Reconstruction of glenoid bone defects in shoulder instability with autologous bone

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Abstract Bone defects, both at glenoid and at the humeral side are a frequent sequel of anterior shoulder instability. Although the transfer of the coracoid process (Latarjet, Bristow procedures) has gained popularity in treating the glenoid defect, equal results can be achieved with the use of a bone graft, for which mainly a graft of the iliac crest is used. Recently, arthroscopic procedures have been developed, leaving the subscapularis muscle largely intact.

Keywords Anterior shoulder instability · Glenoid bone defect · Bone graft · Iliac crest graft

Introduction

Bone defects, both at the humeral as well glenoid side, are a frequent sequel after a shoulder dislocation.

The defect in the humeral head was described in 1855 by Malgaigne [1]; the defect at the glenoid side was, for the first time, described much later by Broca and Hartmann in 1890 [2].

While restoration of the defect at the glenoid side in anterior instability is much easier to treat than at the humeral side, more techniques have been developed to address the bone defects at the glenoid side.

The techniques described by Latarjet [3] and Bristow [4, 5] were originally not invented for treating bone lesions at the ventral glenoid side, but relied on the sling effect of the conjoined tendon; they turned out to be effective in the treatment of shoulder instability, with or without bone lesions of the glenoid.

The first description of the application of a bone graft was by Eden [6]. He used an autograft from the tibia to fill the

defect of the glenoid; the graft was placed slightly medially to the surface on the scapular neck, partially covered by the periosteum of the scapular neck and subsequently the capsule was reattached to the native glenoid.

Hybbinette [7] expanded the technique by fixing the capsule tightly over the graft, thus, fixing the block to the glenoid neck without using any other device. He was also the first surgeon, who used, instead of a graft from the tibia, an autograft from the iliac crest for supplementing the glenoid defect.

Lange [8] modified the technique of Hybbinette by making a groove in the anterior neck of the glenoid to deepen the floor, creating a more stable fixation of the block, also without the use of screws.

The results of these series with these original techniques showed a rather high recurrence rate as well a high rate of osteoarthritis [12, 23].

Since the introduction of the fixation of the bone block with screws, better clinical results were achieved.

Present indications

In a majority of the patients with recurrent anterior instability some bone loss is present, either due to a fracture or an erosion [9]. The majority of defects amount about 10 % of the glenoid surface, when the inferior part is regarded as a circle (Figs. 1 and 2) [10].

Although there is no consensus on the way to measure the bone defect on the glenoid, nor on when a bony procedure is needed, it is generally accepted, that in patients with severe bone loss a bone supplementing procedure for the glenoid defect is recommended.

A recent review showed, with the available evidence, no differences in clinical results in patients treated with either a coracoid transposition (Latarjet procedure) or bone apposition to the glenoid [11•].

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Fig. 1 3D CT scan of the left shoulder with an anterior glenoid defect

Glenoid reconstruction with autologous bone

Several studies have shown the efficacy of bone apposition of the glenoid in treating recurrent shoulder instability.

The technique shows a wide variation: the graft is either fixed by impaction in the scapular neck, the so-called J graft [13]. In most of the other studies the graft is fixed with screws. The capsule is either left alone or fixed to the native glenoid, thus, placing the graft extra-articularly (Fig. 3).

In Tables 1 and 2 the results of the most prominent studies are summarized.

Complications

The complications are related to either the donor site or to the shoulder joint. Minor complications of hematomas have been reported as well as more serious problems, including graft fractures and nerve lesions.

Fig. 2 MRI arthrogram of the same shoulder as fig. 1, showing the glenoid defect as well as the labral detachment

Fig. 3 Iliac Crest Bone Graft, fixed to the glenoid with 2 screws

The recurrence rate is variable and higher in series, where the graft was not fixed with screws to the scapular neck [12, 16]. In the more recent series, with well-fixed transplants, the recurrence rate is very low [13–15, 17].

Arthritis is seen more often, although mostly mild; reports are not always clear on the prevalence of preoperative arthritis and further deterioration. Development of arthritis is possibly prevented when, after fixing the graft the capsule is reattached on the rim of the native glenoid, thus, placing the bone block extra-articularly [15]. Re-attachment of the capsule is recommended, to prevent micro-instability [15].

Nonunion is a risk, which can be prevented by proper fixation of the graft, preferably with 2 screws.

Graft fracture is seen, both in series with and without screw fixation [13].

Dislocation of the graft is sometimes seen when a trauma occurs prior to the consolidation of the bone block: this phenomenon has especially been observed in epileptic patients with a seizure in the immediate postoperative period [13].

Nerve lesions around the shoulder can occur during surgery, with potentially involvement of the axillary or musculocutaneous nerve, but this is very rare compared with the coracoid transfer (Latarjet) procedure.

In relation to the harvesting of the iliac crest graft, the lateral cutaneous femoral nerve can be damaged, causing hyper- or hypoesthesia of this nerve [13].

The approach to the shoulder joint can be performed by either a tenotomy medially to the minor tuberosity as well as through a longitudinal split of the subscapularis muscle. After a tenotomy at follow-up fatty changes as well as atrophy of the subscapularis muscle have been observed, however, without any clinical consequences [15, 17].

Table 1 Patient characteristics, type of graft, recurrence, arthritis

Author	Number	Follow-up	Type graft	Recurrence	Arthritis
Rahme [12]	87	29 yrs (22–37)	ICBG	17	47 %
Auffarth [13]	47	25–152 mo	ICBG, J graft	0	11 %
Warner [14]	11	24–60 mo (33)	ICBG	0	NR
Steffen [15]	43	5–19 yrs (9.2)	ICBG	4	16 %
Oster [16]	78	0.5–27 yrs	ICBG	14	NR
Scheibel [17]	10	24–49 mo (37.9)	ICBG	0	30 %
Hutchinson [18]	15	8–61 mo (32)	ICBG, Allograft	0	0 %
Weng [19]	9	4.5–14 yrs	Allograft	2	NR

Legend brackets mean follow-up, ICBG iliac crest bone graft, mo months, NR not reported, yrs years

Newer developments

In the last years arthroscopic techniques have been developed to perform the introduction of the graft through a minimal invasive (arthroscopic) procedure [20–22].

The advantage of this arthroscopic procedure is the avoidance of dissecting the subscapularis muscle, either by a tenotomy or a longitudinal split, except for making a small entry to introduce either a screw or other fixation devices.

Discussion

In the recent years the coracoid transfer (Latarjet procedure) has gained more popularity.

The advantage of this operation over the bone block procedure is the “sling” effect of the conjoined tendon. Biomechanical cadaveric studies have shown the superiority of the transfer over the bone block procedure with the “sling” as an important stabilizing mechanism [24]. It should, however, be realized, that the superiority of the coracoid transfer procedure is not confirmed by clinical studies [11•].

Both the bone block procedure and the coracoid transfer restore the glenoid arc. In laboratory studies the contact pressures in the shoulder joint are normalized with both procedures [25] and the joint translation is reduced, although to a higher extent in the coracoid transfer compared with the bone block procedure [26]. There are some clear advantages of a

reconstruction of the glenoid defect with a bone block procedure over the coracoid transfer:

- It is a more anatomical procedure, not interfering with the function of the subscapularis muscle.
- It is clinically very effective, with a very low recurrence rate.
- In the near future the procedure can be performed arthroscopically, without need of transferring bone through the subscapularis muscle, contrary to the coracoid transfer.
- When placed extra-articularly, the expected rate of arthritis is low.

Disadvantages are:

- Donor site morbidity (generally the iliac crest) with post-operative pain as main problem.

Conclusions

The bone block procedure is a very effective procedure in treating bone defects in anterior shoulder instability, with a very low recurrence rate, especially when the block is properly fixed to the glenoid neck, and generally low morbidity; if this

Table 2 Mean outcome scores, loss of external rotation

Author	N	Rowe	Constant	ASES	WOSI	Loss of ER (0°)	ER (90°)
Rahme [12]	87	84	85	NR		NR	NR
Auffarth [13]	47	94.3	93.5	NR		4.36°	3.19°
Warner [14]	11	94	NR	94		14°	
Steffen [15]	43	NR	NR	NR	18	4.1°	
Oster [16]	78	NR	NR	NR		NR	
Scheibel [17]	10	89	88	NR	82.6	NR	
Hutchinson [18]	15	NR	91.3	NR	NR	NR	
Weng [19]	9	84	NR	NR	NR	7°	

procedure fails, the more nonanatomical coracoid transfer operation can still be performed.

With the increasing experience in arthroscopic techniques to perform bone procedures in the shoulder joint, there is a great advantage of the bone block procedure over the coracoid transfer, while all surgery can be performed through the rotator interval and no surgery has to be performed through the subscapularis muscle.

Although the Latarjet procedure nowadays seems to be the most popular operation when bone has to be augmented to the glenoid, it can be expected, that in the future the arthroscopic bone block procedure will become the standard procedure.

Compliance with Ethics Guidelines

Conflict of Interest W. Jaap Willems declares that he has no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by the author.

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