Orthopaedics
and Traumatology
2 (1993), 71–77 (No. 2). © Urban & Vogel, Munich

The Antero-superior Exposure for Total Shoulder Replacement

Donald B. Mackenzie

Port Elizabeth, Eastern Cape Province, South Africa

Surgical Principles

The survivorship of total shoulder replacement appears to depend to a large extent on glenoid fixation. Therefore a surgical exposure which provides optimum visualization of the glenoid surface during its preparation will enhance the precision of the bone cuts and presumably the accuracy of component fixation. Whether such improvement will lengthen longevity of the arthroplasty is the subject of a separate study.

Advantages

Total shoulder replacement is most often performed via an extensive delto-pectoral exposure with detachment of part of the deltoid insertion into the humerus. Exposures which involve detachment of the deltoid origin are not recommended because of problems with postoperative dehiscence and consequent weakness of shoulder elevation. A serious deficiency of the delto-pectoral approach is unsatisfactory exposure of the face of the glenoid especially in the well-muscled (Figure 1).

In contrast to the somewhat circuitous route while using the delto-pectoral approach and the necessity to exert strong retraction to the anterior margin of the deltoid, the antero-superior exposure allows face-on visualization of the glenoid cavity and greatly facilitates its preparation to receive polymethylmethacrylate cement and more accurate component positioning. The approach also provides better access to the rotator cuff and facilitates repair of this structure if torn. A further advantage of the antero-superior approach is that the cephalic vein (attention to which, in the delto-pectoral approach, can be tedious and time-consuming) needs not be disturbed.

Disadvantages

The antero-superior approach is unsuitable for total shoulder replacements which also necessitate work on the proximal humerus such as hemi-arthroplasty

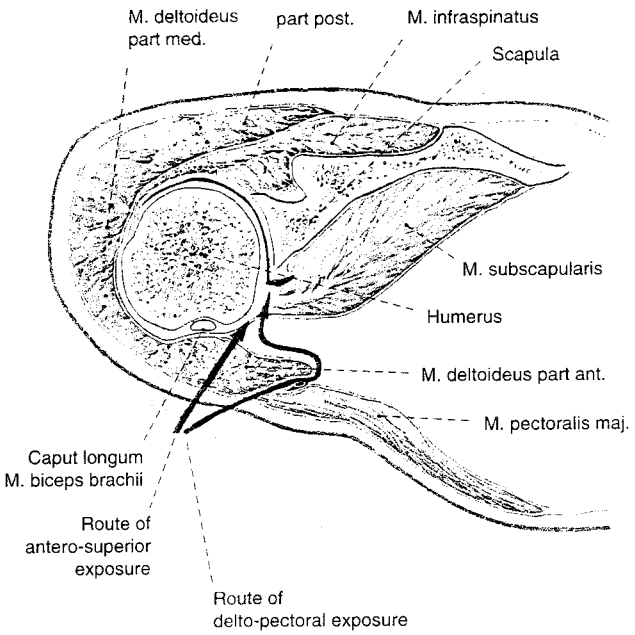

Fig. 1 This figure shows the circuitous route to the face of the glenoid via the delto-pectoral exposure in contrast to the direct antero-superior route.

for displaced three- and four-part fractures and fracture dislocations and also resection arthroplasty for neoplasms of the proximal humerus. In these situations, the delto-pectoral approach affords better exposure and is preferred. In any event, these situations hardly ever require glenoid replacement.

Indications

The antero-superior approach is recommended for total replacement of the gleno-humeral joint for degenerative and rheumatoid arthritis. Incidentally, it is the exposure of choice for operative repair of all grades of tears of the rotator cuff.

Contraindications

The exposure is contraindicated in osteoarthritis associated with dwarfism due to cartilaginous dysplasia with abnormal maturation of growth plate chondroblasts. The approach had to be abandoned in a case of gleno-humeral osteoarthritis in an achondroplastic patient as the branches of the axillary nerve to the anterior fibres of the deltoid were encountered 1 cm from the acromio-clavicular joint.

Patient Information

The patient should be warned that operative injury to the branches of the axillary branches which supply motor function to the anterior deltoid fibres, causing temporary or permanent weakness, while rare, is a possibility. By careful attention to detail and protection of the nerve this complication can be avoided. Obviously the patient is fully informed of the potential dangers of total shoulder replacement, including intra-operative as well as early and late postoperative complications.

Surgical Instruments

- In addition to the instrumentation for the specific type of total shoulder arthroplasty to be performed, a suitable humeral head retractor (e.g. Fukuda ring retractor) (Figure 2), and a Carter Rowe spike are indispensable.
- The slot in the glenoid is made with a high-speed air-driven burr (Roto-osteotome – Stryker). Additional sophisticated instrumentation is unnecessary. Obviously a full inventory of humeral and glenoid components should be available.

Positioning and Anaesthesia (Figures 3a and 3b)

A general inhalation anaesthesia with endotracheal intubation is preferred. The patient's head is directed into the operating enclosure and the anaesthetic tubes pass over the torso towards the feet to the anaesthetic machine. The anaesthetist is thus

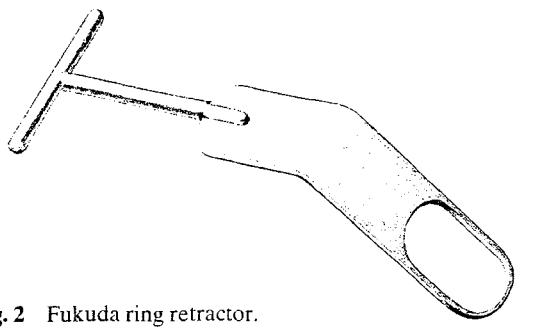

Fig. 2 Fukuda ring retractor.

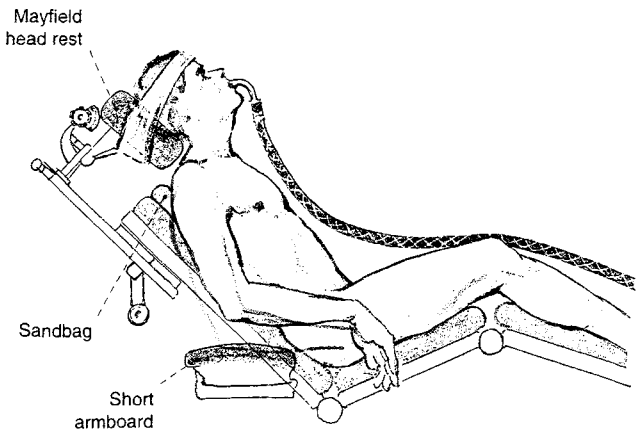

Fig. 3a

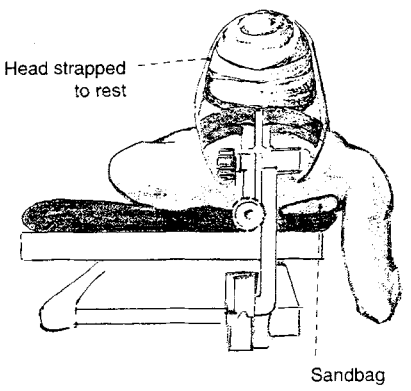

Fig. 3b

Fig. 3a and 3b "Beach chair" position with back elevated 60°, using a Mayfield head rest. Head first into operating enclosure with anaesthetic tubes leading outside.

"banished" from the area of the patient's head and shoulders. Careful patient positioning is critical and makes the difference between a straightforward surgical exercise and a tedious struggle. The patient is placed in the half-sitting (60°) "beach-chair" position with the torso is on the extreme edge of the table to facilitate humeral reaming and preparation. The arm is draped free. A small sandbag is placed so that it will exert fairly firm pressure against the medial border of the scapula in order to direct it, and the glenoid, anteriorly – thus enhancing its exposure. A short arm board is attached to the side of the operating table on which the patient's upper arm rests on a bulky bolster during glenoid preparation. A fibre-optic operating headlamp a useful aid and strongly recommended.

Surgical Technique

Fig. 4 to 7

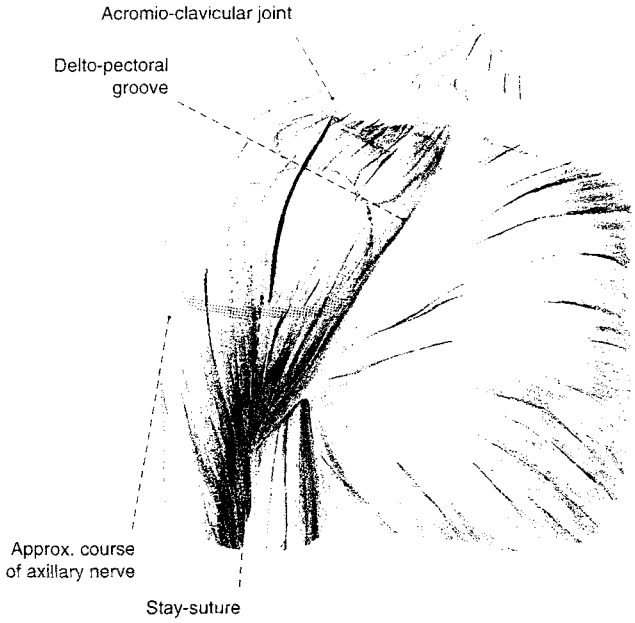

Fig. 4a **Fig. 4b**

Fig. 4a and 4b The skin incision extends distally in a straight line from just posterior to the acromio-clavicular joint for a distance of 9 cm (a). After haemostasis using electrocautery has been achieved, the acromio-clavicular joint is identified and in line with it, the anterior deltoid fibres are split for a distance of not more than 6 cm. A loose No. 1 Vicryl stay suture (b) is placed in the distal (inferior) end of the split to prevent further distal extension and possible injury to the branches of the axillary nerve supplying the deltoid muscle medial to the split. Throughout the procedure the efficiency of the stay suture should be checked and if it tears loose it should be replaced. Assistants should be warned not to apply strong retraction in its vicinity.

Donald B. Mackenzie:
The Antero-superior Exposure for Total Shoulder Replacement
Orthop. Traumatol. 2 (1993), 71–77 (No. 2)

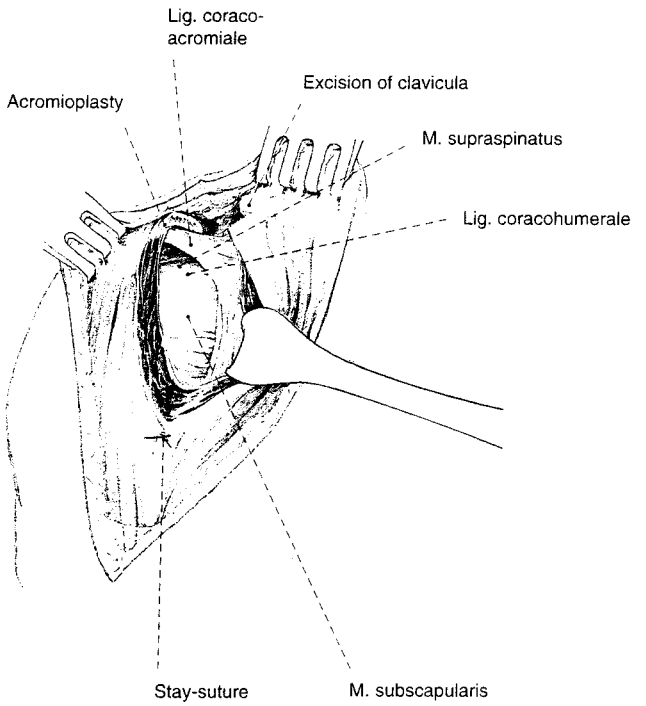

Fig. 5a

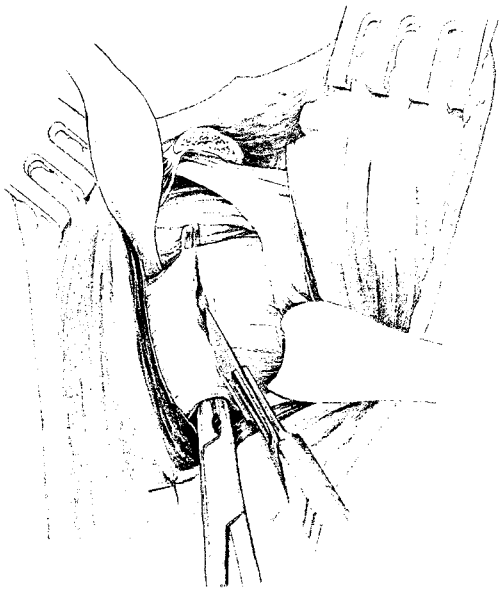

Fig. 5b

Fig. 5a and 5b A subperiosteal detachment of the deltoid origin from the anterior part of the acromion with preservation of the superior acromio-clavicular ligament is now carried out. An anterior acromioplasty according to the technique of Neer is performed. This and excision of the lateral 1 cm of the clavicle, considerably enhances access to and preparation of the proximal humerus (a). The fascia just lateral to the conjoined tendons of coraco-brachialis and the short head of biceps brachii and, in continuity, the coraco-acromial ligament, is now split. An assistant applies gentle external rotation to the shoulder and retraction of the conjoined tendons in a medial direction brings the tendon of the subscapularis into view (b).

Fig. 6a

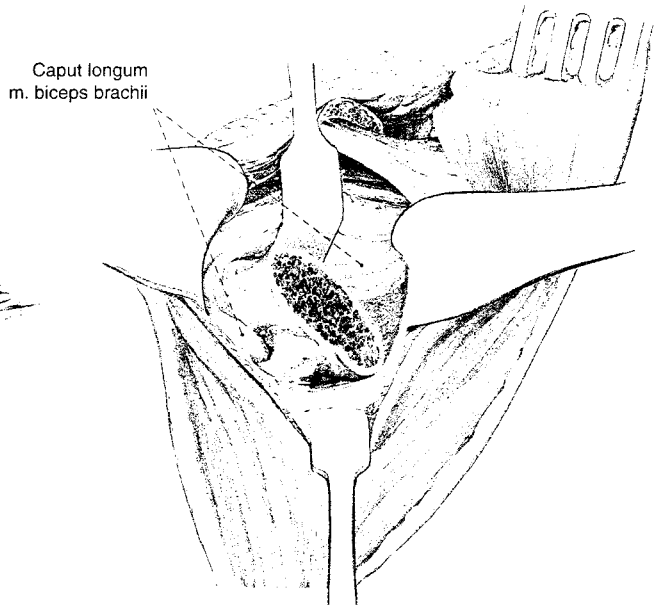

Fig. 6b ▸

Fig. 6a and 6b This structure is now incised transversely about 1.5 cm medial to its insertion on the lesser tuberosity. A Z-lengthening is performed if the tendon is contracted. The anterior circumflex humeral blood vessels are coagulated. The plane between the tendon of subscapularis and the underlying joint capsule is identified and using sharp dissection developed medially. Two stay sutures are placed in the stump of the tendon which is reflected medially. The plane of cleavage is developed as far as the level of the anterior glenoid rim and with the shoulder in maximal external rotation a transverse incision is made in the joint capsule – care being exercised when extending it inferiorly for fear of damage to the main trunk of the axillary nerve. The shoulder joint is thus opened. The humeral head can be delivered out of the joint anteriorly by further gentle external rotation and extension. Excessive abduction is probably best avoided at this stage as it has been claimed to shorten the distance between the axillary nerve branches to the anterior deltoid fibres and the anterior edge of the acromion by 30 % [1]. The humeral head is now resected and the proximal humeral shaft is reamed to receive the humeral component.

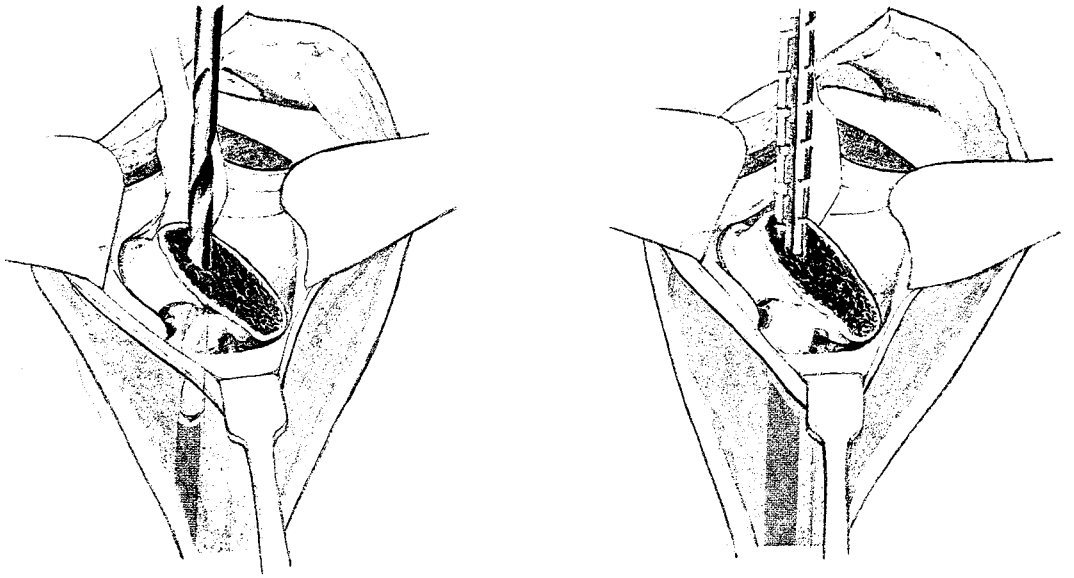

Fig. 7a

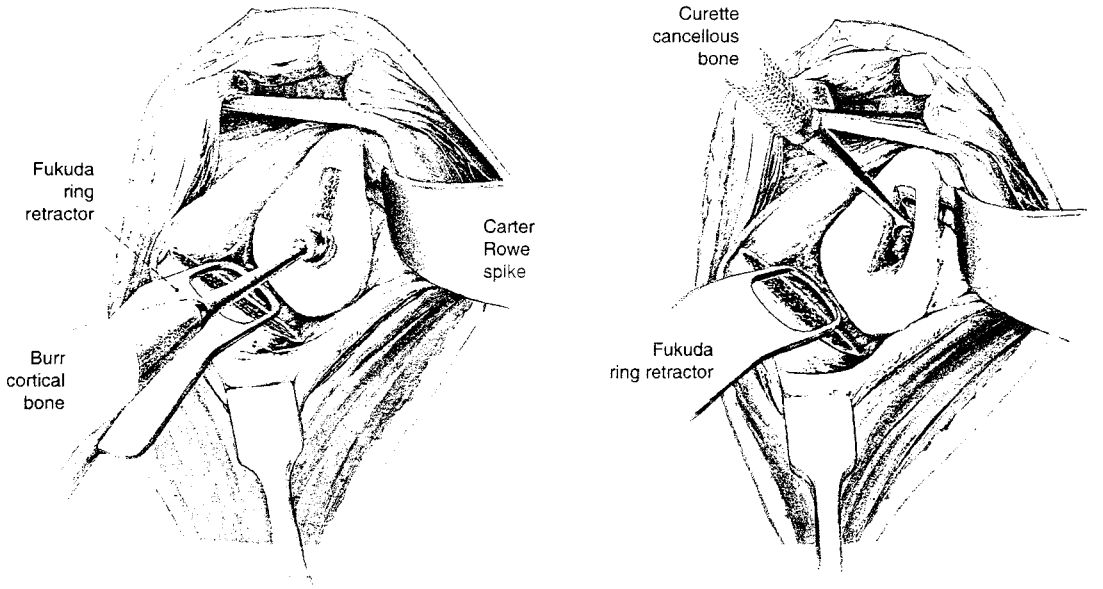

Fig. 7b

Fig. 7a and 7b It should be noted that it is extremely difficult to insert the medullary reamers and broaches as well as the prosthesis unless the arm can be extended off the side of the operating table. The upper arm is now allowed to rest on a bolster (Figure 6a) placed behind it which, in turn, rests on the short armboard thus relaxing tension on the anterior soft tissues and allows introduction of a Fukuda ring retractor (b) behind the posterior glenoid rim and the Carter Row spike in front retracting the anterior soft tissues medially. The proximal humerus is depressed and this manoeuvre affords most satisfactory visualisation of the face of the glenoid greatly facilitating its preparation, as well as cementing and fixation of the glenoid component. After completion of trial reduction, testing for stability of the arthroplasty and definitive component fixation, the arthroplasty is reduced and the subscapularis carefully repaired using interrupted non-absorbable sutures. Suction drainage tubes are placed in position and, starting proximally, a side-to-side repair of the deltoid split, using interrupted No. 1 Vicryl sutures, is performed. Holding the arm in 30° of flexion lessens tension on the anterior deltoid fibres and facilitates the repair. The rest of the wound is then closed and the arm is placed in a Velpeau-type immobiliser.

Postoperative Management

The suction drains are usually removed at about 48 h after the operation. On the first postoperative day static (isometric) exercises are started together with gentle pendulum movements. On day 2 the physiotherapist commences passive stretching movements with the accent on elevation. The goal should be to attain 180° of passive elevation at the end of the first week. Passive external rotation is also commenced but the degree will depend on the operative findings and in particular, the maximal amount of passive external rotation possible after repair of the subscapularis which does not place undue tension on the suture line. This degree of external rotation should not be exceeded for six weeks. To prevent dehiscence of the deltoid repair, active elevation is postponed for three weeks after which assisted active movements are commenced. The patient is instructed in the performance of stretching exercises to maintain full passive mobility. The shoulder immobiliser may usually be discarded at eight weeks.

Special Surgical Considerations

Correct positioning of the patient (beach chair, sandbag).

At least two assistants.

Operating headlamp.

Avoidance of excessive distal splitting of the deltoid muscle – stay suture.

Fukuda ring retractor.

Careful side-to-side approximation of the split in the deltoid with the arm held in 30° of flexion.

Intra- and Post-operative Complications

The only noteworthy intra-operative complication inherent to this surgical exposure is accidental damage to the axillary nerve fibres to the anterior part of the deltoid. This, however, can be avoided by adhering to the precautions set out earlier in this report. Excessive splitting of the anterior deltoid fibres is prevented by avoidance of strong retraction inferiorly and the placement of a stay suture into the inferior portion of the deltoid split.

Postoperative complications inherent to the antero-superior exposure for total shoulder replacement have not been encountered.

Errors and Potential Hazards

Excessively strong retraction in the region of the inferior part of the deltoid split causing the protective stay suture to pull out with extension thereof and consequent damage to the axillary nerve branches to the anterior deltoid fibres should be avoided. As in all operative procedures in this region, the main trunk of the axillary nerve in close relation to the lower edge of the subscapularis as well as the musculo-cutaneous nerve should be protected.

An additional hazard, particularly in patients with thin cortices, is accidental spiral fracture of the shaft of the humerus. This can be prevented by avoidance of excessively strong external rotation of the shoulder joint particularly when preparing the proximal humerus. Adequate capsular release from the humerus and Z-lengthening of the anterior capsule and subscapularis (when shortened) also lessen the chance of producing this complication.

Results

Of a personal series of 188 unconstrained total shoulder replacements since 1979, 142 were performed via an antero-superior approach. At the start of the series there was a preponderance of delto-pectoral exposures but after the antero-superior was first employed (in 1984) and proved to be most satisfactory with regard to access and end-on visualization of the face of the glenoid, it has been used exclusively in total arthroplasty for osteoarthrosis and rheumatoid arthritis.

The indications for the operations are set out in Table 1.

Complications which relate to the antero-superior exposure in the series have been rare (Table 2).

Primary osteoarthrosis	92
Rheumatoid arthritis	16
Secondary osteoarthrosis (recurrent instability and previous septic arthritis)	10
Cuff tear arthropathy	5
Failed previous surgery for arthrosis (glenoidectomy and double Benjamin osteotomy)	3
Missed posterior dislocation	1
Fresh four-part fractures and fracture/dislocations	4
Malunited proximal humerus fractures	7
Revision total shoulder arthroplasty	2
Non-union surgical neck fractures	2
Total	142

Table 1. Indications for 142 unconstrained total shoulder replacements performed via the antero-superior approach since 1984.

Intra-operative	
– Spiral fracture humeral shaft	1
– Abnormally proximal axillary nerve branches	1
Late	
– Paralysis anterior deltoid fibres	1

Table 2. Complications.

The exposure had to be abandoned on two occasions. The first case sustained a spiral fracture of the shaft of the humerus due to excessive torsional strain while applying external rotation and was successfully managed by cerclage wiring via a delto-pectoral exposure with distal extension into the upper arm. In the other case, previously mentioned, with osteoarthrosis associated with achondroplasia, the branches of the axillary nerve to the anterior deltoid fibres were discovered at a distance of 1 cm from the acromio-clavicular joint. The arthroplasty was successfully completed via a delto-pectoral exposure which afforded somewhat cramped but nevertheless adequate exposure of the face of the glenoid. The single late complication comprised paralysis of the deltoid fibres medial to the deltoid split. This, however, did not mar the functional result, as the patient regained excellent overhead movement with sufficient strength for the usual functions of daily living.

The author wishes to acknowledge Dr. Robert J. Neviaser, MD of Washington DC, USA who first brought the antero-superior exposure of the shoulder and its versatility to his attention.

References

1. Burkhead, W. Z. Jr., R. R. Scheinberg, G. Box: Surgical anatomy of the axillary nerve. J. Shoulder Elbow Surg. 1 (1992), 31–36.

Key Words:

Humeral head fracture · Total shoulder replacement · Surgical approach to the shoulder

Address all correspondence to:
Dr. Donald B. Mackenzie
Port Elizabeth
P. O. Box 12528
Centrahil
6006 South Africa