Superior Migration of the Humeral Head

A Radiological Aid in the Diagnosis of Tears of the Rotator Cuff

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The diagnosis of tears of the rotator cuff of the shoulder is often indecisive, and frequently neglected because of the difficulty that is encountered in verifying lesions without surgical exploration. The mechanism of injury, the clinical findings, local anaesthetic blocks, contrast arthrography, plain radiography and cine-radiography are the main diagnostic methods available. All or several may provide the necessary assistance.

In 1962 Golding described an observation made on plain radiography that we believe is not only valid but can often help in the search for the causative lesion. It is the purpose of this report to reiterate the importance of this observation and to offer our interpretation of the pathomechanics of its origin.

Several findings noted in plain radiographs have been associated with tears of the rotator cuff (Codman 1934, Harrison 1949, Golding 1962, Cotton and Rideout 1964, Kernwein 1965). They include sclerosis and atrophy of the greater tuberosity, cystic changes in the upper two-thirds of the anatomical neck, notching between the articular surface of the head and the greater tuberosity, irregular new bone formation on the lateral margin of the acromion, and narrowing of the acromio-humeral interval. It is the latter observation, first made by Golding and emphasised by Cotton and Rideout, on which we have focused our attention.

The musculo-tendinous rotator cuff is inserted into the tuberosities of the head of the humerus along the upper two-thirds of the anatomical neck. The interval between the superior articular surface of the humeral head and the under-surface of the acromion is occupied only by the rotator cuff and occasionally by the easily compressible subacromial bursa, variable in size. It therefore seems reasonable to conceive that any reduction in substance of the contents of this interval will eventually result in narrowing, provided the remaining shoulder muscles—particularly the deltoid—are functioning.

The supraspinatus initiates abduction of the shoulder and is active through the entire range of abduction (Inman, Saunders and Abbot 1944, Basmajian 1963, 1967). Its ability to perform in abduction is a reflection of its action on the gleno-humeral joint, where it depresses the humeral head and fixes it against the glenoid to

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provide a fulcrum for abduction of the arm (Watson-Jones 1955, DePalma 1963, van Linge and Mulder 1963, Heikel 1968, Macnab and Hastings 1968). Van Linge and Mulder (1963), however, demonstrated in ten patients that abduction through a full range could be effected in the presence of a suprascapular nerve block.

METHOD

The basic intention of our radiological study was to determine the relationship between a narrowed acromio-humeral interval and a tear of the rotator cuff (Fig. 1). Standard antero-posterior views of the shoulder with the arm at the side in neutral rotation were the only views used. Antero-posterior views with the arm at the side and in full medial rotation produced no more than one or two millimetres difference from the neutral projections, and were not used routinely; nor were abduction views and tangential views.

According to Golding, the acromio-humeral interval was found to vary between seven and thirteen millimetres in 150 normal subjects. In the series of Cotton and Rideout a range of six to fourteen millimetres was considered normal. The range of these figures is critical in any interpretation of abnormals. We therefore examined sixty standard antero-posterior neutral shoulder radiographs of patients without any evidence of tear of the rotator cuff. Our
findings (Fig. 2) agree closely with those of Golding and of Cotton and Rideout, the range being from seven to fourteen millimetres.

Radiographs were then obtained of fifty-eight patients with surgically proven tears of the rotator cuff and one patient, not operated upon, with a positive contrast arthrogram. The radiographs included in this study were all standard antero-posterior exposures with the arm in neutral rotation at the side of the body. A total of fifty-nine cases comprise the basis of the study. Figure 3 shows the distribution of the cases in the group with known tears of the rotator cuff.

![Fig. 4](image1.png) ![Fig. 5](image2.png)

![Fig. 6](image3.png) ![Fig. 7](image4.png)

Standard antero-posterior radiographs demonstrating four cases of narrowed acromio-humeral intervals in patients with known rotator cuff tears.

For purposes of stricter and more illustrative comparison, let us for the present ignore the group with an interval of six millimetres. It can then be seen that twenty-six of the fifty-nine cases (44 per cent) showed intervals of five millimetres or less (Figs. 4 to 7). If we include the group showing a six-millimetre interval, the proportion becomes 50 per cent.

It is also interesting that only fourteen of fifty-nine patients with known cuff tears had intervals of nine millimetres or more, whereas forty-eight of sixty normal shoulders had intervals of nine millimetres or more. Thus there seems little doubt that the acromio-humeral interval is narrowed in patients with rotator cuff tears in a high proportion of cases.

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DISCUSSION

On the assumption that our observations have supported and enlarged Golding's initial observation, it seems logical to approach the pathomechanics of the development of this finding.

It is doubtful whether this upward migration of the humeral head can occur as an early change in rotator cuff tears, except perhaps when there is complete avulsion of the cuff with retraction of the supraspinatus. More likely a period of time intervenes during which atrophy and further cuff degeneration occur until the thickness of tissue between the humeral head and the under-surface of the acromion is reduced to such a degree that migration occurs.

It is commonly believed that the deltoid exerts a pull in the long axis of the humeral shaft. In the presence of a functionally ineffective supraspinatus (lack of depression of the head and of head-glenoid fixation), the deltoid pulls the head proximally. We believe that it is this impairment of balance between the deltoid and supraspinatus that ultimately leads to the superior migration of the head of the humerus.

SUMMARY

1. A radiological study of the acromio-humeral interval in sixty normal shoulders and in fifty-nine shoulders with known tears of the rotator cuff is reported.
2. The normal acromio-humeral interval was found to be seven to fourteen millimetres, a range that is consistent with previous observations.
3. Narrowing of this interval is a frequent concomitant of a tear of the rotator cuff.
4. An interval of five millimetres or less should be considered compatible with a tear of the rotator cuff until proven otherwise.
5. An explanation of the pathomechanics of the observation has been proposed.

REFERENCES


