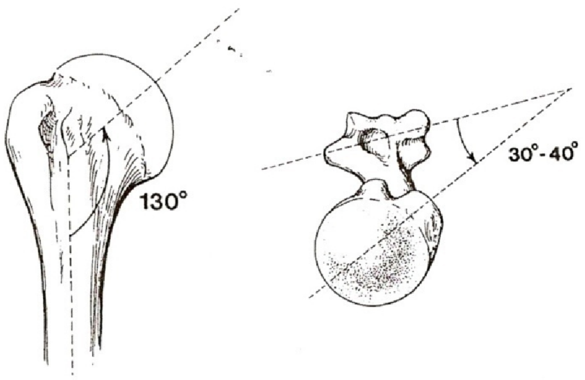

Figure 3. Humeral articular orientation averages 130° at the neck shaft and 30 to 40° of retroversion with respect to the transepicondylar axis [1].

The greater and lesser tuberosities arise from the metaphyseal region and are located on opposite sides of the bicipital groove. The tuberosities play an important role in shoulder function, as they serve as the attachment site for the rotator cuff tendons, with subscapularis inserting on the lesser tuberosity and the supraspinatus, infraspinatus and teres minor inserting on the greater tuberosity. The bicipital groove serves as a trochlea for the long head of biceps tendon, which goes into the glenohumeral (GH) joint to attach to the supraglenoid tubercle. The tendon is constrained in the groove by the transverse humeral ligament as well as the rotator cuff insertions into the tuberosities.

The GH joint is formed by the articulation between the hemispherical humeral head and the relatively smaller, shallow glenoid fossa. The radii of curvature of the two surfaces are well matched to within 2mm of each other [3]. However, a significant mismatch in size between the two leaves the articulation with very little inherent stability. The glenoid fossa is pear shaped, with average vertical and horizontal dimensions of 35mm and 25mm respectively [4]. The articular surface of the larger humeral head has an average vertical dimension of 48mm and an average transverse dimension of 45mm. Around 25 to 30 percent of the humeral head is articulating with the glenoid socket at any time .This geometry will allow for more motion freedom at the expense of stability, therefore stability of the joint is provided by a group of static and dynamic stabilizers.

A. Static Stabilizers

The static stabilizers of the shoulder joint include the glenoid labrum, joint capsule, GH ligaments and coracohumeral ligament. The capsuloligamentous structures play a greater role in joint stability as they help to prevent excessive translation and rotation of the humeral head on the glenoid during activity of the upper extremity.

1. *Rotator interval*: a wedge shaped region bordered by the subscapularis inferiorly, the supraspinatus superiorly and the hood over the bicipital groove laterally. This interval contains the coracohumeral ligament and the superior GH ligament both of which prevent excessive inferior translation and external rotation with the arm at the side. They may also aid in preventing excessive posterior translation when the shoulder is in a flexed, adducted and internally rotated position.
2. *Middle GH ligament*: Maybe absent in 30% of people. When present it acts to prevent anterior translation of the humeral head when the shoulder is externally rotated and abducted 45° [1, 2]. It also serves to limit external rotation of the adducted shoulder and inferior displacement of the adducted, externally rotated shoulder [1].
3. *Inferior GH ligament complex (IGHLC)*: this is the most important static stabilizer of the joint. The complex is composed of the inferior capsule suspended between two ligamentous bands, the anterior and posterior bands of the IGHLC [6]. The IGHLC tightens in a reciprocal fashion depending on the rotation of the humeral head and can act to prevent inferior translation of the abducted shoulder at differing rotational positions. Its primary role is to prevent anteroinferior translation in the abducted and externally rotated shoulder [7].
4. *Posterior capsule*: is the thinnest portion of the capsuloligamentous structures. Its primary function is believed to be in limiting posterior translation of the humeral head.