



Resident's backpack

Anteroinferior shoulder instability. Essential articles

J. M. Antequera Cano

Hospital de Manises. Valencia (Spain)

Correspondence:

Dr. Juan Manuel Antequera Cano
E-mail: juanma.cano91@gmail.com

Received 5 December 2023
Accepted 29 September 2024
Available online: September 2024

ABSTRACT

Anteroinferior glenohumeral dislocation of the shoulder is one of the most frequent disorders found in trauma consultations, affecting especially the young and active population.

A brief review is made of the most important articles and their key findings that have appeared on anteroinferior shoulder instability in recent years. The first description of glenohumeral bone defects as a determining factor for dislocation recurrence is detailed, along with the exposure and significance of the Hill-Sachs impaction lesion. The main risk factors for recurrence after Bankart repair are identified, and mention is made of the articles in which the concepts of *glenoid track*, *off-track* and *on-track* lesion and their therapeutic implications are first reported. A description is made of the subcritical level of glenoid bone loss with respect to the previously established critical levels, together with the relationship of the percentage defect with the type of treatment and function. Lastly, comparison is made of the treatment of bone defects via Latarjet and iliac crest graft.

Key words: Glenohumeral dislocation. Anteroinferior instability. Glenoid defect. *Glenoid track*. Subcritical limit.

RESUMEN

Inestabilidad anteroinferior de hombro. Artículos imprescindibles

La luxación glenohumeral anteroinferior de hombro es una de las patologías más frecuentes que podemos encontrar en las consultas de traumatología, afectando especialmente a la población joven y activa.

A continuación, se hace un breve repaso a los artículos más importantes y sus hallazgos más destacados que han aparecido acerca de la inestabilidad anteroinferior de hombro en los últimos años. Se detalla la primera descripción de los defectos óseos glenohumerales como factor determinante para la recidiva de la luxación, así como la exposición y el significado de la lesión de Hill-Sachs enganchante. Se identifica cuáles son los principales factores de riesgo de recurrencia tras realizar una reparación de Bankart y se mencionan los artículos en los que aparecen por primera vez los conceptos *glenoid track*, lesión *off-track* y *on-track*, y sus implicaciones a nivel terapéutico. La descripción del nivel subcrítico de pérdida ósea glenoidea respecto a los niveles críticos que se habían establecido previamente y la relación del porcentaje de defecto con el tipo de tratamiento y la funcionalidad y, finalmente, se compara el tratamiento de los defectos óseos mediante Latarjet e injerto de cresta ilíaca.

Palabras clave: Luxación glenohumeral. Inestabilidad anteroinferior. Defecto glenoideo. *Glenoid track*. Límite subcrítico.



<https://doi.org/10.24129/j.reacae.31181.fs2312030>

© 2024 Fundación Española de Artroscopia. Publicado por Imaidea Interactiva en FONDOSCIENCE® (www.fondoscience.com). Este es un artículo Open Access bajo la licencia CC BY-NC-ND (www.creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

Anteroinferior glenohumeral dislocation of the shoulder is one of the most frequent disorders found in trauma consultations, affecting especially the young and active population. The shoulder is the most frequently dislocated large joint. Dislocation is usually followed by labral injury, which may predispose to the development of recurrent instability⁽¹⁾.

The most immediate treatment is closed reduction of the dislocation. After a first episode, some patients develop recurrent dislocations or clinically symptomatic subluxations even with activities of daily living. Correct study of the patient and knowledge of his/her disease will help us to identify who is at a high risk of recurrence, in which case the patient may benefit not only from surgical treatment, but also from the most appropriate technique for each specific case. Assessment of the glenoid defect is very important in this respect. A critical level of 20-25%⁽²⁾ has been classically established, above which techniques involving enlargement of the glenoid surface must be considered^(3,4).

Our aim is to discuss the most important articles that have appeared in recent years on the treatment of anteroinferior shoulder instability. To achieve this, it is important to understand the glenoid and humeral head anatomy, the associated risk factors and causes of recurrence, as well as the most appropriate treatment for each type of injury.

Burkhart and De Beer, 2000⁽⁵⁾

This first article by Burkhart and De Beer, entitled: "Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repair: significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion", is a retrospective case series study of 194 Bankart repairs. In it, the authors describe that anatomically the glenoid is pear-shaped, so that in a sagittal plane of the glenoid surface the inferior anteroposterior diameter is greater than the superior anteroposterior diameter.

The debate until then had centred on the type of repair, open versus arthroscopic, and on treatment of the soft tissue. The authors argued that the debate should focus on both humeral and glenoid bone defects, with these defects being a determining factor in the recurrence of dislocation. For this purpose, they established two groups: patients with and without bone defects. The recurrence rate in patients without a bone defect was 4%, versus 67% in patients with a bone defect.

They also described significant glenohumeral bone defects as the presence of an inverted pear-shaped glenoid defect and/or the presence of a humeral defect which they define as an engaging Hill-Sachs lesion. This was the first time that the concept of an engaging Hill-Sachs lesion was described: a Hill-Sachs lesion in which the long axis of the defect is parallel to the anterior glenoid, so

that the humerus can become hooked or "engaged" on the anterior glenoid rim at 90° of abduction and any range of external rotation. When the bone lesion is an engaging Hill-Sachs lesion, the recurrence rate is 100%.

The authors described the anatomical relationship of the glenoid and humeral head, the forces they are subjected to, and the effect of the bony defects upon this relationship of forces. Containment of the humeral head in the glenoid is the result of two variables. The first is the depth effect, with a normal glenoid having a wide and deep, concave surface. When part of the glenoid surface is lost, the remaining glenoid is shallower and less resistant to the shear forces that can lead to dislocation. The second variable is the length of the glenoid arc; the glenoid resists the axial forces of the humeral head until the force vectors reach the limit of the glenoid. It is at this point that the head of the humerus is contained by the bone-ligament interval, and a Bankart lesion may occur. Thus, when there is glenoid bone loss, the length of the glenoid arc is reduced and the arc over which the glenoid can contain the axial force vectors of the humeral head is consequently limited.

The main limitation of this study is that it is a retrospective case series, with a mean follow-up limited to just over two years.

Boileau et al., 2006⁽⁶⁾

In 1995, the failure rate for arthroscopic repair was as high as 50%. This article by Boileau *et al.* entitled: "Risk factors for recurrence of shoulder instability after arthroscopic Bankart repair", consists of a retrospective case series involving a total of 91 consecutive patients subjected to arthroscopic repair. The aim was to identify the risk factors associated with recurrence after repair.

After analysing their results, the authors identified the following risk factors for recurrence of dislocation after arthroscopic repair: glenoid bone loss > 25%, a large Hill-Sachs lesion, hyperlaxity or weakness of the inferior glenohumeral ligament (Gagey test >105°), and the use of three or fewer sutures for repair. A recurrence rate of 75% was recorded in patients with a glenoid defect of 25% and who moreover presented hyperlaxity; the procedure therefore would be contraindicated in these patients.

This was a retrospective study with a follow-up period limited to two years on average; moreover, most of the cases were athletes involved in contact sports.

Di Giacomo et al., 2014⁽⁷⁾

This article, published in 2014 by Di Giacomo *et al.*, was entitled: "Evolving concept of bipolar bone loss and the Hill-Sachs lesion: from engaging/non-engaging lesion to

on-track/off-track lesion". However, the concepts of *glenoid track* (GT), *on-track* lesion and *off-track* lesion were first described by Yamamoto *et al.*⁽⁸⁾ in 2007. The GT is defined as the path taken by the glenoid across the posterior aspect of the humerus in external rotation from an inferomedial to a superolateral position (in a posterior view). It represents 83% of the total width of the glenoid and can be calculated by multiplying the glenoid width $\times 0.83$, when there is no glenoid bone defect. If the Hill-Sachs lesion is within the GT (*on-track* lesion), there is no risk of the lesion "engaging" on the glenoid.

These authors stated that the "engagement" must be quantifiable and, to this end, they proposed an arthroscopic or computed tomography (CT) assessment that takes into account the GT, the influence of glenoid bone loss, and the location of the Hill-Sachs lesion with respect to the *glenoid track*.

The GT depends solely on the size of the glenoid, so that when there is an anteroinferior glenoid bone defect, the width of the GT decreases, and the risk of the Hill-Sachs lesion being *off-track* increases as a result. To calculate the GT in a patient with glenoid bone loss, we subtract the glenoid defect (d) from 83% of the glenoid width (D) that would correspond to the GT in a patient without bone loss ($GT = 0.83 \times D - d$).

After considering the GT, the Hill-Sachs lesion was analysed. They described the Hill-Sachs interval (HSI) as follows: there is a zone of intact bone between the medial margin of the cuff insertion and the lateral margin of the Hill-Sachs lesion. The sum of the width of the Hill-Sachs lesion plus the width of this bony bridge is called the HSI.

Two situations can occur after calculation of the GT and the HSI. $GT > IHS$: this is an *on-track* lesion, i.e., the lesion is within the GT and does not "engage" the glenoid. $GT < IHS$: this is an *off-track* lesion, and therefore the Hill-Sachs lesion "engages" with the anteroinferior border of the glenoid.

It should be noted that the percentage of the glenoid represented by the GT was taken from the data of the study by Yamamoto *et al.*⁽⁸⁾, who derived this percentage from a very limited study of cadavers (9 in total), which may affect reproducibility in the general population. With regard to the limitations of this article, it corresponded to a descriptive study with intra- and inter-observer variability in calculation of the GT in both the CT image and in the arthroscopic measurement, which could affect the reproducibility of this measurement.

Shaha *et al.*, 2015⁽⁹⁾

Shaha *et al.*, in their study entitled: "Redefining 'critical' bone loss in shoulder instability. Functional outcomes worsen with 'subcritical' bone loss", assessed the effect of glenoid bone loss below the previously established criti-

cal level (20-25%) and evaluated effect and functionality in the final outcome after arthroscopic repair.

A total of 72 military personnel (73 shoulders) underwent arthroscopic Bankart repair following dislocation. All had three months of rehabilitation treatment. Those who persisted with instability or apprehension and limitation of daily activities were operated upon.

The authors set a sub-critical limit of 13.5%, which was the limit (dividing all patients into quartiles) between quartiles 2 and 3. They analysed glenoid bone loss and functional outcomes after repair, with the outcomes being significantly poorer in patients with defects greater than 13.5%. The authors then analysed the results excluding those patients who had failed; again, in this case, the functional outcomes were seen to be better in patients with a defect of less than 13.5%.

This study suggested that performing arthroscopic Bankart repair in patients with a defect greater than 13.5% may result in an unacceptable functional outcome, despite the absence of instability.

The limitations of this study are that it represented a retrospective case series, with limited follow-up, and all the patients studied were military personnel.

Moroder *et al.*, 2019⁽¹⁰⁾

In 2019, Moroder *et al.* published a study entitled: "Latarjet procedure versus iliac crest bone graft transfer for treatment of anterior shoulder instability with glenoid bone loss: a prospective randomized trial". This was a prospective randomised clinical trial seeking to determine which technique is better for the treatment of glenoid bone defects. Although there have been many articles describing the results of the Latarjet and iliac crest graft techniques for the treatment of glenoid bone defects, until the appearance of this study there were no prospective randomised trials comparing the two techniques. The authors conducted a prospective two-centre randomised clinical trial comparing the two techniques. For this purpose, a total of 60 consecutive patients were randomised to undergo either Latarjet or crest autograft surgery.

The results showed no significant differences between the two groups in terms of the functional scales, abduction and external rotation, although there were significant differences in internal rotation in favour of the iliac crest graft group.

No episodes of dislocation occurred in either group; however, subluxations occurred in 6.7% of the cases in the iliac crest graft group and in 3.3% of the cases in the Latarjet group. The apprehension and repositioning tests proved positive in 10% of the cases in the iliac crest graft group and in 6.7% of the cases in the Latarjet group. There were no significant differences in these data. In turn, there were no significant differences between the two groups with respect

to postoperative pain or patient satisfaction. In terms of the radiological findings, there were significant differences in the immediate postoperative period in favour of the iliac crest graft group. However, these differences were not significant between the two groups at 12 and 24 months of follow-up.

The authors concluded that there are no significant clinical or radiological differences between the two techniques (except for limitation of internal rotation in the Latarjet group).

Although this was a prospective, randomised clinical trial, its main weakness was the limited follow-up (only two years).

Conclusions

The 5 commented articles allow us to better understand shoulder instability. They allow us to know the anatomical relationship between the different structures; to identify the key elements we need to know when we have a patient with shoulder instability in order to offer the best treatment for each type of injury and patient; and to know the risk factors that can make our treatment inadequate. Based on the progressive description of the concepts of inverted pear, *glenoid track*, *on-track* and *off-track* lesions and subcritical glenoid defects, the different bone defects have modified our treatment algorithm with a view to offering the best therapeutic alternative in each case, not only avoiding recurrence, but also securing the best possible functional outcomes.

Ethical responsibilities

Conflicts of interest. The authors state that they have no conflicts of interest.

Financial support. This study has received no financial support.

Protection of people and animals. The authors declare that this research has not involved human or animal experimentation.

Data confidentiality. The authors declare that the protocols of their work centre referred to the publication of patient information have been followed.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

References

1. Hovelius L, Augustini BG, Fredin H, Johansson O, Norlin R, Thorling J. Primary anterior dislocation of the shoulder in young patients. A ten-year prospective study. *J Bone Joint Surg Am.* 1996;78(11):1677-84.
2. Lo IKY, Parten PM, Burkhart SS. The inverted pear glenoid: an indicator of significant glenoid bone loss. *Arthroscopy.* 2004;20(2):169-74.
3. Itoi E, Lee SB, Berglund LJ, Berge LL, An KN. The effect of a glenoid defect on anteroinferior stability of the shoulder after Bankart repair: a cadaveric study. *J Bone Joint Surg Am.* 2000;82(1):35-46.
4. Shin SJ, Koh YW, Bui C, et al. What Is the Critical Value of Glenoid Bone Loss at Which Soft Tissue Bankart Repair Does Not Restore Glenohumeral Translation, Restricts Range of Motion, and Leads to Abnormal Humeral Head Position? *Am J Sports Med.* 2016;44(11):2784-91.
5. Burkhart SS, De Beer JF. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: Significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. *Arthroscopy.* 2000;16(7):677-94.
6. Boileau P, Villalba M, Héry JY, Balg F, Ahrens L, Neyton P. Risk Factors for Recurrence of Shoulder Instability After Arthroscopic Bankart Repair. *J Bone Joint Surg.* 2006;88-A:1755-63.
7. Di Giacomo G, Itoi E, Burkhart SS. Evolving concept of bipolar bone loss and the Hill-Sachs lesion: From “engaging/non-engaging” lesion to “on-track/off-track” lesion. *Arthroscopy.* 2014;30(1):90-8.
8. Yamamoto N, Itoi E, Abe H, et al. Contact between the glenoid and the humeral head in abduction, external rotation, and horizontal extension: A new concept of glenoid track. *J Shoulder Elb Surg.* 2007;16(5):649-56.
9. Shaha JS, Cook JB, Song DJ, et al. Redefining “critical” bone loss in shoulder instability. *Am J Sports Med.* 2015;43(7):1719-25.
10. Moroder P, Schulz E, Wierer G, et al. Neer Award 2019: Latarjet procedure vs. iliac crest bone graft transfer for treatment of anterior shoulder instability with glenoid bone loss: a prospective randomized trial. *J Shoulder Elbow Surg.* 2019;28(7):1298-307.