International Journal of Orthopaedics

Online Submissions: http: //www.ghrnet.org/index.php/ijo
doi: 10.17554/j.issn.2311-5106.2021.08.420

Int. J. of Orth. 2021 August 28; **8(4)**: 1493-1496
ISSN 2311-5106 (Print), ISSN 2313-1462 (Online)

REVIEW

Hill-Sachs Remplissage Procedure and its Role in Arthroscopic Stabilisation of the Shoulder

Anestis Iossifidis[1], Al-Achraf Khoriati[1]

1 Department of Trauma and Orthopaedic Surgery, Shoulder Unit, Croydon University Hospital, London, UK.

Conflict-of-interest statement: The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

Correspondence to: Anestis Iossifidis, MD, FRCS Ed, FRCS Ed (orth.), Senior Orthopaedic Surgeon, Head of Shoulder & Upper limb Unit, Address: Croydon University Hospital, 530 London Road, Croydon, London, CR7 7YE.
Email: anestis.iossifidis@gmail.com
Telephone: +0044 (0) 7802404708

Received: June 25, 2021
Revised: July 18, 2021
Accepted: July 20 2021
Published online: August 28, 2021

ABSTRACT

The arthroscopic Hill-Sachs Remplissage procedure was first described in 2004 and published in 2008. It consists of an arthroscopic posterior capsulodesis combined with an infraspinatus tenodesis to achieve a "filling in" effect of posterior humeral head defects. The technique was put forward as a solution to high rates of Bankart repair failure, in the presence of large Hill-Sachs lesions. We describe the evolution of the technique and its outcomes and report on the evolving surgical indications over the last decade in response to new paradigm shifts. Due to a better understanding of the pathophysiology of shoulder instability, emphasis was given to both Bankart soft tissue repair and to the associated bony injuries, accounting for both glenoid and humeral head (bipolar) bone loss. We present the transition from the concept of "engaging" Hill-Sachs lesions to the concept of "on-track" / "off-track" lesions and the current role of Remplissage in shoulder instability surgery which remains paramount. We believe that in view of the critical role of bipolar bone defects in shoulder instability, preoperative magnetic resonance imaging assessment of the glenoid track of Hill-Sachs lesions is becoming increasingly important in preoperative planning. This allows the orthopaedic surgeon to detect an "off-track" lesion, select the appropriate surgical technique and improve surgical outcomes.

Key words: Shoulder Remplissage; Shoulder arthoscopic surgery; Shoulder stabilisation; Hill-Sachs lesion.

Iossifidis A, Khoriati A. Hill-Sachs Remplissage Procedure and its Role in Arthroscopic Stabilisation of the Shoulder. *International Journal of Orthopaedics* 2021; **8(4)**: 1493-1496 Available from: URL: http://www.ghrnet.org/index.php/ijo/article/view/3204

INTRODUCTION

In 1861, Flower noticed the presence of a groove posterior to the greater tuberosity in 41 shoulder specimens collected from the pathological museums of London[1]. This grooved defect of the humeral head was named after Hill and Sachs who described it for the first time in 1940 as a compression fracture seen in 27% of 119 radiographs of shoulder dislocations[2]. As the evolution of stabilisation procedures moved from open to arthroscopic techniques, the causal link between posterior Hill-Sachs lesions and instability became apparent. Burkhart et al[3] (2000) demonstrated the significant role of bipolar bony defects, either an engaging Hill-Sachs lesion or large anterior glenoid defect, in the failure of arthroscopic Bankart repair surgery. Those without bone defects had a failure rate of 4% versus a 67% failure rate in those with bone defects[3,4]. Wolf et al (2004) first described the arthroscopic Hill-Sachs "Remplissage" technique in addition to an anterior Bankart repair. It consisted of an arthroscopic posterior capsulodesis combined with an infraspinatus tenodesis to achieve a "filling in" effect of the Hill-Sachs lesion (HSL)[5]. In this article, we describe the evolution of the technique and its outcomes and report on the evolving surgical indications over

the last decade in response to new paradigm shifts. We present the transition from the concept of "engaging" Hill-Sachs lesions to the concept of "on-track" / "off-track" lesions and the current role of Remplissage in shoulder instability surgery.

ORIGINAL TECHNIQUE

In their original paper, Wolf et al (2008) compared their technique to the "arthroscopic repair of a partial-thickness, articular-surface rotator cuff tear"[5]. The infraspinatus tendon and posterior capsule were fixed in place to the surface of the Hill-Sachs lesion. This was achieved with the patient in the lateral decubitus position. The glenohumeral joint was then entered through a posterior portal which was centred directly over the Hill-Sachs lesion, allowing both initial visualisation and working access to it. An anteroinferior as well as an anterosuperior portal would also be used. The former, through the rotator interval and the latter, just inferior to the anterior border of the acromion. Glenoid bone loss, anterior labral pathology and the posterior Hill-Sachs Lesion could all be visualised from this portal. Both the surface of the Hill-Sachs lesion as well as the posterior capsule would next be prepared, along with the anterior labrum. With the posterior portal located in the subdeltoid space, anchors would be then passed, through the posterior capsule and infraspinatus tendon, one superiorly and one inferiorly into the defect (single loaded suture anchors). The anchors for these knots would be tightened in the subdeltoid space. A Bankart repair was then completed. The original authors of this technique recommended the post-operative regimen of 6 weeks in an "immobiliser", with the patient using their arm for normal activities of daily living and not externally rotating the shoulder beyond neutral. Contact sports were not allowed for a period of 6 months.

EVOLUTION OF THE REMPLISSAGE TECHNIQUE

In 2009, the technique was modified by Koo and Burkhart, who described a double-pulley suture technique (double loaded suture anchors) just lateral to the musculotendinous junction of the infraspinatus[6]. This technique avoids strangulation of the infraspinatus muscle belly and broadens the footprint of the repair. Once the anterior glenoid and Hill-Sachs Lesion anchors are placed, the Bankart repair is completed first, followed by tying the Hill-Sachs double loaded sutures in the subacromial space. The authors suggested that the modified version of the remplissage was an excellent solution for addressing the articular arc mismatch created by moderate to large-sized Hill-Sachs lesions without significant glenoid bone loss, and an excellent alternative for borderline arthroscopic cases close to 25% glenoid bone loss with a moderate-sized Hill-Sachs lesion as a means of augmenting stability.

RESULTS

Wolf et al in 2014 reported two to ten years results in 2014 with a recurrence rate of 4.4%[7]. These findings were in keeping with the results of other contemporary systematic reviews. Leroux et al (2013) conducted a systematic review of short-term studies and concluded after a review of 7 articles, that the recurrent rate of dislocation was low (3.4%)[8]. The optimism of these positive early outcomes was somewhat tempered by the fact that the studies were based on lower quality data and sample sizes. One particular study, by Fanceschi et al (2012) demonstrated that Remplissage, when combined with a Bankart repair was superior to Bankart repair alone. The recurrence rate of dislocation was 0% vs 20%[9]. Leroux et al (2013) concluded that although early results were promising, a need for high level-clinical studies was identified[8]. Concerns regarding stiffness emerged in the decade following the development of the Remplissage procedure. Some authors have suggested with the use of biomechanical studies that the placement of sutures medially in the humeral head results in reduced range of motion[10]. Garcia et al (2017) contradicted these studies, suggesting that the rotational range of motion was largely unaffected[11]. Frantz et al (2020) conducted a multicentre randomised control study on 38 patients and found that Remplissage increased the risk of external rotation stiffness in abduction compared with Bankart repair without Remplissage at short-term follow-up[12]. In a systematic review however Liu et al (2018) including 694 patients, concluded that arthroscopic remplissage combined with Bankart repair is an effective procedure in the treatment of patients with engaging Hill-Sachs lesions (20% to 40%) and subcritical glenoid bone loss (< 20%). Patients can expect significant improvements in functional outcomes with a negligible loss of external rotation when compared with isolated Bankart repair. The change in external rotation in 90° of abduction ranged from -11.3° to -1.0°. Return to sport was between 57% and 100%. And recurrence rates of 0% to 20%[13].

EVOLUTION OF THE ROLE OF REMPLISSAGE

In the last decade the first studies into the efficacy of this technique in comparison to other stabilisation procedures emerged. The question of stabilisation technique selection has been a topic of great controversy. Bankart repair with posterior remplissage soft tissue procedures or an anterior bone block Latarjet procedure. Although some studies had speculated over the appropriate criteria for the use of remplissage[14], a systematic review concluded that very few studies were available to accurately establish which bone defects should be treated with bone procedures and the exact percentage of bone loss leading to higher risk of re-dislocation in clinical settings[15]. Numerous cut offs have been suggested for both Hill-Sachs defects and defects of the glenoid. The question remains: in which specific set of conditions is a Remplissage necessary?

THE ROLE OF BIPOLAR BONE DEFECTS

The size of the glenoid defect:

Yamamoto and Itoi (2010) studies on glenoid bony defects with and without Bankart soft tissue repair concluded that a glenoid defect at 3 o'clock which was equal to or greater than 20% of the glenoid length or 25% of the glenoid width, significantly decreased anterior stability and resulted in an unstable shoulder[16,17].

The "engaging" Hill-Sachs defect

Burkhart SS et al (2000) first recognised the significance of large bipolar bone defects particularly the inverted-pear glenoid and the humeral Hill-Sachs lesion and described the "engaging Hill-Sachs lesion". Remplissage was originally performed in patients with engaging Hill- Sachs defects associated with subcritical glenoid defects. Patients with larger glenoid defects would require conversion to a Latarjet procedure[3].

The "off-track "Hill-Sachs defect. The paradigm shift.

Yamamoto and Itoi in 2007 identified a model to account for both glenoid and humeral head (bipolar) bone loss and proposed the concept of the Glenoid track[18]. They suggested that a Hill-Sachs lesion has a high risk of engagement and dislocation if it extends

medially over the medial margin of the glenoid track as such a lesion is considered "off track". The glenoid track is the area of posterior humeral articular surface in contact with the glenoid when the arm moves along the posterior end-range of movement. The width of the glenoid track, defined as the distance between the medial margin of the footprint of the rotator cuff and the medial margin of the glenoid track, was 84% of the glenoid width in cadaveric shoulders and 83% of the glenoid width when the arm was at 90° of abduction in live shoulders. When there is no glenoid defect, the width of the glenoid track is 83% of the glenoid width. When there is a bony defect at the anterior rim of the glenoid, the defect width should be subtracted from the value representing 83% of the length to obtain the true width of the glenoid track. If the medial margin of the Hill-Sachs lesion is more medial than the glenoid track, it is defined as off track and more likely to engage and have a higher risk of recurrent instability.

The concept of engaging / nonengaging Hill-Sachs lesion evolved in to "off-track"/ "on- track" lesions as reported by DiGiacomo, Itoi and Burkhart in 2014[19].

This was supported in 2016 by biomechanical studies that demonstrated that Remplissage of an off-track Hill-Sachs lesion is necessary to restore biomechanical glenohumeral joint stability in a bipolar bone loss model[20]. Locher et al (2016), retrospectively reviewed 100 patients who underwent arthroscopic Bankart repair. Among these patients, 88 were found to have on track and 12 off-track Hill Sachs lesions. The on-track patients had 6% rate of recurrence, while the off-track patients had a recurrence rate of 33%[21].

In 2017, Itoi in an open review, suggested that either Remplissage or Latarjet procedures were indicated for off-track lesions, depending upon the size of the glenoid defect and the risk of recurrence[22]. A treatment algorithm was proposed based on the above evidence, which suggested that patients with greater than 25% glenoid bone loss should undergo a Laterjet procedure to restore the glenoid track. If the Hill-Sachs lesion was still off-track after the Latarjet procedure, it should be augmented with Remplissage. For those patients with an "off-track" lesion and glenoid bone loss of < 25%, a Bankart procedure with Hill Sachs Remplissage was suggested. For those with an "on-track" lesion and < 20% bone loss, a simple anterior Bankart soft tissue stabilisation would suffice.

A systematic review published by Gouveia et al in 2021 was more stringent in its recommendations[23]. The paper considered the literature relating to Bankart Repair with Remplissage in Comparison to Bone Block Augmentation for Anterior Shoulder Instability. The authors found that both procedures had comparable functional outcomes, however bone block procedures carried an increased risk of complications 0% to 66.7% compared to 0% to 2.3% for remplissage. When considering comparative studies reporting subcritical glenoid bone loss, rates of recurrence were 5.7% to 11.6% in the Latarjet group and 0% to 13.3% in the Bankart repair with Remplissage group. When considering studies reporting 10% to 15% mean glenoid bone loss, there was an increased rate of recurrent instability with the soft tissue repair techniques (6.1% to 13.2%) in comparison to bony procedures (0% to 8.2%).

CONCLUSION

The roles of bony and soft tissue procedures in the management of instability have been only recently elucidated and our understanding of the exact role for each type of procedure continues to evolve. Seventeen years after its discovery, the role of Hill-Sachs Remplissage remains very important. Based on our practice and considering the current available evidence, we suggest that the arthroscopic Hill-Sachs Remplissage is an essential tool in the managing "off track" Hill-Sachs lesions with glenoid bone loss of up to 10% and that caution should be advised with patients who present with a glenoid bone loss between 10% and 15%. Selection of the ideal treatment algorithm should be tailored to each patient individually according to the age, number of dislocations, extend of the bipolar bony defects and sport participation. We believe that in view of the critical role of bipolar bone defects in shoulder instability, preoperative magnetic resonance imaging assessment of the glenoid track is becoming increasingly important in preoperative planning by allowing the orthopaedic surgeon to detect an off track HSL and select the appropriate surgical technique.

REFERENCES

1 Flower WH. On the pathological changes produced in the shoulder joint by traumatic dislocations as derived from an examination of all the specimens illustrating this injury in the museums of London. Trans Path Soc London **12**: 179-201, 1861.
2. Hill HA, Sachs MD. The grooved defect of the humeralhead. *Radiology* 1940; **35**: 690-700. [DOI: 10.1148/35.6.690]
3. 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 Oct; **16(7)**: 677-94. [PMID: 11027751]; [DOI: 10.1053/jars.2000.17715]
4. Burkhart SS, Danaceau SM. Articular arc length mismatch as a cause of failed Bankart repair. *Arthroscopy* 2000; **16**: 740-4. [PMID: 11027759]; [DOI: 10.1053/jars.2000.7794]
5. Purchase RJ, Wolf EM, Hobgood ER, Pollock ME, Smalley CC. Hill-Sachs "Remplissage": An Arthroscopic Solution for the Engaging Hill-Sachs Lesion. *Arthroscopy*. 2008 Jun 1; **24(6)**: 723-6. [PMID: 18514117]; [DOI: 10.1016/j.arthro.2008.03.015]
6. Koo SS, Burkhart SS, Ochoa E. Arthroscopic double-pulley remplissage technique for engaging Hill-Sachs lesions in anterior shoulder instability repairs. *Arthroscopy* 2009; **25**: 1343-1348. [PMID: 19896057]; [DOI: 10.1016/j.arthro.2009.06.011]
7. Wolf EM, Arianjam A. Hill-Sachs remplissage, an arthroscopic solution for the engaging Hill-Sachs lesion: 2- to 10-year follow-up and incidence of recurrence. *J Shoulder Elbow Surg* 2014; **23**: 814-820. [PMID: 24295834]; [DOI: 10.1016/j.jse.2013.09.009]
8. Leroux T, Bhatti A, Khoshbin A, Wasserstein D, Henry P, Marks P, et al. Combined arthroscopic Bankart repair and remplissage for recurrent shoulder instability. *Arthroscopy*. 2013 Oct; **29(10)**: 1693-701. [PMID: 23927818]; [DOI: 10.1016/j.arthro.2013.06.007]
9. Franceschi F, Papalia R, Rizzello G, Franceschetti E, Del Buono A, Panascì M, Maffulli N, Denaro V. Remplissage Repair-New Frontiers in the Prevention of Recurrent Shoulder Instability: A 2-Year Follow-up Comparative Study. *Am J Sports Med* 2012 Nov; **40(11)**: 2462-9. [PMID: 22984130]; [DOI: 10.1177/0363546512458572]
10. Elkinson I, Giles JW, Boons HW, Faber KJ, Ferreira LM, Johnson JA, et al. The shoulder remplissage procedure for Hill-Sachs defects: does technique matter? *J Shoulder Elbow Surg.* 2013 Jun; **22(6)**: 835-41. [PMID: 23107147]; [DOI: 10.1016/j.jse.2012.08.015]
11. Garcia GH, Degen RM, Bui CNH, McGarry MH, Lee TQ, Dines JS. Biomechanical comparison of acute Hill-Sachs reduction with remplissage to treat complex anterior instability. *Journal of Shoulder and Elbow Surgery.* 2017 Jun 1; **26(6)**: 1088-96. [PMID: 28131690]; [DOI: 10.1016/j.jse.2016.11.050]
12. Frantz TL, Everhart JS, Cvetanovich GL, Neviaser A, Jones GL, Hettrich CM, et al. What Are the Effects of Remplissage on 6-Month Strength and Range of Motion After Arthroscopic Bankart Repair? A Multicenter Cohort Study. *Orthop J Sports Med.*

2020 Feb; **8(2)**: 2325967120903283. [PMID: 33283013]; [DOI: 10.1177/2325967120903283]

13. Liu JN, Gowd AK, Garcia GH, Cvetanovich GL, Cabarcas BC, Verma NN. Recurrence rate of instability after remplissage for treatment of traumatic anterior shoulder instability: a systematic review in treatment of subcritical glenoid bone loss. *Arthroscopy*. 2018; **34(10)**: 2894-2907. [PMID: 30195960]; [DOI: 10.1016/j.arthro.2018.05.031]
14. Bollier MJ, Arciero R. Management of glenoid and humeral bone loss. *Sports Med Arthrosc Rev.* 2010 Sep; **18(3)**: 140-8 [PMID: 20711045]; [DOI: 10.1097/JSA.0b013e3181e88ef9]
15. Longo UG, Loppini M, Rizzello G, Romeo G, Huijsmans PE, Denaro V. Glenoid and humeral head bone loss in traumatic anterior glenohumeral instability: a systematic review. *Knee Surg Sports Traumatol Arthrosc.* 2014 Feb; **22(2)**: 392-414. [PMID: 23358575]; [DOI: 10.1007/s00167-013-2403-5]
16. Yamamoto N, Muraki T, Sperling JW, Steinmann S, Cofield RH, Itoi E, An K-N. Stabilizing mechanism in bone grafting of a large glenoid defect. *J Bone Joint Surg* [Am] 2010; **92-A**: 2059-2066. [PMID: 20810855]; [DOI: 10.2106/JBJS.I.00261]
17. Yamamoto N, Itoi E, Abe H, Kikuchi K, Seki N, Minagawa H, et al. Effect of an anterior glenoid defect on anterior shoulder stability: a cadaveric study. *Am J Sports Med.* 2009 May; **37(5)**: 949-54. [PMID: 19261900]; [DOI: 10.1177/0363546508330139]
18. Yamamoto N**,** Itoi E, Abe H, Minagawa H, Seki N, Shimada Y, 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 Elbow Surg.* 2007 Oct; **16(5)**: 649-56. [PMID: 17644006]; [DOI: 10.1016/j.jse.2006.12.012]
19. DiGiacomo G, Itoi E, Burkart 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: 90-98. [PMID: 24384275]; [DOI: 10.1016/j.arthro.2013.10.004]
20. Hartzler RU, Bui CN, Jeong WK, et al. Remplissage of an off-track Hill-Sachs lesion is necessary to restore biomechanical glenohumeral joint stability in a bipolar bone loss model. *Arthroscopy* 2016; **32**: 2466-2476. [PMID: 27432588]; [DOI: 10.1016/j.arthro.2016.04.030]
21. Locher J, Wilken F, Beitzel K, Buchmann S, Longo UG, Denaro V, et al. Hill-Sachs Off-track Lesions as Risk Factor for Recurrence of Instability After Arthroscopic Bankart Repair. *Arthroscopy*. 2016 Oct; **32(10)**: 1993-9. [PMID: 27161511]; [DOI: 10.1016/j.arthro.2016.03.005]
22. Itoi E. 'On-track' and 'off-track' shoulder lesions. *EFORT Open Rev*. 2017 Aug 1; **2(8)**: 343-51. [PMID: 28932486]; [DOI: 10.1302/2058-5241.2.170007]
23. Gouveia K, Abidi SK, Shamshoon S, Gohal C, Madden K, Degen RM, Leroux T, Alolabi B, Khan M. Arthroscopic Bankart Repair With Remplissage in Comparison to Bone Block Augmentation for Anterior Shoulder Instability With Bipolar Bone Loss: A Systematic Review. *Arthroscopy*. 2021 Feb; **37(2)**: 706-17. [PMID: 32911004]; [DOI: 10.1016/j.arthro.2020.08.033]