J Shoulder Elbow Surg (2016) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

Rotator cuff–sparing approaches for glenohumeral joint access: an anatomic feasibility study

Tressa D. Amirthanayagam, FRCS(Orth)[a,*], Andrew A. Amis, FREng, DSc(Eng)[a,b], Peter Reilly, MS, FRCS(Orth)[a], Roger J.H. Emery, MS, FRCS(Ed)[a]

[a]*Faculty of Medicine, Department of Surgery & Cancer, Imperial College, London, UK*
[b]*Faculty of Engineering, Department of Mechanical Engineering, Imperial College, London, UK*

Background: The deltopectoral approach for total shoulder arthroplasty can result in subscapularis dysfunction. In addition, glenoid wear is more prevalent posteriorly, a region difficult to access with this approach. We propose a posterior approach for access in total shoulder arthroplasty that uses the internervous interval between the infraspinatus and teres minor. This study compares this internervous posterior approach with other rotator cuff–sparing techniques, namely, the subscapularis-splitting and rotator interval approaches.
Methods: The 3 approaches were performed on 12 fresh frozen cadavers. The degree of circumferential access to the glenohumeral joint, the force exerted on the rotator cuff, the proximity of neurovascular structures, and the depth of the incisions were measured, and digital photographs of the approaches in different arm positions were analyzed.
Results: The posterior approach permits direct linear access to 60% of the humeral and 59% of the glenoid joint circumference compared with 39% and 42% for the subscapularis-splitting approach and 37% and 28% for the rotator interval approach. The mean force of retraction on the rotator cuff was 2.76 (standard deviation [SD], 1.10) N with the posterior approach, 2.72 (SD, 1.22) N with the rotator interval, and 4.75 (SD, 2.56) N with the subscapularis-splitting approach. From the digital photographs and depth measurements, the estimated volumetric access available for instrumentation during surgery was comparable for the 3 approaches.
Conclusion: The internervous posterior approach provides greater access to the shoulder joint while minimizing damage to the rotator cuff.
Level of evidence: Basic Science Study; Anatomy; Cadaver Dissection
© 2016

Keywords: Glenohumeral joint; cadaver; rotator cuff sparing; posterior approach; subscapularis split; rotator interval; total shoulder arthroplasty; shoulder resurfacing

The incidence of total shoulder arthroplasty has been rising in the last decade,[8] and there has been a trend toward smaller implants and more minimally invasive approaches.[22] As demonstrated by the joint registries,[27] the most common approaches in current practice are the deltopectoral and anterosuperior approaches, both of which violate the subscapularis tendon and can lead to long-term dysfunction.[6,7,23,33] As a result, there has been a move toward rotator cuff–sparing approaches. In addition to reducing postoperative cuff dysfunction, another advantage of such approaches is the reduction of postoperative restrictions and the facility for early active mobilization.

Ethical approval was granted by the National Research Ethics Service. REC Ref: 13/LO/1839. IRAS project ID: 132972.

*Reprint requests: Tressa D. Amirthanayagam, FRCS(Orth), Faculty of Medicine, Department of Surgery & Cancer, Imperial College, 76 Eastbury Road, Northwood, Middlesex, HA6 3AR, UK.

E-mail address: TressaAmir@hotmail.com (T.D. Amirthanayagam).

1058-2746/$ - see front matter © 2016
http://dx.doi.org/10.1016/j.jse.2016.08.011

This would have a positive impact on the time and costs of rehabilitation and may result in an earlier return to work.

Lafosse has described an approach for shoulder arthroplasty entirely through the rotator interval, with early promising results. However, this approach is limited in terms of access to the inferior joint for osteophyte removal and referencing for humeral component placement, which can result in implant malpositioning.[9,22] Similarly, a number of authors have proposed subscapularis-sparing approaches involving either a split[2] or partial tenotomy[2,31] of the subscapularis. The subscapularis-splitting approach is commonly used for open anterior stabilization[20] and Latarjet procedures, and its use in shoulder arthroplasty was described as being experimental in 2013.[2] Glenoid wear is more prevalent posteriorly, a region difficult to access with both anterior and superior approaches. In addition, the humeral head itself is retroverted.[18,30] Historically, the posterior approach to the shoulder for arthroplasty has involved deltoid mobilization and acromion osteotomy, such as that described by Kocher in 1902 and used by Engelbrecht in the 1970s,[11-13,21] or complete detachment of the posterior deltoid and external rotator tenotomy.[16,32] However, Brodsky[5] and later Jerosch[19] described a posterior subdeltoid approach that aimed to preserve all the rotator cuff attachments. This involves superolateral retraction of the posterior deltoid with subsequent development of the internervous interval between the infraspinatus and teres minor. This approach has been performed for posterior shoulder disease, such as instability, but like the subscapularis-splitting approach, it remains to be seen whether it can provide sufficient access to the glenohumeral joint for total shoulder arthroplasty. From this review of the literature, the subscapularis-splitting, rotator interval, and internervous posterior approaches represent the most feasible minimally invasive approaches to the shoulder that do not involve any form of tenotomy of the rotator cuff.

All medical devices have to undergo a formal risk assessment procedure to determine whether, on the basis of accepted data, a reasonable risk in a given context has been achieved. Although no such requirements exist for surgical approaches or new procedures, it was thought that this systematic process would be an effective method to minimize potential risk to patients from less commonly used surgical approaches.

The first part of a risk assessment involves analyzing potential risks and then taking steps to mitigate these risks to safe levels. In this case, this involved a detailed literature review of potential complications of total shoulder arthroplasty and how the surgical approach can affect them. The main 3 complications—implant failure (usually secondary to suboptimal implant position or soft tissue imbalance), glenohumeral instability, and rotator cuff dysfunction[3,15,17]—are inextricably linked, with each one having the potential to have an impact on the other.[35] Another significant risk, intraoperative neural injury, is considered rare but has serious consequences for long-term function. In fact, intraoperative neuromonitoring studies suggest that the true incidence of neurologic injury may be significantly higher than that detected clinically.[26]

The factors within a surgical approach that contribute to these complications include the proximity of neurovascular structures, whether the access afforded is sufficient for instrumentation and adequate orientation of the implant, and whether the force through the rotator cuff during retraction could be high enough to result in muscle dysfunction. Thus, this cadaveric study design focused on the quantification of these factors for each rotator cuff–sparing approach. If the risks are deemed acceptable following this study, the next stage of the assessment would involve in vivo testing of the approach with pilot studies.

The aim of this study was to compare the 3 minimally invasive approaches to the glenohumeral joint in terms of ease of access and proximity to neurovascular structures that can be at risk during surgery, with a view to total shoulder arthroplasty with modern implants and instrumentation.

Materials and methods

As part of the risk analysis detailed before, a cadaveric study was designed to quantify the following factors for each approach: access to the pathologic parts of the joint (ie, the osteophytes), access to surgical landmarks for orientation and implantation, access for surgical instruments and implantation, quantification of the minimum force required for adequate access through the rotator cuff during retraction, and proximity of neurovascular structures to the approach.

Specimens and testing sequences

Twelve fresh frozen forequarter cadaveric specimens were used from 9 North American individuals. Of the specimens, 6 shoulders were left sided, 6 right sided, 6 from men, and 6 from women. The mean age was 71 years (range, 57-83 years), and the mean weight was 67 kg (range, 47-109 kg), with 11 from white individuals and 1 from an individual of Afro-Caribbean heritage.

The cadavers were divided into 3 groups of 4 specimens: male right, male left, female right, and female left forequarters. In the first group, the subscapularis-splitting approach was performed first; in the second group, the interval approach; and in the final group, the posterior approach. The specimens were rotated systematically so that all 3 approaches were performed in each cadaveric specimen, with the 6 possible sequences of testing applied to 2 specimens each, to avoid bias arising from previous use. All skin incisions were 10 cm in length, and the capsule and rotator cuff split were repaired with size 2 Ethibond sutures (Ethicon, Johnson & Johnson, Somerville, NJ, USA) after each approach to reduce any effect on subsequent approaches. For each approach, if a statistically significant difference was identified between when it had been performed first and when it was performed as a second or third procedure, only the data from the first approaches were considered.

Access to osteophytes

During total shoulder arthroplasty, adequate removal of the surrounding osteophytes helps minimize impingement of soft tissues and optimize range of motion. In this study, the 3 minimally invasive approaches were compared in terms of the percentage of circumferential access to osteophytes that was achieved.

Download English Version:

https://daneshyari.com/en/article/5710286

Download Persian Version:

https://daneshyari.com/article/5710286

Daneshyari.com