Clinical Article

Ultrasound and the shoulder surgeon

Joe de Beer MBChB, MMed (Ortho)
Karin van Rooyen MBChB
Hans van der Bracht MD
Cape Shoulder Institute, Plattekloof, Panorama, Cape Town, South Africa

Reprint requests:
Dr J de Beer
43 Bloulelie Crescent
Plattekloof
Cape Town 7506
Tel: 021 911-1017
Fax: 021 911-1019
E-mail: jodebeer@iafrica.com

Abstract

Sonography is an effective tool in the evaluation and management of shoulder problems. The utility of shoulder sonography extends across the entire spectrum of shoulder pathology; although most soft tissue structures can be visualised using appropriate techniques, consistent and reliable recognition of pathology requires a reasonable level of skill and experience. Magnetic resonance imaging (MRI) offers an operator-independent and reliable alternative to sonography; however, sonography provides a low-cost office-based imaging method, and both static and dynamic techniques can be performed and interpreted instantly. A concise description of the diagnostic and therapeutic applications of shoulder ultrasonography, as performed by the authors, is presented here.

Diagnostic applications of shoulder sonography

Rotator cuff tears

Sonography, in experienced hands, equals the accuracy of MRI for the diagnosis of full thickness rotator cuff tears.[1] Trained shoulder surgeons and radiologists have comparable results in the diagnosis of these tears.[2] Correct technique and interpretation permit accurate static visualisation of the tendon disinsertion on the greater tuberosity; real-time passive motion of the arm may reveal dyssynchronous motion of the rotator cuff and tuberosity, and a comparison with the contralateral side can be performed *(Figure 1)*. In addition, bony changes on the surface of the greater tuberosity footprint area may be indirect indicators of rotator cuff disease. The presence of subdeltoid effusions and flattening of the cuff tendon should raise the suspicion of rotator cuff pathology, and this is often a bursal-sided partial tear. Articular-sided partial tears may be visualised as hypoechoic or mixed echogenic defects at the articular surface of the cuff. In large tears the degree of retraction can be assessed; however, fatty infiltration and muscle atrophy have not been as well described on sonography as on MRI.

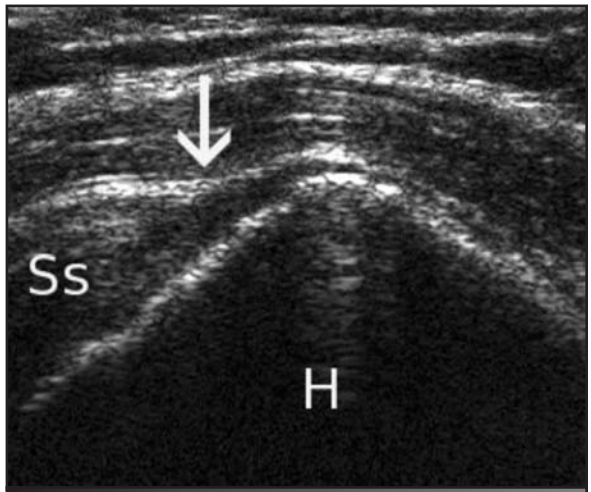

Figure 1: A full-thickness tear (arrow) of the supraspinatus (SS) is shown (H: humeral head). The author has described this previously as the 'sagging rope' sign: the normal rotator cuff has a convex appearance whereas a tear appears as a sagging concavity.

The postoperative integrity of a repaired rotator cuff tear can easily be evaluated by passively moving the arm, and synchronous movement of the cuff with the humeral head indicates an intact repair. The presence of a subacromial/subdeltoid effusion in the follow-up evaluation may indicate inflammation or may even be an early warning of postoperative infection *(Figure 2)*. If the amount of effusion is of concern, ultrasonography-guided needle aspiration of the fluid can be done for laboratory analysis. Lytic areas around the bone anchors may also be an early sign of postoperative infection. Other aspects include visualisation of dislodged bioabsorbable anchors that are not visible on radiographs.

Calcific tendinitis of the rotator cuff

Calcific deposits of the rotator cuff are clearly visible on ultrasonography, and their exact location and size can be evaluated in all dimensions. Ultrasonography is a well-established treatment modality for this condition both with injections and 'needling'. Shoulder ultrasound is also useful for intra-operative localisation of the calcific deposit during arthroscopic calcific deposit excision *(Figure 3)*.

Acromio-clavicular joint (ACJ) degeneration

Ultrasonography is useful in the diagnosis of the ACJ involvement as a cause of pain in the shoulder. The presence of an effusion of the ACJ is a valuable indicator of the ACJ being symptomatic *(Figure 4)*.The size of the effusion can easily be compared to the contralateral side and the surface area of the effusion can be measured. Ameliorative injection testing of the ACJ with local anaesthetic agents under sonographic control is of great value in the diagnosis of ACJ pathology.

Acromioclavicular joint (ACJ) subluxations

The degree of ACJ subluxation can be determined accurately on US due to the three-dimensional advantage. The mobility of the distal end of the clavicle can also be determined by exerting pressure on it. Posterior subluxation of the ACJ, often difficult to visualise on plain radiographs, can also be diagnosed.

Disorders of the long head of the biceps tendon

Effusions in the bicipital groove can be demonstrated with accuracy. The probe should be moved distally down the arm due to the fact that these effusions are often more pronounced distally due to gravitation. Subluxation of the biceps out of the groove is visible, and if necessary passive rotational movements can demonstrate the subluxation in real time *(Figures 5 and 6)*. Dynamic assessment of an hour-glass enlargement of the long biceps tendon has also been recently described.[3]

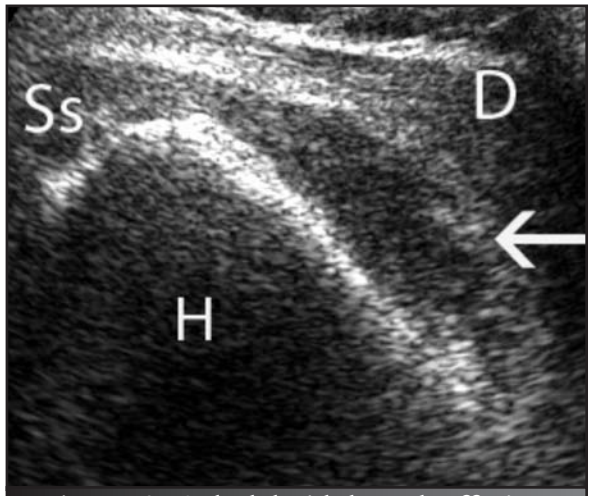

Figure 2: Sub-deltoid bursal effusion (arrow) is shown (H: humeral head, Ss: supraspinatus. D: deltoid).

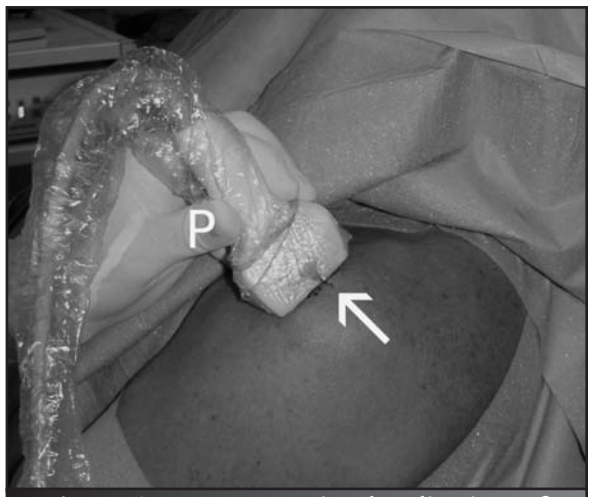

Figure 3: Intra-operative localisation of calcific deposit for arthroscopic removal. Needle (arrow) is shown.

Injections into the groove can be given accurately for ameliorative testing of bicipital pain. Bony morphology of the bicipital groove is well demonstrated on ultrasonography, and disorders of the bony anatomy of the bicipital groove (irregularities, narrow dimensions, etc.) are clearly visible.

Osteoarthritis of the glenohumeral joint

The integrity of the rotator cuff can be evaluated; this has enormous bearing on the treatment options (anatomic prosthesis or reverse prosthesis). Congruency of the joint can be seen; the typical posterior subluxation of the humeral head is apparent when placing the probe on the posterior aspect of the joint.

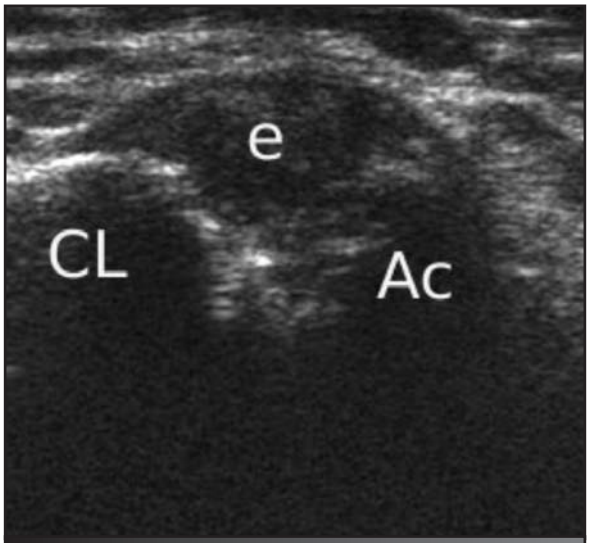

Figure 4: Acromioclavicular joint effusion (e) is shown (Ac: acromion, CL: clavicle).

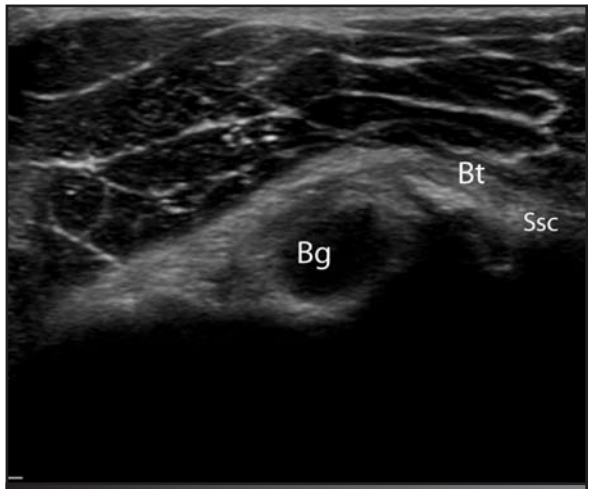

Figure 5: The biceps groove (Bg) is empty and contains an effusion. The biceps tendon (Bt) is subluxed into the insertion of the subscapularis tendon (Ssc).

Shoulder instability and labral tears

The presence and size of a Hill-Sachs lesion become visible by placing the probe on the posterior aspect of the humeral head. Locked posterior dislocation is easily visualised. Dynamic testing is useful in the diagnosis of glenohumeral subluxation and labral lesions.

Fractures

Minimally and undisplaced fractures of the tuberosities of the humeral head that are not visible on radiographs can often be diagnosed on sonography. Fractures of spine of the scapula are difficult to visualise on radiographs and can easily be seen on sonography. Early callus formation can be detected before seen on radiographs.

Thoracic outlet syndrome

Sonography is a useful tool to evaluate potential reasons for nerve compression; in some cases hypertrophy of the scalene muscles with resultant compression of the brachial plexus may be detected.[4]

Diagnostic and therapeutic interventions under sonographic control

Ultrasound-guided injections

The shoulder joint is compartmentalised into three levels (glenohumeral, subacromial and acromioclavicular joints) and ultrasound-guided injections can be given accurately into each of these for therapeutic or diagnostic purposes. In addition, bicipital groove injections and injections into the suprascapular/spinoglenoid notches may be performed using sonographic control.

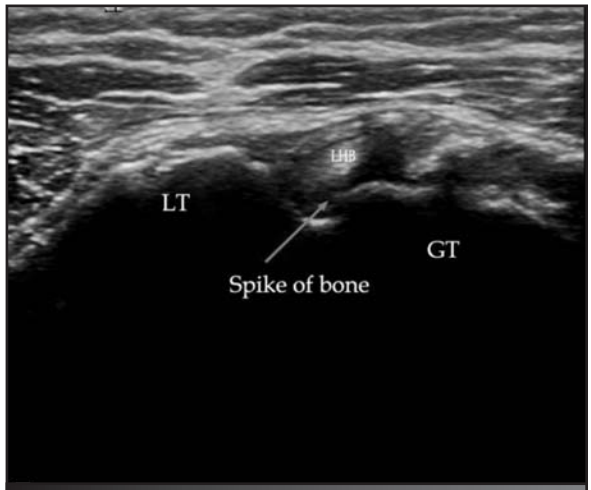

Figure 6: In this case a minimally displaced fracture of the greater tuberosity (GT) caused a spike of bone to protrude into the biceps groove causing severe irritation of the long head of the biceps (LHB). The lesser tuberosity (LT) is demonstrated on the medial side of the groove.

The postoperative integrity of a repaired rotator cuff tear can easily be evaluated by passively moving the arm, and synchronous movement of the cuff with the humeral head indicates an intact repair

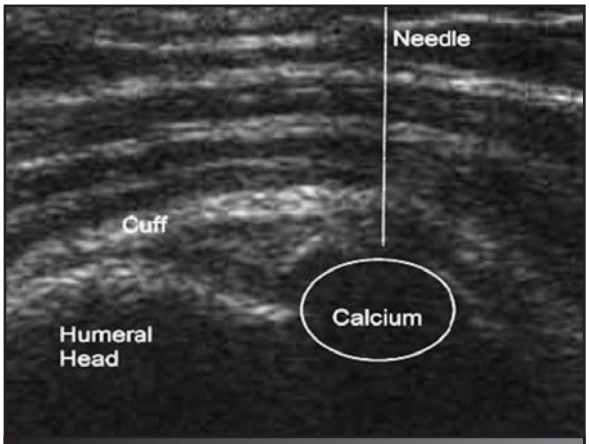

Figure 7: Ultrasound-guided needling of a calcium deposit in the rotator cuff. The needle and calcium deposit have been enhanced for demonstration purposes.

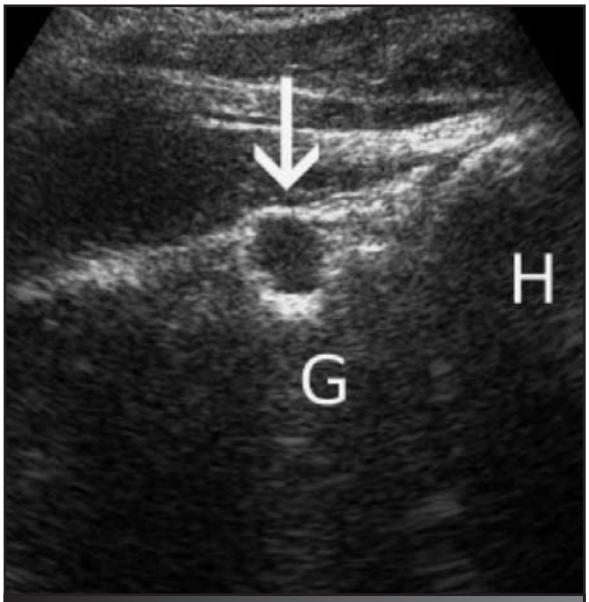

Figure 8: The spinoglenoid notch is shown and a cyst (arrow) is visualised in this region (G: glenoid, H: humeral head).

'Needling' procedure for calcific tendinitis

Correct technique is necessary to achieve a satisfactory success rate to eliminate calcific deposits from the rotator cuff without having to resort to surgical procedures. The senior author (JdB) favours a technique where two large-gauge needles are used to flush the calcium with saline solution after the subacromial space has been well anaesthetised with a local agent *(Figure 7)*.

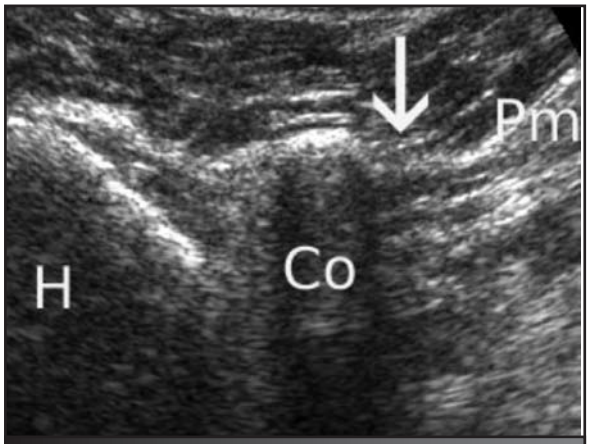

Figure 9: Sonographic visualisation of the pectoralis minor insertion (arrow) is shown (Pm: pectoralis minor muscle, Co: coracoid process, H: humeral head).

Sonography-guided aspiration of peri-labral cysts is a simple procedure with a reasonable success rate

Aspiration of peri-labral cysts

These cysts often result from posterior labral tears and cause impingement of the suprascapular nerve in the spinoglenoid notch. Sonography-guided aspiration of such cysts is a simple procedure with a reasonable success rate and may be followed by surgical evacuation and labral repair if the aspiration fails to resolve the symptoms *(Figure 8)*.

Injection into the defect of os acromiale

The presence of an os acromiale can usually be seen on radiographs. The dilemma is often to decide if pain in the shoulder is caused by the 'non-union' site of the acromion, secondary effect of non-outlet impingement or other causes. A useful diagnostic test is to inject local anaesthetic solution into the defect with sonography control and noting the pain relief.

Thoracic outlet syndrome

Interventional procedures for the thoracic outlet compression syndrome have been suggested; these involve ultrasound-guided injections of local anaesthetic agents into the scalene muscles, and the resultant pain relief from temporary paresis of these muscles is diagnostic. Botulinum toxin injection into the scalene muscles, again with sonographic guidance, may be of great benefit for temporary pain relief over a few months for this condition. Such a positive response serves as a predictor of a good surgical outcome for scalenotomy procedures.

Pectoralis minor injections

Insertional tendinopathy of the pectoralis minor muscle (bench-presser's shoulder) can be effectively treated with a single ultrasound-guided injection of a solution of a local anaesthetic agent and a steroid.[5] The technique for this procedure involves sonographic localisation of the pectoralis minor tendon, and care should be taken to avoid inadvertent injection into the underlying neurovascular structures (*Figure 9)*.

Brachial plexus blocks

Ultrasonography-guided nerve blocks are well described in the peri-operative management of shoulder pain.[6,7]

From the above it is evident that ultrasonography is an indispensable tool for advanced shoulder diagnosis and treatment. Several centres involved in the management of shoulder problems now use office-based sonography in conjunction with clinical examination in a 'one-stop clinic'.

No benefits of any form have been received from a commercial party relating directly or indirectly to the subject of this article.

References

1. Naqvi GA, Jadaan M, Harrington P. Accuracy of ultrasonography and magnetic resonance imaging for detection of full thickness rotator cuff tears. *Int J Shoulder Surg*. 2009;**3** (4):94-97.
2. Jeyam M, Funk L, Harris J. Are shoulder surgeons any good at diagnosing rotator cuff tears using ultrasound? A comparative analysis of surgeon vs radiologist. *Int J Shoulder Surg*. 2008, **2**(1):4-6.
3. Pujol N, Hargunani R, Gadikoppula S, Holloway B, Ahrens PM. Dynamic ultrasound assessment in the diagnosis of intra-articular entrapment of the biceps tendon (hourglass biceps):A preliminary investigation. *Int J Shoulder Surg* 2009; **3**(4):80-84.
4. Boezaart AP, Haller A, Laduzenski S, Koyyalamudi VB, Ihnatsenka B, Wright T. Neurogenic thoracic outlet syndrome: A case report and review of the literature. *Int J Shoulder Surg*. 2010; **4**(2):27-35
5. Bhatia DN, de Beer JF, van Rooyen KS, Lam F, du Toit DF. The 'bench-presser's shoulder': an overuse insertional tendinopathy of the pectoralis minor muscle. *Br J Sports Med*. 2007;41 (8):e11. Epub 2006 Nov 30.
6. Boezaart AP, Tighe P. New trends in regional anesthesia for shoulder surgery: Avoiding devastating complications. *Int J Shoulder Surg*. 2010 Jan;**4** (1):1-7.
7. Boezaart PA. Pitfalls in regional anesthesia for shoulder surgery. *Int J Shoulder Surg* 2007; **1**(1): 30-38.