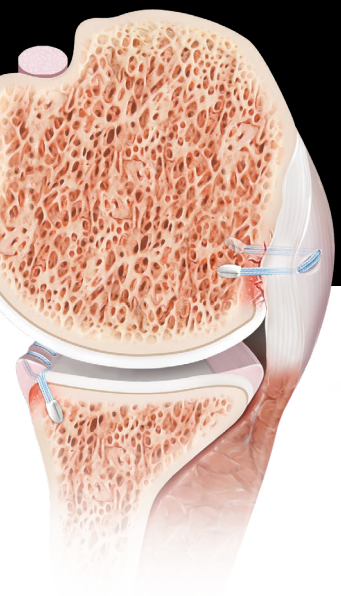

Remplissage for Anterior Instability

Scientific Update

Remplissage, which is used in combination with arthroscopic Bankart repair, addresses anterior instability associated with bipolar bone loss. Biomechanical studies indicate that inserting the posterior capsule and infraspinatus tendon into a Hill-Sachs defect improves joint stability. With unique innovations in knotless products and techniques, the addition of remplissage is more reproducible and efficient. A knotless technique—with two tensionable, knotless anchors that are interconnected—creates a reliably strong repair that eliminates the risk of knot impingement and migration.

Clinical studies have consistently demonstrated that the addition of remplissage reduces recurrence rates, with minimal change to range of motion, compared to an isolated arthroscopic Bankart repair. When compared to Latarjet, remplissage appears to equally prevent recurrence but with a lower complication rate.

Foundations

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):90-98. doi:10.1016/j.arthro.2013.10.004

- Reviews the impact of bipolar bone loss in anterior instability and treatment recommendations
- In abduction and external rotation, the contact zone of the humeral head with the glenoid—termed the glenoid track—is approximately 83% of the glenoid width
- Glenoid track is reduced by both glenoid bone loss and the presence of a Hill-Sachs lesion
  - Calculate the width of the glenoid track with the following formula: 0.83D (normal glenoid diameter) − d (width of glenoid bone loss)
  - Measure the width of the Hill-Sachs lesion to determine if the lesion is "on-track" (within the remaining glenoid track) or "off-track" (exceeds the remaining glenoid track)
  - Authors recommend adding remplissage to off-track lesions with <25% glenoid bone loss

Takeaway

The normal glenohumeral joint has a glenoid track of 83% of the glenoid width in abduction and external rotation, which is reduced with glenoid bone loss or a Hill-Sachs lesion

These concepts provide a paradigm of treatment for the average population but should be taken in the context of the individual patient (ie, an individual with laxity will have a reduced glenoid track due to increased likelihood of anterior subluxation while a low-demand, stiffer patient will have a lower likelihood)

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Shaha JS, Cook JB, Rowles DJ, Bottoni CR, Shaha SH, Tokish JM

Clinical validation of the glenoid track concept in anterior glenohumeral instability. *J Bone Joint Surg Am*. 2016;98(22):1918-1923. doi:10.2106/JBJS.15.01099

- Retrospective study of 57 patients who underwent Bankart repair were evaluated at a mean follow-up of 48 months
- Hill-Sachs lesions were categorized as on-track or off-track based on MRI evaluation
- Recurrence was 8% in the on-track group compared to 75% in the off-track group ($P = .0001$)

Takeaway

Patients with off-track Hill-Sachs lesions have a high risk of recurrence with isolated Bankart repair

Biomechanical Studies

Arciero RA, Parrino A, Bernhardson AS, Diaz-Doran V, Obopilwe E, Cote MP, Golijanin P, Mazzocca AD, Provencher MT

The effect of a combined glenoid and Hill-Sachs defect on glenohumeral stability: a biomechanical cadaveric study using 3-dimensional modeling of 142 patients. *Am J Sports Med*. 2015;43(6):1422-1429. doi:10.1177/0363546515574677

- Hill-Sachs lesions were created in 21 cadaveric shoulders based on modeling from CT scans in 142 patients with recurrent anterior instability
- Anterior translation was examined before and after Bankart repair in models with small and medium Hill-Sachs lesions with the following glenoid bone loss:
  - Intact glenoid
  - 2 mm bone loss (approximately 8% glenoid bone loss)
  - 4 mm bone loss (approximately 15% glenoid bone loss)
  - 6 mm bone loss (approximately 23% glenoid bone loss)
- Results showed that anterior translation persisted after isolated Bankart repair:
  - With an 8% glenoid defect and a medium Hill-Sachs lesion
  - With a 15% glenoid defect and a small Hill-Sachs lesion

Takeaways

Stability after bone loss is related to the combined effects of glenoid bone loss and the size of the Hill-Sachs lesion

Isolated Bankart repairs may be compromised with as little as 2 mm to 4 mm of bone loss, or 8% to 15% of the glenoid width

Hartzler RU, Bui CN, Jeong WK, Akeda M, Peterson A, McGarry M, Denard PJ, Burkhart SS, Lee TQ

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(12):2466-2476. doi:10.1016/j.arthro.2016.04.030

- 8 cadaveric shoulders were placed in a custom apparatus to evaluate passive axial rotation followed by progressive translational loading
- A 15% glenoid bone loss model was used to evaluate on-track (15%) and off-track (30%) Hill-Sachs lesions
- Repair conditions included isolated Bankart repair and Bankart combined with remplissage
- Results showed that engagement occurred:
  - With 1 on-track lesion, which was prevented with isolated Bankart repair alone
  - With all 8 off-track lesions, which was only prevented in mid-range rotation with isolated Bankart repair; prevention of engagement at end-range rotation was prevented in all specimens with the addition of remplissage

Takeaways

Isolated Bankart alone results in persistent engagement of an off-track lesion in a bipolar bone loss model

Remplissage "was necessary to prevent engagement of off-track bipolar lesions"

Funakoshi T, Hartzler R, Stewien E, Burkhart S

Remplissage using interconnected knotless anchors: superior biomechanical properties to a knotted technique? *Arthroscopy.* 2018;34(11):2954-2959. doi:10.1016/j.arthro.2018.06.030

- Cadaveric study of remplissage with 2 different techniques:
  - Knotted technique with 2 anchors
  - Knotless technique with sutures interconnected between the anchors (3.9 mm Knotless Corkscrew® anchors)
- Load to failure was higher with the knotless technique (788 N vs 488 N; $P = .003$)
- Most common mode of failure for the knotted technique was tendon tearing or knot failure
- No failures in the knotless group occurred via suture slippage

Takeaways

Constructs interconnecting knotless repair sutures between 2 anchors are superior to knotted techniques

The knotless construct evaluated in this study can be reproduced with other anchors containing the same mechanism, including Knotless FiberTak® (1.8 mm or 2.6 mm) and 3.0 mm Knotless SutureTak® anchors

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Clinical Studies

Garcia GH, Wu HH, Liu JN, Huffman GR, Kelly JD 4th

Outcomes of the remplissage procedure and its effects on return to sports: average 5-year follow-up. *Am J Sports Med*. 2016;44(5):1124-1130. doi:10.1177/0363546515626199

- Retrospective review of 51 combined Bankart and remplissage repairs with large, off-track lesions and <20% glenoid bone loss
- Functional outcome and recurrence were reviewed at a mean of 5 years postoperatively
- Six shoulders had dislocation events (11.8%) postoperatively
- Average loss of external rotation was 5°
- Rate of return to sport was 95.5%
  - Of those engaged in throwing, difficulty doing so was reported by 65.5%

Takeaways

High return to sport with minimal loss in range of motion and low chance of recurrence with addition of remplissage

Throwing difficulty is common after remplissage, but should be examined in the context that throwing difficulty is common in the setting of bipolar bone loss

Domos P, Ascione F, Wallace AL

Arthroscopic Bankart repair with remplissage for non-engaging Hill-Sachs lesion in professional collision athletes. *Shoulder Elbow*. 2019;11(1):17-25. doi:10.1177/1758573217728414

- Retrospective review of contact athletes with anterior instability and <20% glenoid bone loss evaluated at a mean follow-up of 26 months
  - 20 athletes were treated with combined Bankart and remplissage
  - Matched group was treated isolated Bankart
- There was no difference in postoperative range of motion
- Recurrence was 5% in the remplissage group compared to 30% in the isolated Bankart group (P = .015)

Takeaway

Recurrence in contact athletes is reduced with the addition of remplissage

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Haroun HK, Sobhy MH, Abdelrahman AA

Arthroscopic Bankart repair with remplissage versus Latarjet procedure for management of engaging Hill-Sachs lesions with subcritical glenoid bone loss in traumatic anterior shoulder instability: a systematic review and meta-analysis. *J Shoulder Elbow Surg*. 2020;29(10):2163-2174. doi:10.1016/j.jse.2020.04.032

- Systematic review of 379 patients (from 4 studies) who underwent combined Bankart with remplissage or Latarjet for <20% glenoid bone loss
  - 194 Bankart and remplissage procedures
  - 185 Latarjet procedures
- There was no difference in postoperative range of motion, functional outcome scores, or recurrence between remplissage and Latarjet groups (9.8% vs 7%)
- Risk of complication was 7× higher in the Latarjet group (9% vs 1%; *P* = .003)

Takeaway

Remplissage and Latarjet results in comparable rates of recurrence for subcritical bone loss, but complications are higher with Latarjet

Hurley ET, Toale JP, Davey MS, Colasanti CA, Pauzenberger L, Strauss EJ, Mullett H

Remplissage for anterior shoulder instability with Hill-Sachs lesions: a systematic review and meta-analysis. *J Shoulder Elbow Surg*. 2020;29(12):2487-2494. doi:10.1016/j.jse.2020.06.021

- Literature review of 12 clinical trials comparing arthroscopic Bankart repair and remplissage vs arthroscopic Bankart repair alone or the Latarjet procedure performed in patients with anterior shoulder instability with Hill-Sachs lesions
- Statistical results
  - Remplissage plus Bankart repair had a significantly lower recurrence rate compared to Bankart alone (3.2% vs 16.8%; *P* < .05)
  - Complication rate was significantly lower for remplissage plus Bankart procedures compared to Latarjet procedures (0.5% vs 8.6%; *P* = .003)
  - No significant difference in revision rate of Bankart alone
  - Compared to Latarjet procedures, no significant difference in recurrence rate, revision rate, or revision due to recurrence rate

Takeaway

Patients with subcritical glenoid bone loss have a lower risk for recurrence with remplissage with arthroscopic Bankart repair compared to Bankart repair alone. Latarjet has comparable rates of recurrence and revision but the risk of complications is significantly higher.

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Horinek JL, Menendez ME, Narbona P, Ladermann A, Barth J, Denard PJ

Remplissage yields similar 2-year outcomes, fewer complications, and low recurrence compared to Latarjet across a wide range of preoperative glenoid bone loss. *Arthroscopy.* 2022;38(10):2798-2805. doi:10.1016/j.arthro.2022.03.031

- Multicenter study of 2-year outcomes of arthroscopic Bankart repair with remplissage (ABR) compared to Latarjet
  - 70 ABRs with a mean of 12.3% glenoid bone loss
  - 188 Latarjets with a mean of 7.6% glenoid bone loss
- There was no difference in recurrent dislocation (1.4% ABR vs 3.2% Latarjet; $P = .678$)
- Return to sport among overhead or contact athletes was higher in the ABR group (91.5% vs 72.7%; $P = .007$)
- The complication rate was 0% in the ABR group and 5.9% in the Latarjet group

Takeaway

Remplissage and Latarjet result in comparable rates of recurrence for subcritical bone loss, but complications are higher with Latarjet

Return to sport among overhead and contact athletes may be higher after remplissage compared to Latarjet

Lin A, Barrow AE, Charles S, Shannon M, Fox MA, Herman ZJ, Greiner JJ, Hughes JD, Denard PJ, Narbona P, Lesniak BP, Vyas D

Remplissage reduces recurrent instability in high-risk patients with on-track Hill-Sachs lesions. *J Shoulder Elbow Surg.* 2023;32(6S):S99-S105. doi:10.1016/j.jse.2023.02.011

- Multicenter retrospective study with 2-year follow-up comparing arthroscopic Bankart repair to remplissage in patients with <15% glenoid bone loss and on-track Hill-Sachs lesions
  - 56 remplissages
  - 127 isolated Bankart repairs
- Overall recurrent dislocation was 11% in the isolated Bankart group compared to 1.8% in the remplissage group ($P = .040$)
- Among contact athletes recurrent dislocation was 21% after Bankart compared to 3% after remplissage ($P = .03$)
- When the distance to dislocation (glenoid track minus Hill-Sachs interval) was <10 mm, 67% (6 of 9) contact athletes had recurrent dislocation after isolated Bankart repair

Takeaway

Remplissage lowers the overall risk of recurrent dislocation by over 5× in patients with on-track lesions and <15% glenoid bone loss

Among contact athletes, the differences between remplissage and Bankart become larger. Thus, activity level can also be used to lower the threshold for remplissage, even in on-track lesions

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Woodmass JM, McRae S, Lapner P, Kamikovski I, Jong B, Old J, Marsh J, Dubberley J, Stranges G, Sasyniuk TM, MacDonald PB

Arthroscopic Bankart repair with remplissage in anterior shoulder instability results in fewer redislocations than Bankart repair alone at medium-term follow-up of a randomized controlled trial. *Am J Sports Med*. 2024;52(8):2055-2062. doi:10.1177/03635465241254063

- Medium-term (3- to 9-year) follow-up of a randomized controlled trial of arthroscopic Bankart versus remplissage in patients with <15% glenoid bone loss
  - 52 isolated Bankarts
  - 50 remplissages
- Recurrent dislocation was observed in 22% of Bankarts compared to 7.7% of remplissages
- Recurrent instability (dislocation or subluxation) was observed in 30% of Bankarts compared to 9.6% of remplissages

Takeaway

Remplissage reduces risk of recurrent dislocation or instability events by approximately 3× compared to isolated Bankart repair in patients with <15% glenoid bone loss

Ahmed AF, Polisetty TS, Wang C, Halayqeh S, Sharma S, Miller AS, Pearson Z, Fajolu O, Zikria B, Srikumaran U

Higher return to sport and lower revision rates when performing arthroscopic Bankart repair with remplissage for anterior shoulder instability with a Hill-Sachs lesion: a meta-analysis. *J Shoulder Elbow Surg*. 2024. doi:10.1016/j.jse.2024.01.045

- Meta-analysis of 12 studies in patients with <25% glenoid bone loss, including:
  - 550 isolated Bankarts
  - 347 remplissages
- External rotation at the side was only 1° lower after remplissage, which is not a clinically significant difference
- The odds of recurrent dislocation were 6.3× higher after isolated Bankart repair
- Return to sport was 2.9× higher after remplissage

Takeaway

There is no clinically meaningful difference in postoperative external rotation after isolated Bankart repair compared to remplissage

Return to sport is higher after remplissage compared to isolated Bankart

Gonzalez-Morgado D, Ardebol J, Noble MB, Galasso LA, Menendez ME, Denard PJ

No difference in external rotation loss after isolated Bankart repair, remplissage, or Latarjet: a systematic review and meta-analysis. *Am J Sports Med*. 2025;53(2):493-500. doi:10.1177/03635465241241825

- Meta-analysis of 27 studies in 2100 patients including:
  - 824 isolated Bankart repairs
  - 378 Bankart + remplissage
  - 898 Latarjet procedures
- External rotation at the side recorded for each study and pooled for analysis
  - Mean differences:
    - Bankart vs Bankart + remplissage: 5.9° (*P* = .13)
    - Remplissage vs Latarjet: 9.6° (*P* = .17)
- Recurrence was 6.7× higher after isolated Bankart compared to the addition of remplissage (*P* = .4)

Takeaways

There is no clinically meaningful difference in postoperative external rotation after isolated Bankart repair, remplissage, or Latarjet

Recurrence is 6.7× higher with isolated Bankart compared to the addition of remplissage