Acta Orthop. Belg., 2009, **75**, 736-742

ORIGINAL STUDY

Is the bare spot a valid landmark for glenoid evaluation in arthroscopic Bankart surgery ?

Bertrand SAINTMARD, Frédéric LECOUVET, Alexandra RUBINI, Jean-Emile DUBUC

From the Cliniques Universitaires St Luc (UCL), Brussels, Belgium

The "bare spot "of the glenoid cavity has recently been described as a consistent reference point to identify the center of the glenoid and to quantify the extent of antero-inferior bone loss of the glenoid following anterior shoulder dislocation. The spot should help the surgeon to determine arthroscopically the width of the remaining inferior glenoid cavity. In this study we prospectively compared arthroscopic images and the multidetector spiral CT arthrographic findings recorded in 58 consecutive patients (mean age, 47 years ; range : 17-72 years) with respect to glenohumeral cartilage quality and the presence of a "bare spot". At arthroscopy the "bare spot" was visible in less than 48% of cases and with spiral CT arthrography in less than 26% of cases. We concluded that the "bare spot" seems to be an unreliable landmark to determine the center of the inferior glenoid cavity, as it was present in only half of the shoulders studied.

Keywords : shoulder, dislocation ; bare spot ; arthroscopy ; CT arthrography.

INTRODUCTION

The main complication of anterior shoulder stabilization surgery, whether open or arthroscopic, is recurrent instability. Arthroscopic Bankart repair is less invasive, but early to mid-term results remain inferior to those of open techniques.

Most surgeons currently use suture anchors for arthroscopic stabilization to obtain more reproducible results. Nevertheless, the recurrence rate still ranges between 5% and 20% (*4,10*). Numerous prognostic factors have been reported. Patients whose risk factors preclude arthroscopic stabilisation should be identified in advance. Antero-inferior glenoid bone deficiency is one of these risk factors (*6,9,19*). Bone defects of the antero-inferior glenoid have been reported to be present in 8% to 90% of patient with anterior glenohumeral instability (*2,6,9*). The recurrence rate reaches 12% to 61% (*2,6*) in cases with a glenoid rim fracture. When the glenoid rim fracture exceeds 21% to 25% of the antero-posterior diameter of the glenoid, soft-tissue reconstruction alone is not sufficient for stabilisation, and coracoid transfer is recommended (*2,14,21*).

Burkhart *et al* described a consistent methodology to quantify glenoid bone loss by arthroscopy (*7*).

■ Bertrand Saintmard, MD, Assistant Professor.
■ Jean-Emile Dubuc, MD, Professor.
Orthopaedic Department, Cliniques Universitaires St Luc, Brussels, Belgium.
■ Frédéric Lecouvet, MD, Professor.
■ Alexandra Rubini, MD, Assistant Professor.
Radiology Department, Cliniques Universitaires St Luc, Brussels, Belgium.
Correspondence : B. Saintmard, Département de Chirurgie Orthopédique, Cliniques Universitaires St Luc, Avenue Hippocrate 10/2942, BE-1200 Brussels, Belgium.
E-mail : saintmardbe@gmail.com

No benefits or funds were received in support of this study

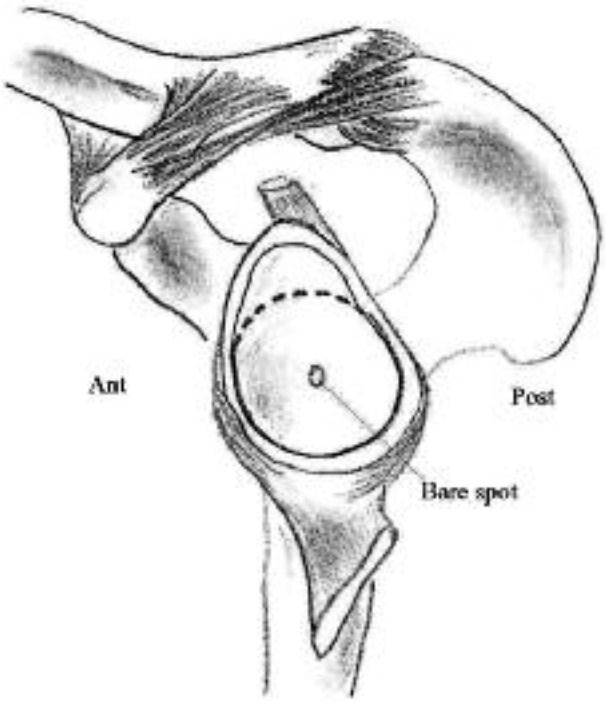

Fig. 1. — Schematic representation of the bare spot, which is located at the geometric center of the inferior glenoid cavity.

According to these authors, the "bare spot" of the glenoid is a consistent reference point located almost exactly at the center of the circle defined by the inferior glenoid articular margin, below the level of the mid-glenoid notch (fig 1). The surgeon can easily measure during arthroscopy the distance from the "bare spot" to the posterior glenoid rim, which should be equal to the distance from the "bare spot" to the intact anterior rim. With increasing bone compression effects, the anterior measurement will become progressively smaller. For example, if the distance from the "bare spot" to the posterior glenoid rim is 12 mm during intraoperative arthroscopic measurement in a patient with recurrent anterior dislocation, the distance from the bare spot to the anterior glenoid rim is supposed to be equal to 12 mm, and a distance of only 6 mm implies a compressive bone loss of 6 mm. Expressing this bone loss as a percentage of the intact anterior glenoid diameter shows a 25% deficiency of the total diameter. In such cases, Burkhart recommends bone grafting by coracoid transfer.

The aim of this study was to prospectively determine if the bare spot is detectable during arthroscopic procedures and CT arthrographic studies.

PATIENTS AND METHODS

Patients

Fifty-eight patients were prospectively enrolled over a 20 month period. The inclusion criteria were : 1) Chronic shoulder pain or disorder elected for arthroscopic treatment ; 2) Multidetector spiral CT arthrography (MDCTa) of the shoulder performed at our institution according to a standardized protocol, as part of the preoperative work-up ; 3) Arthroscopy performed at our institution by the same orthopaedic surgeon with prospective analysis and description of the glenohumeral cartilage according to a defined protocol ; 4) Absence of degenerative shoulder disease with preserved glenohumeral and subacromial joint space on conventional preoperative radiographs, absence of osteophytes and of severe and extensive cartilaginous lesions ; 5) absence of previous arthroscopic or open shoulder surgery.

Twenty-five patients were female and thirty-three were male. Their ages ranged between 17 and 72 years (mean : 47 years). In total, 30 left shoulders and 28 right shoulders were examined.

The indication for arthroscopy was rotator cuff tear (n = 29), chronic instability (n = 17), subacromial impingement syndrome (n = 10) and frozen shoulder (n = 2).

Arthroscopy

All arthroscopic surgery was performed by the same orthopaedic surgeon using the same procedure. The patients were in a lateral position and under general anaesthesia. A 30°, 4 mm arthroscope was introduced into the glenohumeral joint using a posterior approach.

Macroscopic grading of the articular cartilage was based on the Outerbridge classification modified for arthroscopy by Noyes (table I) (*17,18*). This system is based on four carefully recorded parameters : integrity of the articular surface, depth of the substance loss, location of the lesion, and diameter of the lesion.

The glenoid articular surface was divided into three virtual parts in both cranio-caudal and antero-posterior directions, and nine anatomic areas were thus delineated (fig 2). Articular surface lesions were graded from 0 to 4 (table I) (fig 3) : normal cartilage was defined as Grade 0 ; the presence of fibrillation without cartilage

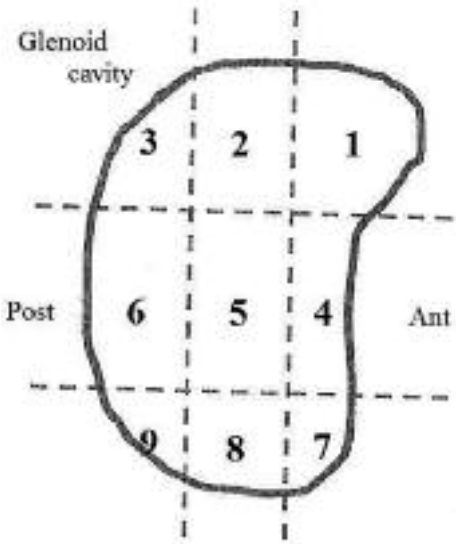

Fig. 2. — Schematic view of the delimitation of nine anatomic regions in the glenoid cartilage surface. These surfaces are divided into three virtual thirds in both cranio-caudal and antero-posterior directions.

loss and softening was Grade 1 ; cartilage loss to half of the cartilage thickness was defined as Grade 2 ; cartilage loss of more than half of the cartilage thickness was Grade 3 and complete loss of normal cartilage was considered as Grade 4.

Image analysis

All spiral CT arthrograms were performed by the same musculoskeletal radiologist and were analyzed separately by both an experienced musculoskeletal radiologist and a 5th-year resident, without knowledge of arthroscopic findings. Coronal and transverse reconstructed images were used. The grade of articular surface damage was determined for each of the nine regions of the glenoid cavity as used in arthroscopic grading. The grading system of cartilage lesions is summarised in table I and fig 3.

Each operator also evaluated the presence of a "bare spot" (i.e., focal cartilage surface abnormality) in the fifth anatomical region.

RESULTS

For the purpose of this study, attention was focused on the fifth anatomical region. On arthroscopic examination, 30 areas were intact (grade 0), 10 areas were categorised as grade 1 ; 11 as grade 2, three as grade 3, and four as grade 4 (table II).

A focal cartilage abnormality, representing the "bare spot" was visible in 28 shoulders, or 48%. Figure 4 illustrates the bare spot seen in both multidetector CT arthrography and arthroscopy. In 8 (28.6%) of these 28 shoulders demonstrating a focal cartilage abnormality in zone 5, adjacent (zone 2, 4, 6, 8) surface.abnormalities were present, suggesting the "bare spot" to be a true focal cartilage lesion rather than to a "constitutional" depression. At CT arthrography, focal cartilage defects (grade 2 or higher) were present in zone 5 in 15 shoulders or 25.8% (table III). An isolated cartilage depression compatible with a "bare spot" was found to be present in only 4 patients.

Furthermore, the radiologists observed that focal cartilage thinning in 38% was apparently due to focal subchondral bone changes and bone expansion in the central portion of the glenoid. This could suggest that focal observations made at arthroscopy could in fact be due to a focal bony "variant" (fig 5).

Table I. — Grading systems for arthroscopic analysis of cartilage lesions and interpretation of MDCTa images

Grade	*Arthroscopic findings*	*Spiral CT arthrography*
0	Normal	Smooth articular surface
1	Fibrillation without cartilage loss or softening	Loss of smooth contour without contrast within cartilage
2	Cartilage loss less than half of cartilage thickness	Penetration of contrast in cartilage to less than half of cartilage thickness
3	Cartilage loss more than half of cartilage thickness but not full thickness loss	Penetration of contrast more than half of cartilage thickness but not down to bone
4	Denuded bone	Penetration of contrast down to subchondral bone

Fig. 3. — Schematic representation of the system used for cartilage grading at arthroscopy and at MDCTa. Grade 0 : sharp surface, without cartilage loss. Grade 1 : loss of the sharp and smooth contour of cartilage surface with appearance of subtle undulations ; no contrast material within the cartilage at MDCTa. Grade 2 : cartilage defect at arthroscopy and contrast penetration at MDCTa involving less than half of the thickness of the normal adjacent cartilage surface. Grade 3 : cartilage defect at arthroscopy and contrast penetration at MDCTa involving at least the superficial half of the cartilage thickness but not reaching the subchondral bone. Grade 4 : complete loss of normal cartilage with contrast material reaching the subchondral bone at MDCTa.

Table II. — Results of arthroscopic findings : grading of articular surface area number 5

Grade	*Number of cartilage areas for each grade*	*Percentage*
0	30	51.7%
1	10	17.2%
2	11	19.0%
3	3	5.2%
4	4	6.9%

Table III. — Results of MDCTa findings : grading of articular surface area number 5

Grade	*Number of cartilage areas for each grade*	*Percentage*
0	43	74.1%
1	0	0%
2	10	17.2%
3	2	3.5%
4	3	5.2%

DISCUSSION

The presence of glenoid bone loss results in a less favourable outcome following treatment for anterior glenohumeral instability (*2,6,9,19*). However, several authors consider that there is no relationship between a glenoid rim defect and recurrence after surgery (*11,12*). In order to assess the glenoid bone loss and its impact on instability, a reproducible and practical method is necessary.

As mentioned above, Burkhart *et al* (*7*) have used the "bare spot" as a consistent landmark to identify the center of the inferior glenoid and to assess a possible glenoid bone loss.

Recently, Huysmans *et al* (*13*) reported their findings in a cadaveric study, based on 40 scapulae. In 39 of the 40 scapulae, the inferior glenoid had the shape of a circle. Statistically, the "bare spot" was not the mathematical center of the inferior glenoid, but the differences in distances to the anterior, inferior and posterior rims were very small. They concluded that the "bare spot" is roughly at the center of the inferior portion of the glenoid cavity and can be used as a reference landmark during arthroscopy to evaluate the amount of bone loss.

Kralinger *et al* (*15*) published in 2007 a study in which they analysed 20 glenoids. When measured manually, the mean distance from the "bare spot" to the anterior margin was 10.9 mm ; the mean distance to the posterior margin was 13.7 mm and to the inferior margin 9.7 mm. These distances were significantly different. According to these authors, the "bare spot" did not prove consistent and, in agreement with other authors, they recommended preoperative bilateral CT scans to accurately quantify glenoid bone loss. Aigner *et al* (*1*) confirmed that the "bare spot" showed an eccentric position within the inferior glenoid cavity.

Tena-Arregui *et al* (*20*) used 20 frozen foetuses with a gestational age of 24 to 40 +/-2 weeks, obtained from spontaneous abortions to study the shoulder joint. The arthroscopic images of the fetal glenohumeral joint were similar to those of adult shoulders, but a "bare spot" was not observed.

In our study, the "bare spot" was visible in less than 48% of cases and was thus considered to be an unreliable landmark for the determination of the center of the inferior glenoid cavity. The observations of our radiologists further question not only the existence and consistency of the "bare spot" but also its signification.

Several factors may lead to recurrence of instability after reconstruction. The risk is higher among younger patients (*4,5,16*) involved in competitive

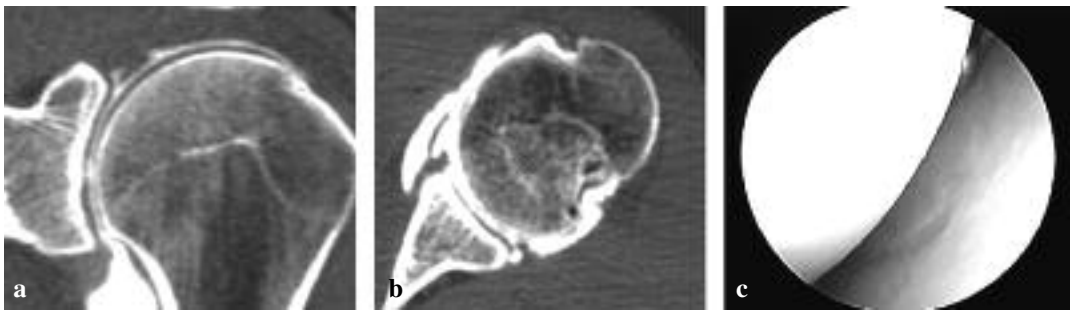

Fig. 4. — Representation of bare spot. a, b : MDCTA view ; c : arthroscopic view (MDCTA = Multidetector CT arthrography)

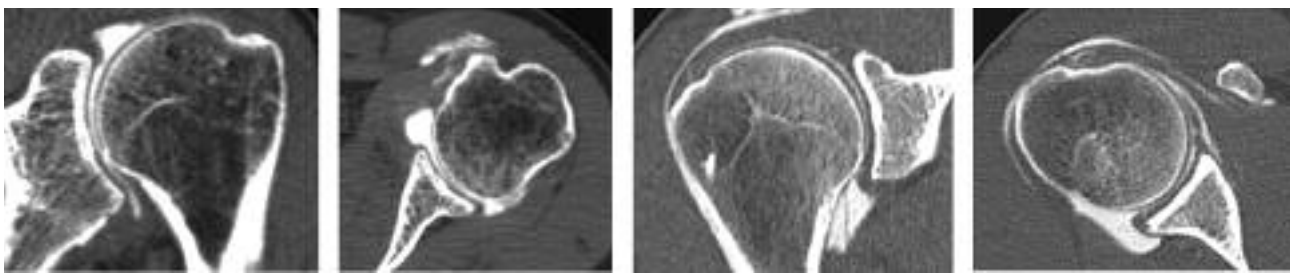

Fig. 5. — MDCTa view showing focal subchondral bone bulging. The focal cartilage thinning seems to be due to focal subchondral bone changes. This could suggest that the "arthroscopic bare spot" could in fact be due to a focal bony "variant".

Table IV. — Instability severity index score

Prognostic factors	*Points*
Age at surgery (yrs)	
≤ 20	2
> 20	0
Degree of sports participation (preoperative)	
Competitive	2
Recreational or none	0
Type of sport (preoperative)	
Contact or forced overhead	1
Other	0
Shoulder hyperlaxity	
Shoulder hyperlaxity (anterior or inferior)	1
Normal laxity	0
Hill-Sachs on antero-posterior radiograph	
Visible in external rotation	2
Not visible in external rotation	0
Glenoid loss of contour on antero-posterior radiograph	
Loss of contour	2
No lesion	0
Total (points)	10

sports (*19,20*). Bilateral hyperlaxity (*4,16*) also increases the risk of recurrent instability. Recently, Balg and Boileau (*3*) developed a preoperative score taking into account these various factors. This score measures the severity of the instability and is based on a preoperative questionnaire, clinical examination and radiographs (table IV). It assists the surgeon in choosing between arthroscopic anterior stabilization using the Bankart procedure and open surgery with a Latarjet procedure. Six factors were taken into account : age at surgery, degree of sports participation, type of sport, shoulder hyperlaxity, presence of a Hill-Sachs on antero-posterior radiographs and loss of glenoid contour on antero-posterior radiographs. Each item was scored, the possible maximum score being 10. According to their results, patients with a score of three points had an acceptable recurrence risk of 5% and thus might benefit from arthroscopic Bankart surgery. If the score was over six, the recurrence risk was 70%. This was considered unacceptable and the patients were then advised to undergo open surgery. In the intermediate score group (score between 4 and 6), the situation was arguable : the recurrence risk was 10% and the authors recommended arthroscopic Bankart surgery.

In conclusion, the “bare spot” appeared to be an unreliable landmark to determine the center of the inferior glenoid cavity, as it was only identified in less than half of the cases. In our opinion, this method is unreliable. In addition, the CT data raise the question of an abnormality of bone rather than cartilage.

In contrast, the instability severity score appears to be a simple and reliable tool to help the surgeon in choosing the appropriate technique. Further studies are needed to validate its prognostic accuracy.

REFERENCES

1. **Aigner F, Longato S, Fritsch H, Kralinger F.** Anatomical considerations regarding the bare spot of the glenoid cavity. *Surg Radiol Anat* 2004 ; 26 : 308-311.
2. **Bigliani LU, Newton PM, Steinmann SP, Connor PM, Mc-Ilveen SJ.** Glenoid rim lesions associated with recurrent anterior dislocation of the shoulder. *Am J Sports Med* 1998 ; 26 : 41-45.
3. **Balg F, Boileau P.** The instability severity index score. A simple preoperative score to select patients for arthroscopic or open shoulder stabilization. *J Bone Joint Surg* 2007 ; 89-B : 1470-1477.
4. **Boileau P.** [Anterior shoulder instability : the role and contribution of arthroscopy.] (in French). *Cahiers d’Enseignement de la Sofcot.* Paris : Editions scientifiques et médicales. Elsevier SAS, 2002 ; 79 : 77-112.
5. **Bonnevialle N, Mansat P, Bellumore Y, Mansat M, Bonnevialle P.** [Surgical treatment of anterior shoulder instability in rugby players : clinical and radiographic results with minimum five year follow-up.] (in French). *Rev Chir Orthop Réparat Appar Moteur* 2008 ; 94 : 635-642.
6. **Burkhart SS, DeBeer JF.** Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs : significance of the glenoid’s «inverted pear» and the humeral «engaging Hill-Sachs lesion». *Arthroscop*y 2000 ; 16 : 677-694.
7. **Burkhart SS, DeBeer JF, Tehrany AM, Parten PM.** Quantifying glenoid bone loss arthroscopically in shoulder instability. *Arthroscopy* 2002 ; 18 : 488-491.
8. **d’Elia G, Di Giacomo A, D’Alessandro P, Cirillo LC.** Traumatic anterior glenohumeral instability : quantification of glenoid bone loss by spiral CT. *Radiol Med* 2008 ; 113 : 496-503.
9. **Edwards TB, Boulahia A, Walch G.** Radiographic analysis of bone defects in chronic anterior shoulder instability. *Arthroscopy* 2003 ; 19 : 732-739.
10. **Garofalo R, Mocci A, Moretti B.** Arthroscopic treatment of anterior shoulder instability using knotless suture anchors. *Arthroscopy* 2005 ; 21 : 1283-1289.
11. **Green MR, Christensen KP.** Arthroscopic Bankart procedure : two to five year follow-up with clinical correlation to severity of glenoid labral lesion. *Am J Sports Med* 1995 ; 23 : 276-281.
12. **Guanche CA, Quick DC, Sodergren KM, Buss DD.** Arthroscopic versus open reconstruction of the shoulder in patients with isolated Bankart lesions. *Am J Sports Med* 1996 ; 24 : 144-148.
13. **Huysmans PE, Haen PS, Kidd M, Dhert WJ, Willems JW.** The shape of the inferior part of the glenoid : a cadaveric study. *J Shoulder Elbow Surg* 2006 ; 15 : 759-763.
14. **Itoi E, Lee SB, Berglund LJ, Berge LL, An KN.** The effect of a glenoid defect on anteroinferior instability of the shoulder after Bankart repair : A cadaver study. *J Bone Joint Surg* 2000 ; 82-A : 35-46.
15. **Kralinger F, Aigner F, Longato S, Rieger M, Wambacher M.** Is the bare spot a consistent landmark for shoulder ? A study of 20 embalmed glenoids with 3-dimensional computed tomographic reconstruction. *Arthroscopy* 2006 ; 23 : 449.
16. **Lafosse L, Iserain A, Kempf J, Hardy P.** Arthroscopic treatment of chronic anterior shoulder instability. *Rev Chir Orthop Répar Appar Mot* 2000 ; 86 : 106-109.

17. Noyes FR, Stabler CL. A system for grading articular cartilage lesions at arthroscopy. *Am J Sports Med* 1989 ; 17 : 505-513.

18. Outerbridge RE. The etiology of chondromalacia patellae. *J Bone Joint Surg* 1961 ; 43 : 752-757.

19. Seebauer L, Goebel M. [Treatment strategies for chronic glenoid defects following anterior and posterior shoulder dislocation.] (in German). *Oper Orthop Traumatol* 2008 ; 20 : 500-510.

20. Tena-Arregui J, Barrio-Asensio C, Puerta-Fonolla J, Murillo-Gonzalez J. Arthroscopic study of the shoulder joint in fetuses. *Arthroscopy* 2005 ; 21 : 1114-1119.

21. Wiedemann E, Jäger A, Nebelung W. [Pathomorphology of shoulder instability.] (in German). *Orthopäde* 2009 ; 38 : 16-23.