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Prosthesis position in shoulder arthroplasty

A cadaver study of the humeral component

In six cadaver shoulder joints, the external rotation was measured applying a constant external torque to the humerus before and after insertion of a non-constrained shoulder joint prosthesis at different degrees of retroversion. At 35–45° of retroversion there was no difference between the external rotation of the inserted prosthesis and the external rotation of the joint before arthroplasty.

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In shoulder arthroplasty with a non-constrained prosthesis, it is normally recommended that the humeral component be placed at 20–40° of retroversion (Neer et al. 1982, Tanner & Cofield 1981, Cofield 1984). The extent to which retroversion of the humeral component in a non-constrained Neer prosthesis affects the degree of external rotation was studied in an experimental set-up, placing the humeral component at different degrees of retroversion, and measuring external rotation with the application of a constant external rotatory torque to the humerus.

Material and methods

Six shoulder joint specimens without known shoulder joint disease were used. Each specimen consisted of anterior stabilizing structures, capsule, the coracohumeral ligament, the subscapular muscle and tendon and the supraspinatus muscle and its tendon. The posterior muscles and the capsule were removed. The tendon of the biceps muscle was divided just below the intertubercular groove. In the middle of the humeral shaft, a nail was inserted in the same plane as the transcondylar axis of the elbow. The nail was later used as a guide for placing the humeral component at the desired degree of retroversion. The specimen was suspended with the medial border of the scapula in a vertical position (Figure 1).

A lever was fixed at the distal part of the humerus. The lever was fitted with strain gauges for measurement of external rotatory torque. The external rotation angle was measured by the Z-angle sensor at a right angle to the X-Y angle sensor, which measures the abduction angle. The humerus was abducted 0–90° in the same plane as the scapula with application of a constant external rotatory torque of ducted 0–90° in the same plane as the scapula with application of a constant external rotatory torque of 1.5 Nm. Corresponding movement curves of external rotation and abduction were traced and plotted on an X-Y diagram. Simultaneously, the signals were fed through a data acquisition system to a microcomputer (R.C. 702). The curves were finally calculated for exactly 1.5 Nm and plotted at the regional computer service center (RECAU).

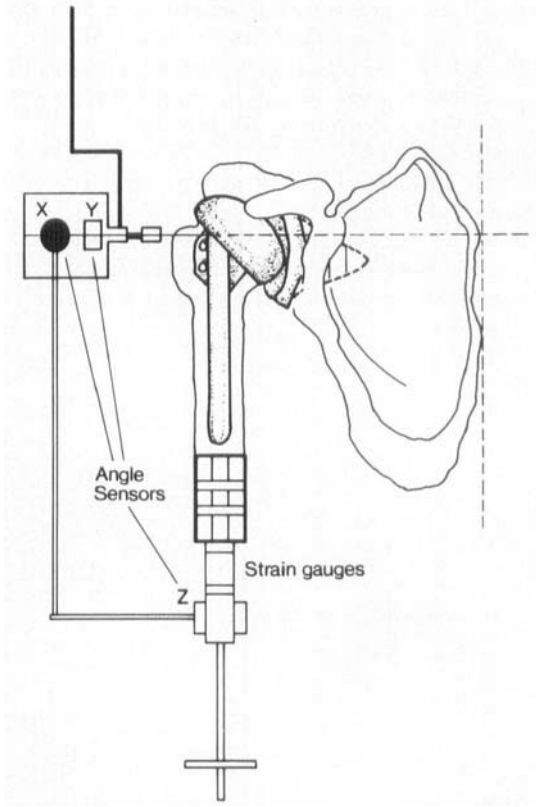

Figure 1. Experimental set-up for measuring external rotation before and after inserting a non-constrained prosthesis at different degrees of retroversion.

Before inserting the prosthesis, the external rotation of the suspended joint was measured. The cavitas component was then inserted from behind and cemented. Afterwards, the humeral head was cut with a specially constructed guide consisting of a metal plate with the same slope as the head of the prosthesis. To this plate was fixed a rod, and to the rod an indicator to ensure placement of the plate at the desired degree of retroversion (Ovesen 1984). In this way it was possible, by gradually resecting the humeral head, to place the humeral component uncemented and with a head thickness of 15 mm at 0, 15, 30, 35, 40 and 45° of retroversion, and for each degree of retroversion to measure the external rotation.

Results

Arthroplasty reduced external rotation in the entire abduction range when retroversion of the humeral component was less than 40° (Figure 2). Thus, with a 35° retroversion of the prosthesis in the last part of abduction, external rotation was only a few degrees less than before arthroplasty. Insertion of the prosthesis with a retroversion of 40° only reduced external rotation a few degrees in the first 40° of abduction, and in the range covered by the next 20°, external rotation was more pronounced than before arthroplasty. In the final part of the abduction, external rotation was reduced a few degrees, although it was almost the same as before the prosthesis was inserted. With a prosthetic retroversion of 45°, external rotation was greater than in the intact joint from 10° through the entire abduction range. Anterior dislocation was not noted in any case, even at 0° of retroversion. However, even if the posterior part of the humeral component was displaced anteriorly, it still remained inside the cavitas component.

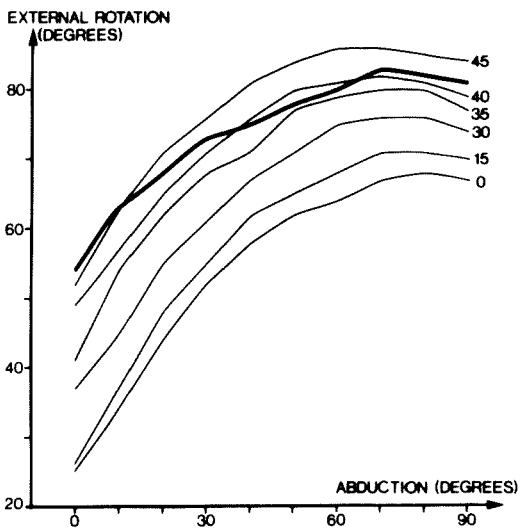

Figure 2. External rotation before and after insertion of a non-constrained prosthesis. Numbers at end of curves indicate degrees of retroversion. Full thickness curve depicts external rotation of intact joint.

Discussion

The head of the humerus is normally directed proximally, medially and about 30° retroverted (Saha 1971).

In shoulder joint replacement, the aim must be to restore movements resembling those of the normal joint as much as possible. Using a non-constrained prosthesis, only the humeral component can be altered. Insufficient external rotation after shoulder joint arthroplasty may be due to incorrect positioning of the humeral component. Our experiment has confirmed that the humeral component should be placed in at least 35° of retroversion when using a non-constrained prosthesis.

Acknowledgements

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