ORIGINAL ARTICLE

Iliac bone-block autograft for posterior shoulder instability[☆]

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Summary

Introduction. — Posterior shoulder instability is a rare condition, representing only 4% of all shoulder-joint instabilities. Numerous surgical techniques are used to treat it when conservative functional treatment proves to be insufficient. This retrospective study relates to 8 patients, presenting recurrent posterior shoulder instability, all treated with a posterior iliac bone-block procedure. The results were assessed both clinically and with contemporary imaging techniques.

Materials and methods. — A unique identical surgical technique was used in all these cases including a posterior deltoid head detachment, an infraspinatus muscle dissociation and a bone-block positioning intended to extend and enlarge the glenoid cavity rather than to act as an actual block. Seven of these 8 cases were posttraumatic (including 2 with a concomitant congenital hyperlaxity past history) and the non-traumatic 1 was secondary to an epileptic seizure episode. All the patients had a typical posterior shoulder instability clinical presentation in the form of recurrent true dislocation incidents. In 6 cases, imaging revealed lesions of the humeral head or the glenoid cavity. These lesions were displacement-related anterior impaction defects of the humeral head (McLaughlin lesion) and/or a fracture (or erosion) of the posterior glenoid rim. Mean postoperative follow-up was 34 months.

Results. — No cases of postoperative suprascapular nerve deficit were observed. All patients recovered normal joint range of motion in abduction and anterior elevation; in 3 patients, however, external rotation ended up being limited by an average 20° compared to the opposite side. The mean Constant score was 96.25 points and the mean Duplay score 90. Only 4 patients were able to return to their preoperative sports activity level. Three required an additional procedure, 2 for hardware removal and 1 for posterior deltoid repair, which all lead to an uneventful evolution. Imaging at follow-up (X-ray or CT) did not show any instance of bone-block pseudoarthrosis or osteolysis nor did it exhibit glenohumeral early degenerative changes. In all, at a mean 3 years' follow-up, the present series showed satisfactory results in 80% of cases. A literature review found comparable results for bone-block stabilization procedures.

No recurrences of instability are reported with this technique, the main difficulty of which residing in the correct positioning of the bone-block. The stabilizing efficacy and low subsequent arthritic changes of the iliac posterior bone-block graft procedure seem thus confirmed by these encouraging results.

Discussion and conclusion. — The iliac posterior shoulder bone-block is effective in managing instances of involuntary posterior shoulder instability. A review of the literature confirmed these satisfactory results in terms of non-recurrence, pain relief and function recovery with this technique; the main difficulties of this technique remains in the correct positioning of the bone-block and the proper orientation of the fixation screws.

Introduction

Posterior shoulder instability accounts for only 4% of cases of recurrent shoulder dislocation.

Apart from involuntary forms, for which surgery is not indicated, the origin of posterior instability implicates either the bone, with abnormal joint surface orientation or osteochondral fracture of the humeral head or glenoid cavity, or else a postero-inferior capsuloligamentary deficit which may be either traumatic or congenital, due to hyperlaxity.

It is necessary to analyze the various clinical and radiological forms in order to determine treatment. First-line functional management is indicated in all cases and, according to Burkhead and Rockwood [1], effective in 80% in case of hyperlaxity or absence of bone abnormality. Where this fails, open — or, for a few teams, arthroscopic — surgery is indicated. The techniques involve osteotomy of the glenoid cavity or humeral head, or filling any defects in the humerus and/or capsule. There are also posterior bone-block techniques, which consist in extending the posterior glenoid surface with a posterior extracapsular bone graft.

There is, however, no consensus attitude for posterior shoulder instability management; published series are rare and show a low degree of evidence. Posterior bone-block would seem to be a reliable and effective stabilization technique in case of either bone or capsule abnormality.

The present report is of our experience on a series of 8 cases, with a review of the literature.

Material and methods

Material

A consecutive series of 8 patients were operated on by a single surgeon in our department between 1996 and 2006, receiving posterior iliac bone-block management of clinical congenital or acquired involuntary posterior shoulder instability. Any cases of voluntary instability were excluded. Data were collected retrospectively, including all patients operated, without age or gender criteria.

All of the patients in the present series were, in fact, male. Mean age was 28.7 years (range: 23—33). There were 5 left and 3 right shoulders, with dominant-side involvement in 3 cases. Two patients presented with bilateral instability, but only 1 side was operated on. Seven of the patients were manual workers (soldiers or firemen). Four practiced armed or contact sports at competition level, 3 practiced leisure sport, and just 1 had no sports activity.

Surgical technique

All iliac bone-blocks involved the same surgical technique.

Under general anesthesia, the patient was installed in lateral decubitus, with the upper limb held in a U-shaped support (Fig. 2).

The approach was posterior, by an L-shaped incision along the spine of the scapula, descending to the acromion (Fig. 1). The deltoid muscle was detached sub-periosteally to the spine of the scapula. The deltoid was dissociated along its fiber axis for a few centimeters at the acromion, providing access to the infraspinatus muscle. Dissociation along the infraspinatus fiber axis gave access to the mid-third of the posterior face of the glenoid cavity. The dissociation was located by finger palpation of the joint interline through the muscle. The suprascapular pedicle was located, as there is a danger of it passing into the spinoglenoid angle (Fig. 3). A vertical juxtaglenoid capsulotomy was then performed. Any lesions to the fat pad were dissected. The posterior edge of the glenoid cavity was
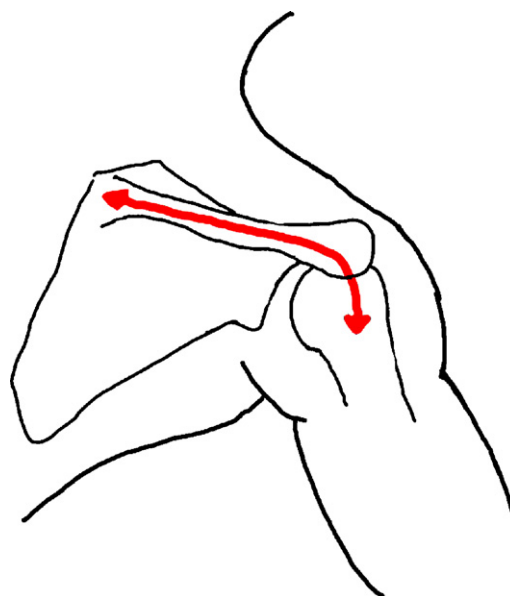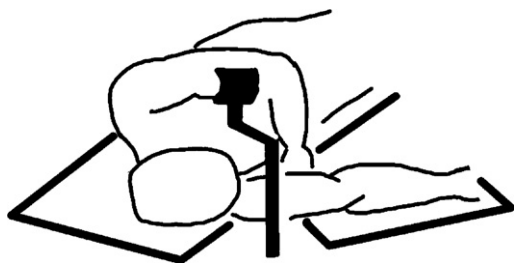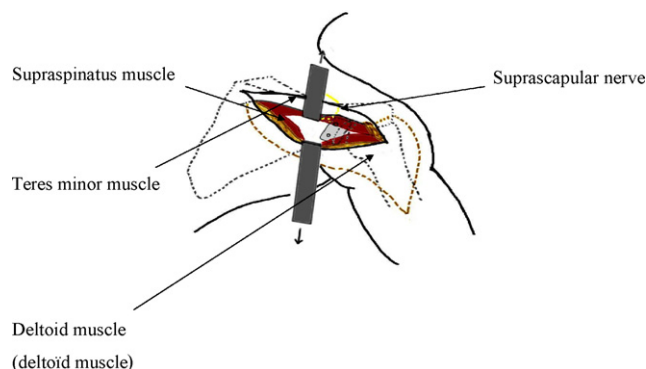

Figure 1 Cutaneous incision (O.Barbier).

Figure 2   Installation of patient in lateral decubitus (O. Barbier).
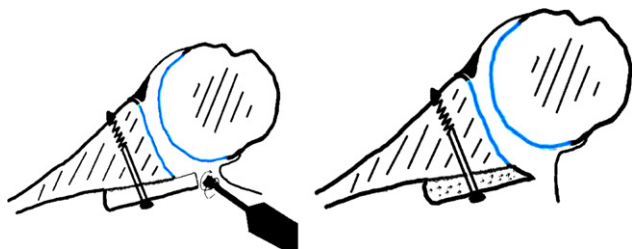

Figure 3   Posterior shoulder approach (O.Barbier).

then abraded as preparation for the bone-block graft and to ensure consolidation.

The second step consisted in harvesting a monocortical iliac bone graft of 25 mm length, 10 mm width and 10 mm thickness from the endopelvic part of the ipsilateral crest.

In the third step, the graft was positioned so as to project by about 5 mm. It was then fixed using two 4.5 diameter malleolar compression screws. The bone-block was then progressively reduced, using a rounded burr, so as to obtain a posterior enlargement of the glenoid cavity rather than a blocking effect as such (Fig. 4). This step had to be performed with great care, to avoid subsequent conflict with the humeral head during rotation and to obtain the joint enlargement effect sought after. The posterior capsule was sutured onto the osteosynthesis screws. The posterior deltoid muscle was reinserted by bone suture onto the spine of the scapula.

The shoulder was immobilized in neutral rotation, with the elbow against the body and a cushion on the anterior part of the abdomen, so as to prevent internal rotation. The cushion was kept in place for 1 month. Passive rehabilitation, with prohibition of internal rotation, was initiated as

Figure 4   Bone-block abrasion by round burr (O. Barbier).

of the early postoperative phase, to minimize glenohumeral stiffening.

Methods

This was a retrospective, single-center (hôpital d'instruction des Armées-Bégin, France), single-surgeon study.

Follow-up included analysis of preoperative data:

- onset context;
- functional disturbance;
- number of displacement episodes;
- voluntary nature or not;
- joint mobility.

X-rays, preoperative scans and surgical reports were reviewed for any associated bone compression lesions or joint (fat pad) lesions.

The objective items recorded on follow-up were the Constant shoulder function score with separate analysis of each item, and the Walch—Duplay score [2]. The Constant score of shoulder function, widely used to assess the rotator cuff, is clinically practicable, validated and relevant, and is therefore considered as the reference assessment of shoulder function in France. The Duplay score was initially used in anterior shoulder instability, but is transposable to posterior instability and represents a validated tool to measure the resumption of sports activity and functional disturbance, stability, pain and mobility. Postoperative assessment further comprised the interval to resumption and the type and level of sports activity. Physical examination looked for any persisting antero-posterior drawer, sign of sulcus or apprehension in flexion − internal rotation − adduction. Passive and active mobility were assessed. The follow-up checks included shoulder X-ray (frontal under 3 rotations, and 1 profile) and scan, to assess the condition of the bone-block (position, lysis, pseudoarthrosis) and any possible associated glenohumeral arthritis.

Results

The mean follow-up was 34 months (range: 10 to 60).

Preoperatively (Table 1), all patients complained of recurrent true posterior dislocation, and 1 (patient 1) further reported chronic pain and episodes of shoulder locking. Functional disturbance had been evolving over a mean 3 years (range: 1—6) at first preoperative consultation. Seven cases were posttraumatic (1 road accident, 2 work accidents and 4 sports accidents) and the other was secondary to an epileptic seizure. The mean age at first posterior dislocation was 24 years (range: 21—30). The reduction time (from less than 30 minutes to more than 180 minutes) and type (spontaneous or under general anesthesia) and the duration (0—4 weeks) of immobilization with Dujarier's bandaging varied widely. Fifty percent of the patients had had physiotherapy prior to surgery. Three had already undergone shoulder surgery: 1 (patient 4) had had 2 shoulder arthroscopies with fat pad resection and reinsertion; the other 2 had been operated on, for anterior shoulder instability, by anterior coracoid bone-block (patient 2) or anterior Bankart procedure (patient 5). All had had sev-

Table 1 Preoperative examination data.

	1	2	3	4	5	6	7	8
Reduction time	< 30 min	30 min	> 180	< 30 min	4 h	< 30 min	< 30 min	<30 min
Reduction	Spontaneous	General anesthesia	Spontaneous	Spontaneous	General anesthesia	Immediate	Spontaneous	Spontaneous
Immobilization time	4 weeks	2 weeks	None	None	4 weeks	3 weeks	None	4 weeks
Rehabilitation	Yes	No	No	Yes	Yes	Yes	No	No
Recurrence interval	6—12 months	<6 months	2 months	12—24 months	<6 months	<6 months	12—24 months	<6 months
Preoperative clinical exam	Posterior projection, anterior, posterior and inferior drawer	Posterior projection, anterior, posterior and inferior drawer	Posterior drawer	Posterior projection, posterior drawer	Posterior projection., anterior and inferior drawer	Posterior projection, posterior drawer	Normal	Posterior drawer
Apprehension in flex RI add	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Imaging	No lesion	No lesion	Humeral defect + glenoid fracture	Humeral defect + glenoid fracture	Humeral defect + glenoid fracture	Humeral defect	Humeral defect + glenoid fracture	Glenoid fracture + retroversion D(AP) <N
Peroperative findings	No	No	Glenoid fracture + fat pad lesion + posterior detachment pocket	Glenoid fracture + fat pad lesion + posterior detachment pocket	Glenoid fracture + fat pad lesion + posterior detachment pocket	Glenoid fracture + fat pad lesion	Glenoid fracture + fat pad lesion	Glenoid fracture + fat pad lesion + posterior detachment pocket

eral (2 to 15) recurrences in the year following the initial trauma.

All the patients showed normal active and passive mobility. There were no signs of rotator cuff lesion. Six of the 8 showed signs of apprehension in flexion − internal rotation − adduction. Four showed posterior projection on the Jerk test. Seven had a posterior drawer and 3 (patients 1, 2 and 5) had congenital hyperlaxity associated with an anterior drawer and positive sulcus test. The mean preoperative Constant score was 82.5/100 (range: 70—100).

All patients underwent frontal shoulder X-ray in neutral, external and internal rotation and a CT scan or arthroscan. Six patients (75 %) showed a posterior labrum lesion, and 6 showed compression lesions with anterior humeral head defect in 5 cases and posterior glenoid fracture in 5 cases. Two patients had no osteochondral lesions. There was no shoulder arthritis. One patient showed posterior glenoid hyperplasia with 20° retroversion and reduced antero-posterior glenoid cavity diameter secondary to a childhood fracture of the superior extremity of the humerus with associated growth cartilage damage. Two patients had undergone shoulder arthroscopy prior to surgery, which disclosed the same lesions as seen on the scan.

All of the patients were operated on in our institution between 1996 and 2006 by the same surgeon, using the same posterior iliac bone-block technique. The mean interval to surgery was 36 months (range: 3—85). There were no peroperative complications. Peroperative findings confirmed imaging data. The bone-block was fixed using two 45 mm malleolar screws in 7 cases and one 400 mm malleolar screw in 1 case (patient 1). Only 1 patient showed hematoma at the iliac harvesting site, associated with anesthesia in the femoral cutaneous nerve territory, which resolved spontaneously within a few days. Mean in-hospital stay time was 6 days (range: 4—10).

There were no early complications (infection, downstream neurovascular deficit or reflex sympathetic dystrophy). At follow-up, 3 patients had been reoperated for the shoulder: 1 to remove osteosynthesis material (too long a screw) associated to deltoid reinsertion (break in the initial posterior deltoid head suture), and the other 2 to remove osteosynthesis material under arthroscopy (anterior pain due to too long a screw in 1 case and painful cracking due to conflict between the screws and the humeral head in the other).

There was no residual antero-posterior or inferior drawer (sulcus test) or posterior projection on external flexion—rotation. No patient showed apprehension in flexion − internal rotation − adduction and rotator cuff tests were normal in all cases. Active and passive mobility in anterior elevation and abduction was 170° and 180° respectively in all patients. Mean external rotation with the elbow against the body was 45° (range: 30°—70°), with 48% reduction (33—70%) compared to the ipsilateral shoulder in 3 patients.

The mean postoperative Constant score (Table 2) was 96.25/100 (range: 85—100). Four patients complained of residual pain without impact on daily life. Functional, mobility and strength assessments were normal in all cases. The mean total Walch—Duplay score (Table 3) was 90 (range: 70—100).

Four of the 7 patients who had played sports before their trauma were able to resume their activity, at a mean 6

Table 2　Pre- and postoperative Constant scores.

Constant Score	Preoperative	Postoperative
Pain(40)	10 (5—15)	11.9 (5—15)
Function (20)	17.5 (5—20)	19.4 (15—20)
Mobility (40)	34 (25—40)	40
Strength (25)	20.7 (15—25)	25
Total (100)	82.5 (70—100)	96.3 (85—100)

Table 3　Postoperative Duplay scores.

	Duplay Score
Everyday Activity (25)	21.25 (15—25)
Stability (25)	25
Pain (25)	25
Mobility (25)	18.75 (5—25)
Total (100)	90(70—100)

months after surgery, although none recovered their former level. All the competition sports players had resumed their former activity, but at a lower (leisure) level. None of the occasional (leisure) players had resumed their sport. In 50% of cases, this failure to resume sports activity was not due to the operated shoulder.

All the patients considered themselves cured, although 5 of the 8 were not pain-free (intermittent pain).

The CT control revealed a well-positioned bone-block (subequatorial and flush) in all cases (Fig. 5). No shoulder arthritis was found (Fig. 6). Bone-block consolidation was 100%.
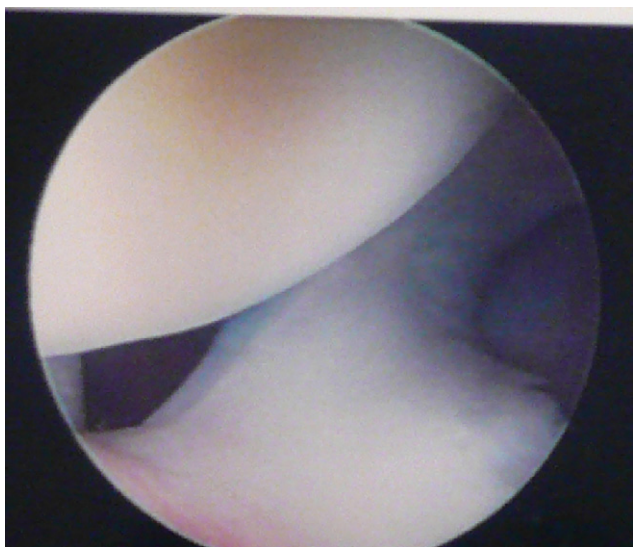
Discussion

Only 4% of cases of shoulder instability are posterior and treatment remains difficult. We shall not consider the man-

Figure 5　Coronal cross-section shoulder scans: flush posterior bone-block in position.

Figure 6 Shoulder arthroscopy 2 years after posterior bone-block procedure: no arthritis.

agement of voluntary forms here, as this is never surgical but rather psychiatric.

Initial treatment for involuntary forms is usually functional, with physiotherapy to strengthen the supraspinatus, infraspinatus and deltoid muscles associated to proprioceptive training and neuromuscular reprogramming [3]. Where there is no congenital bone abnormality, this proves sufficient in 80% of cases, even where there is hyperlaxity. In posttraumatic forms with bone sequelae, however, results are much poorer, with a 60% failure rate. [1]. Compression lesions, on the other hand, although of poor prognosis, do not seem to counter-indicate functional management.

When such functional treatment does prove insufficient and the patient complains of chronic posterior shoulder instability, surgery is indicated [4]. The surgeon then disposes of a vast range of options, none of which has been shown to be better than another. Published series have been small, uniquely retrospective and with a low level of evidence as they tended to mix true recurrent dislocation with chronic subluxation and posterior instability supervening on multidirectional laxity with posttraumatic forms. The present series has the interest of comprising only cases of recurrent dislocation.

Certain authors recommend increasing glenoid cavity anteversion by posterior opening osteotomy in case of retroversion exceeding 10°, although this would seem to be an extremely rare indication. Gerber et al. [5], Hawkins [6] and Johnston et al. [7] reported high rates of complication (severe coracoid conflict) and failure with this technique. Putti-Platt-type posterior myoplasty does not seem advisable, being associated with a high rate of recurrence (83% according to Hawkins et al. [8] and 72% according to Hurley et al. [9]). Open posterior capsulorrhaphy, according to Fuchs et al. and Burkhead and Rockwood, is effective only in rare indications of posterior instability associated with inferior hyperlaxity without glenoid bone abnormality or history of trauma [1,10].

Apart from specific osteotomy indications, 2 techniques seem to predominate: posterior Bankart-type capsule

reinsertion and posterior bone-block. An open or arthroscopic posterior Bankart procedure with reinsertion of the capsule/posterior labrum complex seems to be effective only in case of true but isolated posttraumatic posterior capsule-labral lesion (without history of surgery or inferior hyperlaxity) [11]. The present series included 1 patient with multidirectional instability, whose shoulder was permanently unstable despite initial management by posterior Bankart. Tibone and Ting (1990) reported a 45% failure rate with this technique in a series in which 40% of the patients presented with multidirectional instability [12]. McIntyre reported 25% recurrence in a series of 20 arthroscopic posterior Bankart procedures, 30% of which were voluntary forms [13]. Williams et al. reported 8% 5-year failure in a series of 27 cases without inferior laxity or surgical history [14]. In 2003, Kim et al. reported 27 cases of recurrent traumatic unidirectional posterior subluxation managed by arthroscopic labrum repair and posterior capsule retention; in only 1 case did the shoulder remain unstable, all the others improving in terms of pain, stability and function [15].

Posterior bone-block techniques were long considered a last resort after all else had failed. They involve either an iliac bone-block harvested preoperatively from the endopelvic face of the ipsilateral iliac wing or an acromial block with deltoid flap pedicle, following Kouvalchouk et al. [16].

In the present series, posterior iliac bone-block seemed to be an effective treatment for posterior shoulder instability, inasmuch as no patients showed recurrence and all considered themselves cured even if some were not free of pain. The sample (8 patients over 9 years) was small, as to be expected from the low prevalence of this pathology. The literature on posterior bone-block techniques confirms the present findings. There is, however, not just 1 bone-block technique, but a range of variants in terms of approach and type. Mowery et al. (1985) [17] reported 100% success in 5 posterior iliac bone-blocks using a horizontal approach through the spine of the scapula, detaching the posterior deltoid and passing between infraspinatus and teres minor. Kouvalchouk et al. (1993) [16] reported 5 posterior pediculated acromial bone-blocks with complete recovery of mobility and no instability or bone resorption on X-ray. Goutallier et al. [18] published a series of 11 patients with good clinical results despite 3 cases of resorption found on radiography. Essadki et al. (2000) [19] reporting on 6 sports players with superior shoulder subluxation managed by posterior iliac bone-block, plus posterior capsuloplasty in 1 patient presenting with multidirectional instability, found no recurrence at 3 years' follow-up, near-normal recovery of mobility (15° deficit in all directions) in 50% of cases, and resumption of sports activity, at the previous level in 50% of cases. Gosens et al. (2001) [20] reported 11 cases of shoulder instability managed by bone-block, with 72 months' follow-up: they found 100% success in case of unidirectional instability, compared to 20% for multidirectional instability and therefore recommended this technique in the former indication. Sirveaux et al. [11], in a retrospective study with a mean 13 years' follow-up in 18 patients, half of whom had been managed by posterior acromial bone-block and the other half by iliac graft, reported no recurrence in either group nor any difference in terms of stability, function or pain; acromial grafts, however, allowed earlier resumption

of sport, at 7 months versus 13 months with iliac grafts. Moreover, 30% of the patients were obliged to either stop or change sports activities due to apprehension or residual pain, and 30% still felt clinical apprehension which the author thought required capsule retention surgery.

The technique, however, is not without complications: 3 of our patients were re-operated to remove osteosynthesis material or for persistent pain, due in 1 case to screws which were too long and causing anterior pain and in the other to a slightly projecting bone-block causing posterior conflict between humerus head, screw and bone-block. Likewise, Sirveaux et al. [11] and Hinojosa et al. [21] reported technical problems with an intra-articular screw. Sirveaux et al. [11] reported 22% repeat surgery in his series, a much higher rate than found with anterior bone-block techniques (6% according to the SOFCOT symposium) [22]. Such problems can be avoided by checking the orientation of the glenoid cavity during arthrotomy, achieving good exposure, aiming the screw at the tip of the coracoid apophysis or else taking a peroperative profile control X-ray (which is more difficult to do and to interpret). It would seem helpful to use small-diameter screws of appropriate length, as anterior projection of the screw tip is badly tolerated. A third patient presented with deltoid detachment, probably due to resuming physical activity too quickly. Three of our patients complained of persistent pain around the graft harvesting site, 1 showing a large hematoma and lateral femoral cutaneous nerve impairment.

The approach adopted here involved detaching the superior edge of the deltoid from the spine of the scapula and dissociating the deltoid along the axis of its fibers. Detaching the posterior deltoid from the spine of the scapula is not without risk, as this muscle has an important functional role in posterior shoulder stability. Simply dissociating the deltoid fibers along their axis or leaning the posterior deltoid back in 90° antepulsion does not provide sufficiently good exposure to check the suprascapularis pedicle and perform the arthrotomy. Most authors agree with Essadki et al. [19] that detaching the posterior part of the deltoid provides better exposure and is to be recommended. The exposure of the glenoid cavity and of the posterior capsule through the rotator cuff muscles, on the other hand, remains controversial: in the present series, the posterior face of the glenoid was exposed by dissociating the infraspinatus muscle along its fiber axis. In the literature, various approaches are reported but all are subject to discussion: Fuchs et al. [10] and Kouvalchouk et al. [16] recommend sectioning the tendinous part of infraspinatus, to provide comfortable exposure of the posterior face of the glenoid cavity, but this requires repair at the end of surgery, delays rehabilitation with a risk of suture breakage and compromises functional amplitude recovery. Fried [23] and Mowery et al. [17] suggest passing between the teres minor and infraspinatus and locating the axillary nerve, but this interval is hard to locate, and Essadki et al. [19] reported poor glenoid exposure with this approach, which moreover risks lesion of the axillary nerve. Passing between supra- and infraspinatus certainly improves exposure, but runs the risk of suprascapularis nerve lesion, leading to infraspinatus muscle atrophy: while this approach provides good exposure of the posterior face of the glenoid cavity, it requires locating the suprascapularis nerve. Finally, the last option, which was chosen in the present series, is to dissociate the infraspinatus fibers along their axis, remaining 1.5 to 2 cm from the posterior edge of the glenoid cavity, and to locate the suprascapularis nerve, which branches onto the infraspinatus, so as to avoid any lesion. This approach provides access to the posterior face of the glenoid, at the right level. According to Kouvalchouk et al. [16], this approach provides sufficient exposure to graft an acromial but not an iliac bone-block, the latter being larger in size.

Regarding positioning, it is unanimously agreed that the bone-block must be flush and not projecting. It serves just to prolong the glenoid joint, rather than actually as a block. Our technique is to place the bone-block so as to project slightly by 5 mm and then progressively to abrade it with a round burr so as to extend the glenoid joint surface harmoniously. If the bone-block projects too much, it will cause conflict with the humeral head, with a risk of arthritis; and if it is too internal, it fails to extend the glenoid cavity and will be ineffective (Fig. 4).

Posterior bone-block techniques were long considered arthrogenic; in the present series, however, no medium-term postoperative arthritis was observed. This finding is concordant with the literature ([16], [19]). Sirveaux et al. [11] reported only 3 cases of arthritis, 1 of which was associated with a technical error, among 18 patients followed over a mean 13 years.

Conclusion

Posterior shoulder instability is rare. When surgery is required, the surgeon, whose experience with this pathology will tend to be limited, is confronted by a real difficulty. The present resurfacing posterior bone-block stabilization technique, consisting in adding an iliac bone graft to the posterior surface of the glenoid cavity and abrading so as to enlarge the joint surface without creating a block effect as such, seems, from the present data and the published literature, to be effective and reliable in case of involuntary posterior instability.

The main lessons are that this is a glenoid enlargement ''plasty'' and that the bone-block must be flush, so as not to enter in conflict with the humeral head. The screws often cause complications and should be oriented and measured so as not to protrude anteriorly or cause posterior conflict. The technique requires compliance with a rigorous rehabilitation program.

This technique is a justifiable option in case of involuntary posterior shoulder instability when functional management has proved insufficient.

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