# The instability severity index score

## A SIMPLE PRE-OPERATIVE SCORE TO SELECT PATIENTS FOR ARTHROSCOPIC OR OPEN SHOULDER STABILISATION

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**There is no simple method available to identify patients who will develop recurrent instability after an arthroscopic Bankart procedure and who would be better served by an open operation.**

**We carried out a prospective case-control study of 131 consecutive unselected patients with recurrent anterior shoulder instability who underwent this procedure using suture anchors. At follow-up after a mean of 31.2 months (24 to 52) 19 (14.5%) had recurrent instability. The following risk factors were identified: patient age under 20 years at the time of surgery; involvement in competitive or contact sports or those involving forced overhead activity; shoulder hyperlaxity; a Hill-Sachs lesion present on an anteroposterior radiograph of the shoulder in external rotation and/or loss of the sclerotic inferior glenoid contour.**

**These factors were integrated in a 10-point pre-operative instability severity index score and tested retrospectively on the same population. Patients with a score over 6 points had an unacceptable recurrence risk of 70% ($p < 0.001$). On this basis we believe that an arthroscopic Bankart repair is contraindicated in these patients, to whom we now suggest a Bristow-Latarjet procedure instead.**

The main complication of anterior shoulder stabilisation, whether open or arthroscopic, is recurrent instability. The arthroscopic Bankart repair may be less invasive but its early to mid-term results remain inferior to those of open techniques.[1-5]

Currently, most surgeons use suture anchors for arthroscopic stabilisation because they give more reproducible results.[6] Even so, there is still a recurrence rate of between 5% and 20%.[7-10] In our hands,[11] there is a 15% recurrence rate after undertaking this procedure in unselected patients, suggesting that very careful patient selection is required.

Patients whose risk factors preclude arthroscopic stabilisation should thus be identified pre-operatively. Numerous prognostic factors have been reported. Younger patients are at an increased risk,[5,8,12-15] but no clear age limit has been defined. Certain sports confer an increased risk,[5,8,14,16,17] as does participation at a high competitive level.[5,17,18] The presence of a bone defect has been implicated,[5,18-21] but the size of defect that puts the shoulder at risk is unknown. Bilateral instability and hyperlaxity[5,8,22,23] have also been shown to increase the risk of recurrent instability.

If these risk factors were applied strictly, they would exclude most patients from an arthroscopic Bankart procedure. Most were identified in small series using old or non-standard techniques. We recently identified certain risk factors,[11] but their relative importance could not be weighed.

Our hypothesis was that risk factors for recurrent instability after arthroscopic suture anchor stabilisation can be identified with a pre-operative questionnaire, physical examination, and a plain anteroposterior (AP) radiograph.

The aims of this study, therefore, were to determine the pre-operative risk factors for recurrent instability in a prospective cohort study of unselected patients operated on using a standardised suture-anchor technique; and to incorporate those factors into an instability severity score that would grade the risk and help the surgeon to choose the best surgical option, whether open or arthroscopic, for patients with recurrent anterior shoulder instability.

## Patients and Methods

To examine this hypothesis, we performed a case-control study comparing patients with recurrent anterior instability after arthroscopic Bankart repair, with those in whom the operation had been successful.

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**Table I.** Pre-operative patient demographics

| Population description | Number (%) |
|---|---|
| Gender | |
| Male | 103 (*78.6*) |
| Female | 28 (*21.4*) |
| Affected side | |
| Right | 73 (*55.7*) |
| Left | 58 (*44.3*) |
| Dominance | |
| Dominant | 82 (*62.6*) |
| Non-dominant | 49 (*37.4*) |
| Mean age in years (range) | 27.3 (14 to 62) |
| Type of instability | |
| Dislocation | 34 (*26.0*) |
| Subluxation | 48 (*36.6*) |
| Both | 49 (*37.4*) |
| Mean number of episodes (range) | |
| Total | *17.9* (*2* to *200*) |
| Dislocation | *2.6* (*0* to *40*) |
| Subluxation | *15.2* (*0* to *20*) |
| Traumatic first event | |
| Traumatic | 110 (*84.0*) |
| Atraumatic (minor trauma) | 21 (*16.0*) |
| Bilateral instability | |
| Unilateral | 110 (*84.0*) |
| Bilateral | 21 (*16.0*) |
| Level of sport practised | |
| Competitive | 30 (*22.9*) |
| Recreation | 86 (*65.6*) |
| None | 15 (*11.5*) |
| Type of sport | |
| None | 15 (*11.5*) |
| No risk | 16 (*12.2*) |
| Contact | 32 (*24.4*) |
| Overhead | 20 (*15.3*) |
| Forced overhead | 48 (*36.6*) |
| Shoulder hyperlaxity | |
| None | 41 (*31.3*) |
| Anterior | 20 (*15.3*) |
| Inferior | 55 (*41.9*) |
| Both | 15 (*11.5*) |
| Hill-Sachs on AP* radiograph | |
| None | 21 (*16.0*) |
| In internal rotation | 110 (*84.0*) |
| In neutral rotation | 67 (*51.1*) |
| In external rotation | 32 (*24.4*) |
| Glenoid lesion on AP radiograph | |
| None | 86 (*65.6*) |
| Loss of inferior contour | 19 (*14.5*) |
| Fracture | 26 (*19.9*) |
| Osteoarthritis on AP radiograph[30] | |
| None | 120 (*91.6*) |
| Samilson 1 | 9 (*6.9*) |
| Samilson 2 | 2 (*1.5*) |
| Samilson 3 | 0 (*0*) |

* AP, anteroposterior

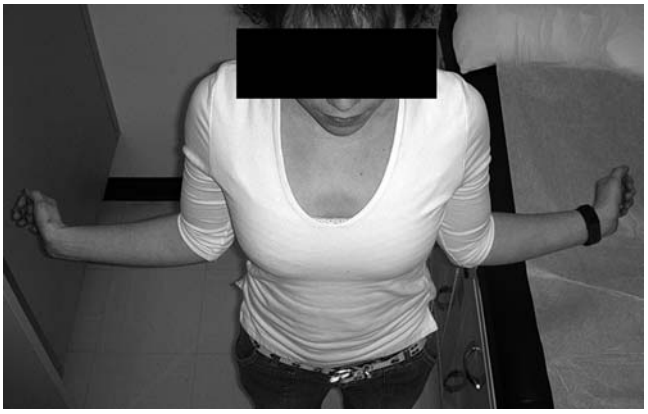

Fig. 1

External rotation of more than 85° with the arm at the side demonstrates anterior shoulder hyperlaxity.

The inclusion criteria were recurrent anterior instability (dislocation or subluxation) with or without hyperlaxity, an arthroscopic Bankart repair, and a minimum of 24 months' follow-up. Exclusion criteria were: patients with a concomitant rotator cuff lesion (7) or an acute first-time dislocation (3); surgery for recurrent instability after a previous anterior stabilisation (14); surgery for a painful, unstable shoulder without true dislocation or subluxation (18), and multidirectional instability. No patient was excluded for bone loss, high-risk sports and activities or competition.

Between July 1999 and August 2002 the senior author (PB) performed 176 consecutive arthroscopic Bankart repairs. After applying the inclusion and exclusion criteria, there were 134 patients to review. Three patients (2.2%) were lost during follow-up. The patient demographics are shown in Table I.

The gender, affected side, hand dominance, and age at surgery were noted. The type of instability (dislocation and/or subluxation) and a description of the first episode (traumatic or atraumatic) were noted. The mean number of episodes was recorded. Bilateral symptoms were noted, but no bilateral surgery was done. The level of sport practised (competitive, recreational, or none) and type of sport (no risk, contact sport, overhead, or forced overhead) were recorded.

Shoulder apprehension tests for all directions of instability were carried out. Hyperlaxity was assessed. Anterior hyperlaxity was defined as external rotation greater than 85° with the arm at the side (Fig. 1).[24] Inferior hyperlaxity was defined as a positive hyperabduction test (the Gagey test[25] as modified by Coste et al,[26] Fig. 2) in which a side-to-side difference greater than 20° is positive. Complete ranges of movement were noted. The Walch-Duplay[27,28] instability score was measured.

Anteroposterior radiographs were taken in internal, neutral and external rotation. The presence or absence of a Hill-Sachs[29] lesion was noted for each. If present on the external rotation view, its location was more superior on

Fig. 2a

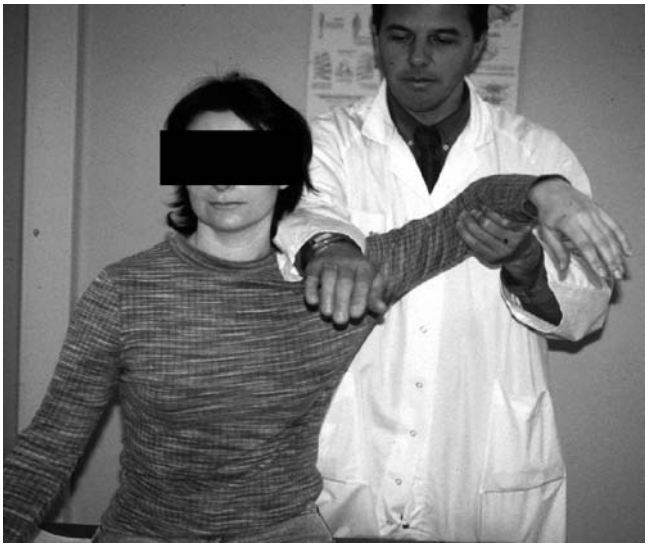

Fig. 2b

A difference in hyperabduction of 20° or more between the sides demonstrates inferior shoulder hyperlaxity (i.e. a stretched inferior axillary pouch).

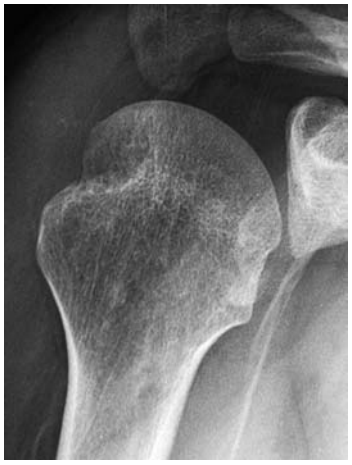

Fig. 3a

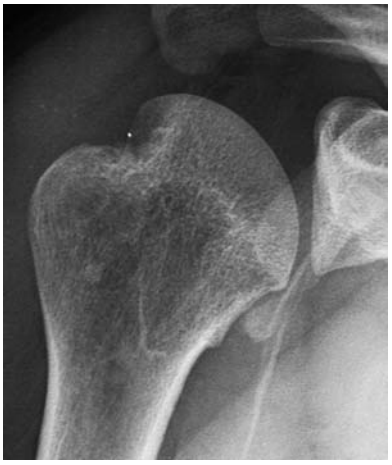

Fig. 3b

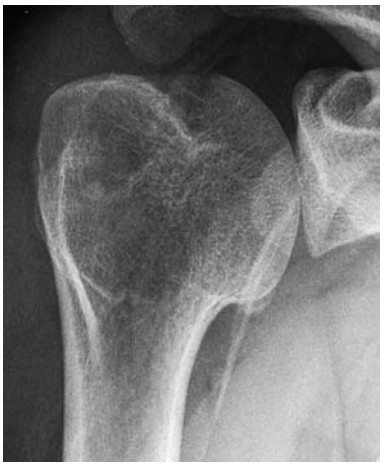

Fig. 3c

Hill-Sachs lesion on anteroposterior radiographs showing, a) internal rotation, b) neutral rotation, and c) external rotation (i.e. superior humeral bone loss).

the humeral head. Glenoid lesions were noted. We distinguished between an avulsion fracture and a loss of anteroinferior sclerotic contour (Figs 3 and 4). Osteoarthritis was graded using Samilson's classification.[30]

Patients were placed in the beach-chair position under general anaesthesia with an interscalene block for postoperative analgesia. The shoulder was examined to confirm the instability (Table II). Anterior and inferior translation were graded arthroscopically while the joint was distended with air only. The Bankart lesion was confirmed and any bony lesion was graded subjectively. The quality of the anterior capsule was graded according to Detrisac and Johnson,[31] and the appearance of the anterior band of the inferior glenohumeral ligament was noted. The presence of a superior labrum anterior to posterior (SLAP) lesion and the numbers of anchors used were recorded.

The same suture-anchor technique was used for each procedure.[32] The labrum and anterior capsule were ele-

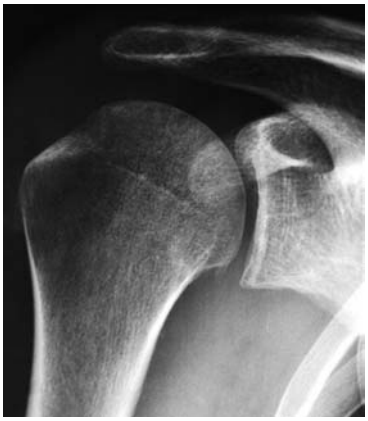

Fig. 4a

Fig. 4b

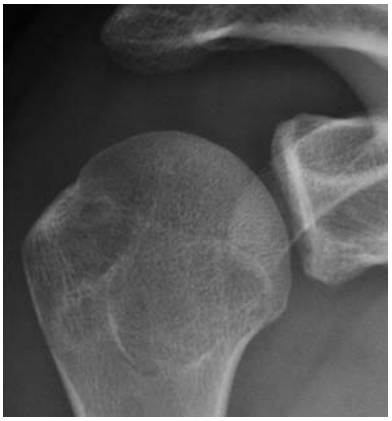

Fig. 4c

Glenoid lesions on anteroposterior radiographs showing a) normal shoulders, b) avulsion fracture, and c) loss of inferior contour.

vated from the anterior glenoid, the aim being to shift the labrum proximally and laterally. Visualisation of the subscapularis fibres and a feeling of elasticity of the inferior glenohumeral ligament were thought to indicate satisfactory soft-tissue mobilisation. The aim of the procedure was to retension the anterior capsule. After decorticating the glenoid neck, holes were sited at the edge of the anterior articular surface. A hooked needle (Spectrum, ConMed Linvatec, Largo, Florida) was used to pass a suture (PDS II #1, Ethicon, Cincinnati, Ohio), starting with the most inferior labrum and capsule. The suture was placed on an absorbable anchor (Panalok; DePuy Mitek, Raynham, Massachusetts) which was inserted into the most inferior hole. The same steps were repeated progressively, moving from inferior to superior along the anterior margin of the glenoid.

Pendulum exercises were started the day after surgery. The patient remained in a sling in internal rotation for one month, at which time physiotherapy was started. External rotation was limited to 45° until day 45. Strengthening exercises were started after two to three months. No return to sports was allowed until six months had elapsed.

At follow-up, any recurrent instability or symptoms were noted. A recurrence was defined as a further dislocation or any subjective complaint of subluxation. The time to recurrence and the circumstances of that recurrence were noted. The range of shoulder movement and apprehension test results were noted. Duplay and Rowe scores[21,27,28] and the patient's subjective assessment were recorded. The AP radiographs were repeated and any osteoarthritis was graded.

**Statistical analysis**. Either a Pearson's chi-squared or Fisher's exact test was performed to test for categorical values, depending on the sample size. Independent *t*-tests were used in a univariate analysis to test means against recurrence. Paired Student's *t*-tests were used to compare means. A score was calculated with this information, keeping factors with a p-value < 0.05 and those with strong support in the literature. The score was then re-applied to the study population and a stepwise scale with associated recurrence rate was tested. Analysis was performed using SPSS statistical software version 11.0 (SPSS Inc., Chicago, Illinois).

## Results

The mean follow-up was 31.2 months (24 to 52). In total, 100 patients (76.3%) had no symptoms and 12 (9.2%) had anterior discomfort without instability or apprehension. A new episode of subluxation was present in 14 (10.7%) and a dislocation in five (3.8%). The overall recurrence rate was therefore 14.5% and occurred after a mean 16.7 months (4 to 32). It was traumatic in seven (36.8%), and six patients (31.5%) needed further surgery. Differences in the ranges of movement were not statistically significant, except for a mean loss of 9° (-70° to 35°) of external rotation. The mean Walch-Duplay score increased from 38.8 (0 to 90) to 82.1 (15 to 100). The mean Rowe score at final follow-up was 81.5 (10 to 100). Most patients (114; 87.0%) were satisfied with their outcome.

Numerous pre-, intra- and and post-operative factors were tested against recurrence in a univariate analysis (Table III). In the pre-operative questionnaire, being aged under 20 at the time of surgery, and competitive sport were both significantly related to recurrence. In the pre-operative physical examination, shoulder hyperlaxity, whether anterior or inferior, was also significant. On the anteroposterior radiograph, the presence of a Hill-Sachs lesion on external rotation, and the disappearance of the normal sclerotic contour of the anteroinferior glenoid, was related to recurrence. Intra-operatively, the use of fewer than four suture anchors was related to recurrence. At the post-

**Table II.** Intra-operative findings

| Findings* | Number (%) |
|---|---|
| Anterior translation (with air) | |
| 25% to 50% | 1 (*0.8*) |
| 50% to 75% | 16 (*12.2*) |
| 75% to 100% | 81 (*61.8*) |
| More than 100% | 33 (*25.9*) |
| Inferior translation (with air) | |
| 25% to 50% | 45 (*34.4*) |
| 50% to 75% | 47 (*35.9*) |
| 75% to 100% | 34 (*25.9*) |
| More than 100% | 5 (*3.8*) |
| Hill-Sachs fracture | |
| None | 21 (*16.0*) |
| Small | 50 (*38.2*) |
| Medium | 14 (*10.7*) |
| Large | 46 (*35.1*) |
| Glenoid fracture | |
| None | 84 (*64.1*) |
| Small | 42 (*32.1*) |
| Medium | 2 (*1.5*) |
| Large | 3 (*2.3*) |
| Appearance of IGHL | |
| Normal | 36 (*27.5*) |
| Stretched | 71 (*54.2*) |
| Torn | 24 (*18.3*) |
| Quality of anteroinferior capsule | |
| Detrisac 1 | 9 (*6.9*) |
| Detrisac 2 | 68 (*51.9*) |
| Detrisac 3 | 44 (*33.6*) |
| Detrisac 4 | 10 (*7.6*) |
| SLAP lesion | |
| None | 85 (*64.8*) |
| Type 1 | 0 (*0*) |
| Type 2 | 41 (*31.3*) |
| Type 3 | 4 (*3.1*) |
| Type 4 | 1 (*0.8*) |
| Mean number of anchors (range) | 4.37 (*2* to *8*) |

* IGHL, interior glenohumeral ligament; SLAP, superior labrum anterior to posterior

operative assessment, competitive sport remained a significant factor.

**Instability severity index score.** A scoring system was developed using significant or pertinent risk factors (Table IV). A stepwise approach was used to determine the best scoring system. A score out of ten was chosen and included six significant pre-operative factors. The categories of 'patient younger than 20 years' and 'involved in competitive sports' scored two points each, 'contact or forced overhead activities' scored one point, and 'anterior or inferior hyperlaxity' scored one point. On the AP radiograph, two points were added if a Hill-Sachs lesion was visible on external rotation, and two points if there was loss of the normal inferior glenoid contour.

After applying this score to the study population, the mean score for those with recurrence was 5.3 (0 to 10) and the mean score without a recurrence was 2.7 (0 to 8) ($p < 0.001$). Score thresholds were tested, and if a patient scored three or less, the recurrence rate was 5%. If the score was six or less the recurrence rate was 10% but if it was more than six, the recurrence rate rose to 70%($p < 0.001$).

## Discussion

Appropriate patient selection is the next most important factor after a good surgical technique if good, reproducible results are to be achieved from an arthroscopic Bankart repair for recurrent anterior shoulder instability. Our hypothesis was that risk factors for recurrent instability are present and identifiable pre-operatively, and could be incorporated into a severity scoring system to help with patient selection. In order to verify this hypothesis, we performed a case-control study, comparing patients with a failed arthroscopic Bankart repair to those with a successful result. Our 14.5% recurrence rate is comparable with other published series.[9,12,13,33]

We identified six risk factors that predicted an increased recurrence rate: a patient aged less than 20 years at the time of surgery, sports involving contact or forced overhead activity, practised at a competitive level; shoulder hyperlaxity; a superior Hill-Sachs lesion visible in external rotation, and a loss of contour of the inferior glenoid on a plain AP radiograph.

These factors were incorporated into the instability severity index score and were tested retrospectively on the same population. We found that if the score was more than six points, the risk of recurrence after an arthroscopic Bankart repair was 70%. Consequently, we now advise our patients to have a procedure such as the Bristow[34] or Latarjet[35] procedure, rather than an arthroscopic Bankart if their instability index score is over six points.

The strengths of this study are threefold. First, we included every patient who had undergone the same standardised operation by the same experienced surgeon over a four-year period. Secondly, each patient was followed for at least two years, and only three of 134 (2.2%) were lost to follow-up. Thirdly, we were able to construct a scoring system to help us improve our pre-operative patient selection. For this reason, we deliberately included only pre-operative findings. The factors we identified can easily be elicited during routine clinical examination and do not rely on special tests or expensive imaging.

There are some weaknesses in the study. There was a tendency to underestimate the risk by patients who had changed to a less challenging sport prior to surgery as a direct result of their shoulder instability. The post-operative return to sport is relevant to post-operative stability but not to a pre-operative recurrence risk scoring system. Given that the risk of contact or forced overhead sports is often reported[8,14,16,17] and figures as a significant element of the only other instability score,[36] we included it in our score.

**Table III.** Recurrence factor analysis

| Risk factors | No recurrence (%) | Recurrence (%) | p-value* |
|---|---|---|---|
| Gender | | | |
| Male | 86 (*83.5*) | 17 (*16.5*) | 0.363 |
| Female | 26 (*92.9*) | 2 (*7.1*) | |
| Dominance | | | |
| Dominant | 67 (*81.7*) | 15 (*18.3*) | 0.131 |
| Non-dominant | 45 (*91.8*) | 4 (*8.2*) | |
| Mean age (range) (yrs) | 28.2 (15 to 62) (*10.2*) | 22.2 (14 to 37) (*5.7*) | 0.014 |
| ≤ 20 | 24 (*68.6*) | 11 (*31.4*) | 0.001 |
| > 20 | 88 (*91.7*) | 8 (*8.3*) | |
| Type of instability | | | |
| Dislocation | 30 (*88.2*) | 4 (*11.8*) | |
| Subluxation | 40 (*83.3*) | 8 (*16.7*) | 0.823 |
| Both | 42 (*85.7*) | 7 (*14.3*) | |
| Mean number of episodes (range) | | | |
| Total | 18.7 (1 to 51) | 12.9 (1 to 200) | 0.423 |
| Dislocation | 2.8 (0. to 12) | 1.5 (0 to 40) | 0.287 |
| Subluxation | 15.8 (0 to 50) | 11.5 (0 to 200) | 0.542 |
| Traumatic first event | | | |
| Yes | 92 (*83.6*) | 18 (*16.4*) | 0.307 |
| No | 20 (*95.2*) | 1 (*4.8*) | |
| Bilateral instability | | | |
| Unilateral | 93 (*84.5*) | 17 (*15.5*) | 0.737 |
| Bilateral | 19 (*90.5*) | 2 (*9.5*) | |
| Type of sports (pre-op) | | | |
| Contact or forced overhead | 66 (*82.5*) | 14 (17.5) | 0.310 |
| Other | 46 (*90.2*) | 5 (*9.8*) | |
| Degree of sport practised (pre-op) | | | |
| Competitive | 22 (*73.3*) | 8 (*26.7*) | 0.031 |
| Recreation or none | 90 (*89.1*) | 11 (*10.9*) | |
| Shoulder hyperlaxity | | | |
| No | 39 (*95.1*) | 2 (*4.9*) | 0.036 |
| Yes (anterior or inferior) | 73 (*81.1*) | 17 (*18.9*) | |
| Hill-Sachs on AP† radiograph | | | |
| No | 20 (*95.2*) | 1 (*4.8*) | |
| Internal or neutral rotation | 70 (*89.8*) | 8 (*10.2*) | 0.195 |
| External rotation | 22 (*68.8*) | 10 (*31.3*) | 0.002 |
| Glenoid lesion on AP radiograph | | | |
| No | 77 (*89.5*) | 9 (*10.5*) | |
| Loss of contour | 12 (*63.2*) | 7 (*36.8*) | 0.011 |
| Avulsion-fracture | 23 (*88.5*) | 3 (*11.5*) | |
| Glenoid lesion on AP radiograph | | | |
| No or avulsion-fracture | 100 (*89.3*) | 12 (*10.7*) | 0.003 |
| Loss of contour | 12 (*63.2*) | 7 (*36.8*) | |
| Number of anchors (intra-operative) | | | |
| Fewer than four | 11 (*61.1*) | 7 (*38.9*) | 0.002 |
| Four or more | 101 (*89.4*) | 12 (*10.6*) | |
| Anterior translation (intra-operative) | | | |
| No dislocation | 86 (*87.8*) | 12 (*12.2*) | 0.206 |
| Dislocation | 26 (*78.8*) | 7 (*21.2*) | |
| Detrisac (intra-operative) | | | |
| Type 1 | 8 (*88.9*) | 1 (*11.1*) | |
| Type 2 | 58 (*85.3*) | 10 (*14.7*) | 0.956 |
| Type 3 | 37 (*84.1*) | 7 (*15.9*) | |
| Type 4 | 9 (*90.0*) | 1 (*10.0*) | |
| Post-operative degree of sports practised | | | |
| Competitive | 5 (*50.0*) | 5 (*50.0*) | 0.013 |
| Recreation or none | 40 (*85.1*) | 7 (*14.9*) | |
| Post-operative type of sports practised | | | |
| Contact or forced-overhead | 18 (*66.7*) | 9 (*33.3*) | 0.072 |
| Other | 26 (*86.7*) | 4 (*13.3*) | |

* Pearson's chi-squared or Fisher's exact tests for categorical values, and independent Student's *t*-test for means
† AP, anteroposterior

**Table IV.** Instability severity index score is based on a pre-operative questionnaire, clinical examination, and radiographs

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

* AP, anteroposterior

Bony lesions were simply noted on plain radiographs. The size of the Hill-Sachs lesion increases as it is seen on more views; its presence on the external rotation view implies that it is located more superiorly on the humeral head. Glenoid evaluation is difficult on a plain radiograph, and we had postulated that the loss of the inferior sclerotic contour represented a significant inferior bony erosion (inferior glenoid bone loss). These findings were not correlated with CT or MR scanning. The size of these lesions is difficult to assess even with scans, which can be tiresome to obtain in day-to-day practice. Although more specific radiological views have been proposed to detect glenoid lesions by Garth, Slappey and Ochs[37] and Bernageau et al,[38] they are difficult to obtain in a routine clinic. The concept of the inverted-pear glenoid proposed by Burkhart and De Beer[19] is attractive but can only be assessed during arthroscopy; it is therefore not applicable to pre-operative evaluation and cannot be included in the risk-benefit discussion that the surgeon must have with the patient before proposing an arthroscopic Bankart repair.

The only other instability recurrence risk score was published by Calvo et al.[36] They used a transglenoid suture technique which is known to be less effective than the use of suture anchors. Furthermore, they used post-operative factors, which prevents the score from being used pre-operatively to help choose the appropriate procedure. Our score includes only pre-operative elements and is based on the most popular current arthroscopic technique.

In summary, our study shows that a simple scoring system based on factors derived from a pre-operative questionnaire, physical examination and AP radiographs may help to distinguish between patients who will benefit from an arthroscopic anterior stabilisation using suture anchors and those who will not. According to our results, patients with a score of six points or less have an acceptable recurrence risk of 10%, and are therefore potentially good candidates for this procedure. By contrast, those patients with more than six points have an unacceptable recurrence risk of 70% and should be advised to undergo open surgery (i.e. Laterjet procedure). The information gained from this study has already helped us in our daily practice by informing our patients pre-operatively of the risks and benefits of an arthroscopic Bankart procedure. Nonetheless, these results need to be confirmed and we have established a prospective clinical study based on the instability severity index scoring system to validate its prognostic accuracy.

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

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