Anterior Shoulder Instability Part II—Latarjet, Remplissage, and Glenoid Bone-Grafting—An International Consensus Statement

Eoghan T. Hurley, M.B., B.Ch., M.Ch., Ph.D., Bogdan A. Matache, M.D., C.M., F.R.C.S.C., Ivan Wong, M.D., F.R.C.S.C., Eiji Itoi, M.D., Ph.D., Eric J. Strauss, M.D., Ruth A. Delaney, F.R.C.S., Lionel Neyton, M.D., George S. Athwal, M.D., F.R.C.S.C., Leo Pauzenberger, M.D., Hannan Mullett, M.Ch., F.R.C.S.I. (Tr & Orth), Laith M. Jazrawi, M.D., and The Anterior Shoulder Instability International Consensus Group

Purpose: The purpose of this study was to establish consensus statements via a modified Delphi process on the Latarjet procedure, remplissage, and glenoid-bone grafting for anterior shoulder instability. **Methods:** A consensus process on the treatment utilizing a modified Delphi technique was conducted, with 65 shoulder surgeons from 14 countries across 5 continents participating. Experts were assigned to one of 9 working groups defined by specific subtopics of interest within anterior shoulder instability. **Results:** The technical approaches identified in the statements on the Latarjet procedure and glenoid bone-graft were that a subscapularis split approach should be utilized, and that it is unclear whether a capsular repair is routinely required. Furthermore, despite similar indications, glenoid bone-grafting may be preferred over the Latarjet in patients with bone-loss greater than can be treated with a coracoid graft, and in cases of surgeon preference, failed prior Latarjet or glenoid bone-grafting procedure, and epilepsy. In contrast, the primary indications for a remplissage procedure was either an off-track or engaging Hill-Sachs lesion without severe glenoid bone loss. Additionally, in contrast to the bone-block procedure, complications following remplissage are rare, and loss of shoulder external rotation can be minimized by performing the tenodesis via the safe-zone and not over medializing the fixation. **Conclusion:** Overall, 89% of statements reached unanimous or strong consensus. The statements that reached unanimous consensus were the prognostic factors that are important to consider in those undergoing a glenoid bone-grafting procedure including age, activity level, Hill-Sachs Lesion, extent of glenoid bone-loss, hyperlaxity, prior surgeries, and arthritic changes. Furthermore, there was unanimous agreement that it is unclear whether a capsular repair is routinely required with a glenoid bone graft, but it may be beneficial in some cases. There was no unanimous agreement on any aspect related to the Latarjet procedure or Remplissage. **Level of Evidence:** Level V, expert opinion.

See commentaries on pages 243, 247, and 250

From the NYU Langone Health, New York, New York, USA (E.T.H., E.J.S., L.M.J.); Sports Surgery Clinic, Dublin, Ireland (E.T.H., R.A.D., L.P., H.M.); Laval University, Quebec City, Quebec, Canada (B.A.M.); Dalhousie University, Halifax, Nova Scotia, Canada (I.W.); Tohoku University School of Medicine, Sendai, Japan (E.I.); Centre Orthopédique Santy, Lyon, France (L.N.); and Western University, London, Ontario, Canada (G.S.A.).

The Anterior Shoulder Instability International Consensus Group includes Michael J. Alaia, Robert A. Arciero, Asheesh Bedi, Robert H. Brophy, Emilio Calvo, Kirk A. Campbell, Cordelia W. Carter, J Tristan Cassidy, Michael G. Ciccotti, Brian J. Cole, Philippe Collin, Frank A. Cordasco, Sara E. Edwards, Brandon J. Erickson, Luc Favard, Rachel M. Frank, Lennard Funk, Grant E. Garrigues, Giovanni Di Giacomo, Guillem Gonzalez-Lomas, Philipp R. Heuberer, Andreas B. Imhoff, John D. Kelly, Moin Khan, Aaron J. Krych, John E Kuhn, Young M. Kwon, Alexandre Lädermann, William N. Levine, Darren LimFat, Augustus D. Mazzocca, Peter B. MacDonald, Eric C. McCarty, Robert J. Meislin, Peter J. Millett, Diarmuid C. Molony, Cathal J. Moran, Philipp Moroder, Daniel Moya, Kieran O'Shea, Brett D. Owens, Matthew T. Provencher, Yong Girl Rhee, Scott A. Rodeo, Andrew S. Rokito, Claudio Rosso, Markus Scheibel, Nikhil N. Verma, Mandeep S. Virk, Gilles Walch, Russell F. Warren, Brian R. Waterman, Daniel B. Whelan, and Joseph D. Zuckerman.

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Introduction

Bone loss is a challenging problem in the setting of anterior shoulder instability, as it is difficult to treat and increases the risk of recurrent instability.[1-3] Glenoid-sided bone loss is commonly treated with the Latarjet procedure, which acts to widen the glenoid articular surface while simultaneously providing stability in abduction by way of the sling effect provided by the transposed conjoint tendon.[4] The Latarjet procedure was originally described by Dr. Michel Latarjet in 1954 in the same edition of the same journal that Dr. Albert Trillat described his eponymous procedure.[5,6] Despite the long-term follow-up data available on this procedure, some surgeons are still hesitant to offer it to patients because of its nonanatomic nature and fear of disrupting the subscapularis tendon.[7,8] Alternatively, glenoid bone grafting by means of a free graft transfer may be used to reconstruct the anterior aspect of the glenoid.[9] While proponents of using autograft sources, such as iliac crest cite theoretically improved healing rates and a lower cost over allograft, distal tibial allograft has, thus, far proven to reliably match the congruity of the glenoid arc and has demonstrated excellent union rates.[10-14]

Humeral-sided bone loss resulting in an "off-track" and/or engaging Hill-Sachs lesion is commonly treated either indirectly with one of the above procedures, or directly by means of a remplissage.[15] The remplissage procedure, first described by Dr. Eugene Wolf in 2008, acts to fill the lesion and render it extra-articular through tenodesis of the infraspinatus and posterior capsule into the defect.[16-20] However, the indications for these procedures are ill defined and often based on surgeon preference.[1,21] Furthermore, surgeons may be hesitant to perform this procedure in overhead athletes due to the risk of reduced range of motion, and instead opt for a bone-grafting procedure as a means of indirectly treating the Hill-Sachs lesion.[22]

The Anterior Shoulder Instability International Consensus Group (ASI-ICG) was created with a mandate to establish clinical guidelines for key aspects of the treatment of this pathology. The purpose of this study was to establish consensus statements via a modified Delphi process on Latarjet procedure, remplissage, and glenoid bone grafting for anterior shoulder instability. Our hypothesis was that there would be consensus on the majority of statements regarding the Latarjet procedure, remplissage, and glenoid bone grafting for anterior shoulder instability.

Methods

Consensus Working Groups

Sixty-five shoulder surgeons from 14 countries across 5 continents participated in these consensus statements

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Address correspondence to Eoghan T. Hurley, M.B., B.Ch., M.Ch., Ph.D., Sports Surgery Clinic, Northwood Avenue, Santry Demesne, Dublin 9, D09 C523, Dublin, Ireland. E-mail: eoghanhurley@rcsi.ie

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on anterior shoulder instability, with 69 initially being invited and 4 declining. The working groups were established by the steering committee: Laith M. Jazrawi, Bogdan A. Matache, Ivan Wong, Eiji Itoi, Eric J. Strauss, Ruth A. Delaney, Lionel Neyton, George S. Athwal, Leo Pauzenberger, Hannan Mullett. These authors contributed to the creation and recommended people to be involved in the process. Furthermore, the past few conferences of the American Association of Nurse Anesthetists, the American Orthopaedic Society for Sports Medicine, the American Shoulder and Elbow Surgeons, the European Society for Surgery of the Shoulder and Elbow, the European Society of Sports Traumatology, the Knee Surgery & Arthroscopy, and the International Conference on Sustainable Expert Systems were screened for those invited speakers whose speech or research focused on anterior shoulder instability to ensure that the thought leaders in this area were invited. Furthermore, we sought to include surgeons from multiple countries so that different philosophies and viewpoints were included. Experts were assigned to one of 9 working groups defined by specific subtopics within anterior shoulder instability, including 1) diagnosis, 2) nonoperative management, 3) Bankart repair, 4) Latarjet procedure, 5) remplissage, 6) glenoid bone grafting, 7) revision surgery, 8) rehabilitation and return to play, and 9) follow-up. Working groups were kept geographically balanced to limit bias and ensure the groups were representative. Thus, each working group was assigned surgeons from at least 2 different continents, and all groups had surgeons from at least 3 different countries involved in an effort to minimize regional bias. The working groups are shown in Appendix Box 1. Furthermore, the participants were instructed to answer the questionnaires based on the best available evidence rather than personal preference. A liaison (E.T.H.) served as the primary point of contact and dealt with communication and the distribution of surveys to ensure consistency across the working groups. Additionally, the liaison formulated each subsequent round of questionnaires based on the prior round's responses. To reduce the potential for bias in the data analysis and/or literature review, the liaison did not submit answers to the questionnaires or partake in the voting process.

Delphi Consensus Method

Nine working groups covering the principal topics of interest in the area of anterior shoulder instability were established. A set of questions pertaining to each working group was generated on the basis of clinical relevance and areas of controversy identified through systematic review of the literature and by the nine experts on the steering committee. A modification of the Delphi method was used to generate consensus statements for each working group, with groups completing 3 initial rounds of questionnaires, followed by amendments, and lastly a final vote. Surveys were distributed in a blinded fashion using RedCap. All of the questionnaire responses and votes were anonymized. Questions progressed from an open-ended to a more structured format and were designed to elucidate areas of agreement and disagreement between group members. Once a preliminary consensus statement was generated within a working group, participants were asked whether they "agreed" or "disagreed" with it. If there was unanimous agreement within a group on a preliminary consensus statement, this statement was elevated to a final vote. If the agreement was not unanimous within a group, these questions were subject to further suggested changes anonymously through the RedCap software by members of the entire consensus group, with statements being amended where there was agreement with the proposed change. The final voting process allowed all study participants to assess the consensus statements generated by the other working groups and vote on whether they "agreed" or "disagreed" with them; thus, all statements were voted on by all 65 participants.

Final Voting

After the final votes for each question occurred, the degree of agreement was expressed using a percentage rounded to the nearest whole number. Consensus was defined as 80-89%, whereas strong consensus was defined as 90-99%, and unanimous consensus was indicated by receiving 100% of the votes in favor of a proposed statement.

Results

Latarjet Procedure

Of the 10 total questions and consensus statements in this group, none achieved unanimous consensus, 9 achieved strong consensus, and 1 achieved consensus. The most clinically relevant statements were that the primary relative indications for a Latarjet procedure are a) recurrent instability, b) failed prior surgery, c) collision athlete, d) critical glenoid bone-loss (>15-20%), and e) bipolar bone loss resulting in "off-track" lesion. The primary relative contraindication for a Latarjet procedure are a) multidirectional instability, b) voluntary dislocators, c) uncontrolled epilepsy/seizure disorder, d) irreparable rotator cuff tear, and e) glenoid bone loss exceeding that which can be addressed with the coracoid. Additionally, the arthroscopic technique is a viable alternative and results in similar outcomes. However, it is a technically challenging procedure and is only advisable to perform in a high-volume setting. All of these statements are shown in Table 1, and the initial questions from Rounds 1-3 are included in Appendix Box 2.

Table 1. Latarjet Procedure

Questions & Answers	Agreement	Consensus
Q: What are the indications for a Latarjet procedure?	97%	Strong Consensus
A: The primary relative indications for a Latarjet procedure are a) recurrent instability, b) failed prior surgery, c) collision athlete, d) critical glenoid bone loss (>15-20%), and e) bipolar bone loss resulting in an "off-track" lesion.		
Q: What are the contraindications for a Latarjet procedure?	92%	Strong Consensus
A: The primary relative contraindication for a Latarjet procedure are a) multidirectional instability, b) voluntary dislocators, c) uncontrolled epilepsy/seizure disorder, d) irreparable rotator cuff tear, and e) glenoid bone loss exceeding that which can be addressed with the coracoid.		
Q: Is there an amount of glenoid bone loss above which a Latarjet procedure should be performed?	92%	Strong Consensus
A: The Latarjet procedure should be performed in patients with >15-20% glenoid bone loss.		
Q: What prognostic factors should be considered in patients undergoing a Latarjet procedure?	97%	Strong Consensus
A: The prognostic factors that are important to consider specifically in those undergoing a Latarjet procedure include a) smoking, b) prior ipsilateral instability surgery, c) patient aspirations, d) arthritis, e) age, f) preoperative stiffness, g) hyperlaxity, h) glenoid bone loss, and i) Hill-Sachs lesions.		
Q: Should the Latarjet procedure be performed arthroscopically? If so, is there a minimum number of cases to achieve proficiency?	98%	Strong Consensus
A: The arthroscopic technique is a viable alternative and results in similar outcomes. However, it is a technically challenging procedure and is only advisable to perform in a high-volume setting.		
Q: To what degree are complications a concern following a Latarjet procedure? How can complications be reduced?	90%	Strong Consensus
A: Complications are a concern following a Latarjet procedure, and the following strategies can be used to reduce them a) careful dissection, b) identifying the musculocutaneous and axillary nerves, c) preventing overlateralization of the graft and contour flush to native cartilage, d) tranexamic acid to reduce blood loss, e) accurate screw placement, and f) careful preparation of the glenoid neck and coracoid.		
Q: Should the coracoid transfer procedure be performed using the classic or congruent-arc technique?	87%	Consensus
A: The coracoid transfer procedure should be performed using the classic technique.		
Q: What is the optimal method of fixation of a coracoid graft?	94%	Strong Consensus
A: Two screws are the optimal method of fixation for a coracoid graft.		
Q: Is a capsular repair required in a Latarjet procedure?	95%	Strong Consensus
A: A capsular repair is not required with a Latarjet, but it may be beneficial in some cases.		
Q: Should a subscapularis split or partial/complete takedown be used in a Latarjet procedure?	95%	Strong Consensus
A: A subscapularis split should be used to access the glenohumeral joint in a Latarjet procedure.		

Remplissage

Of the 8 total questions and consensus statements in this group, none achieved unanimous consensus, 7 achieved strong consensus, 1 achieved consensus. The most clinically relevant statements were that the primary relative indications for a remplissage procedure are in the setting of a large Hill-Sachs lesion, either a) off track on preoperative imaging, or b) engaging at the time of arthroscopy and primary relative contraindications for a remplissage procedure are relative, but include a) small Hill-Sachs lesion, either on-track on preoperative imaging or non-engaging at arthroscopy, b) severe glenoid bone loss, c) preoperative stiffness, d) infraspinatus compromise, and e) overhead athlete. Additionally, loss of external range of motion is a small concern and unlikely to be clinically significant in most patients. This can be minimized by fixing the tendon via the safe-zone and not over medializing the fixation. All of these statements are shown in Table 2, and the initial questions from Rounds 1-3 are included in Appendix Box 3.

Glenoid Bone-Grafting

Of the 10 total questions and consensus statements in this group, 2 achieved unanimous consensus, 7 achieved strong consensus, and 1 achieved consensus. The statements achieving unanimous consensus were the following: the prognostic factors that are important to consider specifically in those undergoing a glenoid bone-grafting procedure include a) age, b) activity level, c) Hill-Sachs Lesion, d) extent of glenoid bone-loss, e) hyperlaxity, f) prior surgeries, and g) arthritic changes. It is unclear whether a capsular repair is routinely required with a glenoid bone graft, but it may be beneficial in some cases. All of these statements are shown in Table 3, and the initial questions from Rounds 1-3 are included in Appendix Box 4.

Discussion

The most important finding from this study was that all of the statements reached consensus, with two reaching unanimous agreement. Overall, 89% of statements reached unanimous or strong consensus. The statements that reached unanimous consensus were: 1) the prognostic factors that are important to consider in those undergoing a glenoid bone-grafting procedure, including age, activity level, Hill-Sachs Lesion, extent of glenoid bone loss, hyperlaxity, prior surgeries, and arthritic changes; and 2) it is unclear whether a capsular repair is routinely required with a

Table 2. Remplissage

Questions and Answers	Agreement	Consensus
Q: What are the indications for a remplissage procedure?	93%	Strong Consensus
A: The primary relative indications for a remplissage procedure are in the setting of a large Hill-Sachs lesion, either a) off-track on preoperative imaging, or b) engaging at the time of arthroscopy.		
Q: What are the contraindications for a remplissage procedure?	95%	Strong Consensus
A: The primary relative contraindications for a remplissage procedure are relative, but include a) small Hill-Sachs lesion, either on-track on preoperative imaging or nonengaging at arthroscopy, b) severe glenoid bone loss, c) preoperative stiffness, d) infraspinatus compromise, and e) overhead athlete.		
Q: Should a remplissage procedure ever be indicated in isolation?	82%	Consensus
A: A remplissage procedure may be indicated in isolation in the setting of a previous Latarjet procedure with recurrent instability where there is a large Hill-Sachs lesion.		
Q: What prognostic factors should be considered in patients undergoing a remplissage?	98%	Strong Consensus
A: The prognostic factors that are important to consider specifically in those undergoing a remplissage procedure include: a) activity level, b) Hill-Sachs size, c) Hill-Sachs track, d) glenoid bone-loss, and e) connective tissue disorder.		
Q: To what degree are complications a concern following a remplissage procedure? How can complications be reduced?	98%	Strong Consensus
A: Loss of external range of motion is a small concern and unlikely to be clinically significant in most patients. This can be minimized by fixing the tendon via the safe zone and not overmedializing the fixation.		
Q: How should the infraspinatus/posterior capsule be fixed to the Hill-Sachs defect?	98%	Strong Consensus
A: There is no ideal fixation method for the infraspinatus/posterior capsule to the Hill-Sachs defect.		
Q: If knotted anchors are used, should the sutures be tied under direct visualization in the subacromial space?	97%	Strong Consensus
A: Sutures do not need to be tied under direct visualization in the subacromial space.		
Q: Should the addition of a remplissage procedure to a Bankart repair alter the postoperative rehabilitation protocol?	98%	Strong Consensus
A: The addition of a remplissage procedure to a Bankart repair should not alter the postoperative rehabilitation protocol; however, it is important to consider the infraspinatus and external rotation in the first few weeks.		

glenoid bone graft, but it may be beneficial in some cases. There was no unanimous agreement on any aspect related to the Latarjet or remplissage procedures. These consensus statements represent the ASI-ICG's expert agreement on the Latarjet procedure, remplissage, and glenoid bone grafting. Ultimately, these studies represent Level V data as expert opinion, and our hope is that it will serve as a catalyst to address the gaps in the evidence where they exist while providing guidance based on the current evidence.

The Latarjet procedure was agreed with strong consensus to be indicated in patients with a high risk of postoperative recurrent instability.[3,15,23-25] Long-favored in Europe, particularly in France, it has seen an increased usage worldwide because of the historically low rate of recurrence associated with this procedure at long-term follow-up.[7,26-29] Additionally, the ASI-ICG achieved strong consensus on only a few relative contraindications to performing the Latarjet procedure, including glenoid bone loss in excess of that which a coracoid transfer can correct. The maximum amount of glenoid bone loss that a coracoid transfer can treat is unclear and surgeon-dependent given the lack of comparative literature. In contrast, the critical amount of glenoid bone loss for which a Latarjet procedure is indicated has been an area of keen scientific interest and has shown to range between 15-20%.[1,2,21]

In recent years, there has been increased interest in performing the Latarjet procedure arthroscopically, with Lafosse et al. pioneering this technique in 2007.[25,30,31] The initial results have been shown to result in similar outcomes, as compared to the open approach, but this remains a technically challenging procedure that is only advisable in high-volume settings to reduce the potential for complications, as this group has advised.[32,33] However, despite comparable clinical outcomes, there appears to be a difference in graft positioning between the open and arthroscopic technique, the long-term implications of which are unknown.[34-36] Additionally, because of the nonanatomic nature and proximity to neurovascular structures, there is a concern about the Latarjet procedure's complication rate.[37] This may, in part, be due to the difficult learning curve associated with this procedure.[12,38] While some initial studies reported a 30% complication rate, more recent ones have shown this to range between 4 and 7% in the hands of high-volume users.[33,37,39-42] Delaney et al.[43] used intraoperative neuromonitoring to show that the axillary and musculocutaneous nerves were most at risk of injury during glenoid exposure and graft insertion. There were several proposed strategies by this group to reduce the complication rate during a Latarjet procedure, including careful identification of the at-risk neurovascular structures and avoidance of graft overmedialization. Additionally, a

Table 3. Glenoid Bone Grafting

Questions and Answers	Agreement	Consensus
Q: What are the indications for glenoid bone-grafting? When would you consider performing glenoid bone grafting instead of a Latarjet procedure?	93%	Strong Consensus
A: The primary relative indications for glenoid bone-grafting are a) > 20% bone-loss, b) failed prior Latarjet procedure, and c) epilepsy. Additionally, the relative indications for glenoid bone-grafting over a Latarjet procedure is a) bone-loss greater than can be treated with a coracoid graft, b) surgeon preference, c) Failed prior Latarjet or glenoid bone-grafting procedure, and d) epilepsy.		
Q: What are the contraindications for glenoid bone-grafting?	92%	Strong Consensus
A: The primary relative contra-indications for glenoid bone-grafting are a) minimal glenoid bone-loss, b) infection, and c) axillary nerve damage.		
Q: What prognostic factors should be considered in patients undergoing glenoid bone-grafting?	100%	Unanimous
A: The prognostic factors that are important to consider specifically in those undergoing a glenoid bone-grafting procedure include a) age, b) activity level, c) Hill-Sachs Lesion, d) extent of glenoid bone-loss, e) hyperlaxity, f) prior surgeries, g) arthritic changes.		
Q: Is there a preferred bone-graft for treating anterior shoulder instability?	98%	Strong Consensus
A: There is no optimal bone-graft, and the choice should be based on surgeon preference.		
Q: Is autologous or allogeneic bone preferable for treating anterior shoulder instability?	92%	Strong Consensus
A: Either autologous bone or fresh allogeneic bone are preferable for treating anterior shoulder instability. However, other sources of allogeneic bone-graft may be inferior.		
Q: To what degree are complications a concern following glenoid bone-grafting? How can complications be reduced?	93%	Strong Consensus
A: Complications following glenoid bone-grafting are less of a concern than following the Latarjet procedure. The following strategies may be used to reduce complications a) careful dissection and identification of neurovascular structures, b) preventing over-medialization of the graft, and contouring flush to native cartilage.		
Q: Is resorption of the bone graft correlated with an inferior outcome after glenoid bone grafting?	95%	Strong Consensus
A: Remodeling is normal, but true resorption is correlated with an inferior outcome after glenoid bone grafting.		
Q: What is the optimal method of fixation for a glenoid bone graft?	95%	Strong Consensus
A: The optimal fixation of glenoid bone-graft is based on surgeon preference using either screw fixation or a J-bone graft.		
Q: Is a capsular repair required with a glenoid bone graft?	100%	Unanimous
A: It is unclear whether a capsular repair is routinely required with a glenoid bone graft, but it may be beneficial in some cases.		
Q: Should a subscapularis split or partial/complete takedown be used with a glenoid bone graft?	85%	Consensus
A: A subscapularis split should be used to access the joint with a glenoid bone graft.		

recent randomized controlled trial by Hurley et al.[44] found that the use of tranexamic acid reduced postoperative hematoma formation and subsequent pain following the open Latarjet procedure.

Recent literature suggests equivalency between the classic and congruent arc methods of Latarjet graft placement.[45-47] While consensus that the Latarjet procedure should be performed using the classic technique was achieved, some participants preferred the congruent arc method owing to the increased arc width it affords. However, the congruent arc technique may not be feasible in patients with thin coracoids (decreased sagittal thickness). Furthermore, the theoretical benefits of an increased arc may not outweigh the risk of graft fracture due to a narrower corridor for screw placement, which can weaken the fixation construct and affect graft incorporation. Additionally, there was strong consensus that the coracoid should be fixated with two screws, as several biomechanical and clinical studies have shown higher failure rates with suture-button fixation.[48-50] Furthermore, the role of capsular and labral repair remains unclear, and while it is not required in all cases, it may be beneficial in some patients. Finally, while there was strong consensus supporting a subscapularis split rather than a takedown to minimize damage to the tendon, subscapularis weakness and/or fatty infiltration is still a known sequela of this procedure.[8,51,52]

Remplissage is primarily indicated in the setting of a Bankart repair in patients with an "off-track" Hill-Sachs lesion due to its ability to fill in the defect, thus rendering the bone defect extra-articular and preventing it from engaging with the glenoid.[16-19] However, there was strong consensus that a Remplissage is relatively contraindicated in a throwing athlete given the risk of postoperative reduction in range of motion following this procedure.[22] Furthermore, it is unclear whether there exists a threshold for subcritical glenoid bone loss above which a remplissage should be abandoned in favor of a Latarjet or glenoid bone-grafting procedure. Nevertheless, Yang et al.[53] found that with greater than 10% glenoid bone loss, the outcomes were worse in those who received a Bankart repair and remplissage instead of a Latarjet procedure. The only

statement in this group that did not achieve strong consensus was that a remplissage may be indicated in isolation for patients with recurrent instability who had a previous Latarjet procedure with an unaddressed Hill-Sachs lesion, possibly because of a lack of literature on this topic.

There was strong consensus on all of the technical aspects of the remplissage procedure. Firstly, it was agreed that external range of motion loss is unlikely to be clinically significant but can be minimized by tenodesing the infraspinatus and posterior capsule within its safe-zone and not overmedializing the fixation.[54,55] Furthermore, it was agreed that there was no optimal fixation method and that if knotted anchors were used, they did not need to be tied under direct visualization. Finally, there was strong consensus agreement that a remplissage procedure need not alter the rehabilitation protocol of an isolated Bankart repair.

Glenoid bone grafting is primarily used as a salvage procedure or in patients with more severe glenoid bone loss.[9,56] However, a recent randomized controlled trial by Moroder et al.[57] found that iliac crest bone graft transfer resulted in similar clinical results as the Latarjet procedure. Additionally, glenoid bone grafting may have several potential advantages over the Latarjet procedure, including its ability to accommodate a greater degree of glenoid bone loss and reduced risk of convulsion-related graft failure in patients with epilepsy.[58] However, it should be noted that uncontrolled epilepsy is a relative contraindication to any stabilization procedure given the higher risk of failure. Finally, it should be noted that surgeon preference in using the glenoid bone graft over the Latarjet was a relative indication in performing either procedure when both could be reasonable options.

The technical aspects of glenoid bone grafting were agreed to be similar to the Latarjet procedure, but the risk of complications was felt to be lower. Additionally, glenoid bone grafts may not require hardware for fixation, as the J-bone has been shown to have successful long-term outcomes and has the potential to restore normal glenoid anatomy and can be performed arthroscopically.[59-62] However, the optimal glenoid graft is undefined, with strong consensus that this decision should be based on surgeon preference. Additionally, it was further agreed that only autologous or fresh allogenic bone grafts should be used, as freeze-dried bone graft results in inferior outcomes.[9] Finally, this group agreed that it was important to differentiate between remodeling and resorption, as true resorption is correlated with inferior outcomes after glenoid bone grafting.[63-65]

Limitations

This consensus statement has several potential limitations. First, consensus statements are considered to be level V data, as they represent expert opinion, and there may be inherent biases in selecting the participants.[66,67] Ultimately, it is somewhat subjective in how the experts were selected, but that is the case with any expert panel, and we tried to minimize this bias. Furthermore, the questions and topics addressed may represent a potential source of bias, as there was no standardized process for generating them but were agreed upon by the group leaders. Furthermore, the use of a Likert scale may have allowed for more nuanced responses, allowing authors to have varying levels of agreement where statements had multiple components, and allowing participants to indicate varying levels of agreement with such statements. Also, there were some limitations in the content discussed, as this article did not address the specifics of salvage treatment for massive Hill-Sachs lesions in the setting of anterior shoulder instability, and the use humeral allografts and partial humeral head resurfacing. Additionally, these statements involved a modification of the Delphi process, as the participants worked on their individual groups for the first three rounds and not all of the statements. Finally, there are some limitations with the Delphi process itself, as it may represent the lowest common denominator of expert opinion with less ownership of ideas, and ultimately represents Level V data.[67]

Conclusions

Overall, 89% of statements reached unanimous or strong consensus. The statements that reached unanimous consensus were the prognostic factors that are important to consider in those undergoing a glenoid bone-grafting procedure, including age, activity level, Hill-Sachs Lesion, extent of glenoid bone loss, hyperlaxity, prior surgeries, and arthritic changes. Furthermore, there was unanimous agreement that it is unclear whether a capsular repair is routinely required with a glenoid bone graft, but it may be beneficial in some cases. There was no unanimous agreement on any aspect related to the Latarjet procedure or remplissage.

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Appendix

Appendix Box 1. List of Consensus Members

G1 Diagnosis	
Alaia	USA
Cassidy	Ireland
Collin	France
Di Giacomo	Italy
Frank	USA
Waterman	USA
Wong	Canada
G2 Nonoperative Management	
Carter	USA
Erickson	USA
Itoi	Japan
Kuhn	USA
O'Shea	Ireland
Rokito	USA
Whelan	Canada
G3 Bankart Repair	
Calvo	Spain
Campbell	USA
Imhoff	Germany
Millett	USA
Moran	Ireland
Strauss	USA
Verma	USA
G4 Latarjet	
Delaney	Ireland
Garrigues	USA
Lim Fat	Mauritius
Neyton	France
Moya	Argentina
Scheibel	Germany
Virk	USA
G5 Remplissage	
Athwal	Canada
Kelly	USA
Khan	Canada
Meislin	USA
MacDonald	Canada
Molony	Ireland
Rhee	South Korea
G6 Glenoid Bone Grafting	
Heuberer	Austria
Kwon	USA
Mazzoca	USA
Moroder	Germany
Pauzenberger	Austria
Provencher	USA
Rosso	Switzerland
G7 Revision Surgery	
Arciero	USA
Cordasco	USA
Jazrawi	USA
Ladermann	Switzerland
Levine	USA
McCarty	USA
Walch	France
Warner	USA
G8 Rehabilitation/RTP	
Brophy	USA
Cole	USA
Ciccotti	USA
Funk	United Kingdom
Lomas	USA
Mullett	Ireland
Owens	USA
Warren	USA
G9 Follow-up	
Bedi	USA
Favard	France
Krych	USA
Matache	Canada
Rodeo	USA
Edwards	USA
Zuckerman	USA

(continued)

Appendix Box 2. Group 4: Latarjet

Round 1

1. What are the indications for a Latarjet procedure?
2. What are the contraindications for a Latarjet procedure?
3. Is there an amount of glenoid bone loss above which a Latarjet procedure should be performed?
4. What prognostic factors should be considered in patients undergoing a Latarjet procedure?
5. Should the Latarjet procedure be performed arthroscopically? If so, is there a minimum number of cases to achieve proficiency?
6. To what degree are complications a concern following a Latarjet procedure? How can complications be reduced?
7. Should the coracoid transfer procedure be performed using the classic or congruent-arc technique?
8. What is the optimal method of fixation of a coracoid graft?
9. Is a capsular repair required in a Latarjet procedure?
10. Should a subscapularis split or partial/complete takedown be used in a Latarjet procedure?

Round 2

1. Which of the following do you agree are indications for a Latarjet procedure?
   a. Recurrent instability
   b. Failed prior surgery
   c. Collision athlete
   d. Critical glenoid bone loss (>15%)
   e. Bipolar bone loss resulting in "off-track" lesion
2. Which of the following do you agree are contraindications for a Latarjet procedure?
   a. Multidirectional instability
   b. Voluntary dislocators
   c. Uncontrolled epilepsy/seizure disorder
   d. Coracoid <25 mm
   e. Age >50
   f. Irreparable rotator cuff tear
   g. >30% bone loss
3. There is no minimal amount glenoid bone loss for a Latarjet procedure to be performed. Do you agree with this statement? If not, why not? The Latarjet procedure should be performed in patients with >15% glenoid bone loss. Do you agree with this statement? If not, why not?
4. What prognostic factors should be considered in patients undergoing a Latarjet procedure?
   a. Smoking
   b. Prior surgery
   c. Sport played
   d. Patient aspirations
   e. Arthritis
   f. Age
   g. Preoperative stiffness
   h. Hyperlaxity
   i. Glenoid bone loss
   j. Hill-Sachs lesions
5. The arthroscopic technique is a viable alternative; however, it is a technically challenging procedure and is only advisable to perform in a high-volume setting. Do you agree with this statement? If not, why not?
6. The Latarjet procedure should be performed using the classic technique. Do you agree with this statement? If not, why not?
7. Which of the following do you agree should be done to reduce complications?
   a. Careful dissection
   b. Identifying the nerve
   c. Preventing overmedialization of the graft, and contour flush to native cartilage
   d. Tranexamic acid to reduce blood loss
   e. Vancomycin to reduce wound infection
8. Two screws are the optimal method of fixation for a coracoid graft. Do you agree with this statement? If not, why not?
9. A capsular repair is not required in a Latarjet procedure. Do you agree with this statement? If not, why not? If a capsular repair is not required with a Latarjet do you think it may be beneficial in some cases. Do you agree with this statement? If not, why not?
10. A subscapularis split should be used to access the glenohumeral a Latarjet procedure. Do you agree with this statement? If not, why not?

Round 3

1. Q: What are the indications for a Latarjet procedure?
   A: The primary relative indication for a Latarjet procedure are a) recurrent instability, b) failed prior surgery, c) collision athlete, d) critical glenoid bone-loss (>15-20%), and e) bipolar bone loss resulting in "off-track" lesion.

   Do you agree with this statement? If not, why not?
2. Q: What are the contraindications for a Latarjet procedure?
   A: The primary relative contraindication for a Latarjet procedure are a) multidirectional instability, b) voluntary dislocators, c) uncontrolled epilepsy/seizure disorder, and d) irreparable rotator cuff tear.

   Do you agree with this statement? If not, why not?
3. Q: Is there an amount of glenoid bone loss above which a Latarjet procedure should be performed?
   A: The Latarjet procedure should be performed in patients with >15-20% glenoid bone loss.

   Do you agree with this statement? If not, why not?

4. Q: What prognostic factors should be considered in patients undergoing a Latarjet procedure?
   A: The prognostic factors that are important to consider specifically in those undergoing a Latarjet procedure include a) smoking, b) prior surgery, c) patient aspirations, d) arthritis, e) age, f) preoperative stiffness, g) hyperlaxity, h) glenoid bone-loss, and i) Hill-Sachs lesions.

   Do you agree with this statement? If not, why not?
5. Q: Should the coracoid transfer procedure be performed arthroscopically? If so, is there a minimum number of cases to achieve proficiency?
   A: The arthroscopic technique is a viable alternative; however, it is a technically challenging procedure and is only advisable to perform in a high-volume setting.

   Do you agree with this statement? If not, why not?
6. Q: To what degree are complications a concern following a Latarjet procedure? How can complications be reduced?
   A: Complications are a concern following a Latarjet procedure, and the following strategies can be used to reduce them a) careful dissection, b) identifying the nerve, c) preventing overlateralization of the graft, and contour flush to native cartilage, d) Tranexamic acid to reduce blood loss, and e) vancomycin to reduce wound infection.

   Do you agree with this statement? If not, why not?
7. Q: Should the coracoid transfer procedure be performed using the standard or congruent-arc technique?
   A: The coracoid transfer procedure should be performed using the classic technique.

   Do you agree with this statement? If not, why not?
8. Q: What is the optimal method of fixation of a coracoid graft?
   A: Two screws are the optimal method of fixation for a coracoid graft.

   Do you agree with this statement? If not, why not?
9. Q: Is a capsular repair required in a Latarjet procedure?
   A: A capsular repair is not required with a Latarjet, but it may be beneficial in some cases.

   Do you agree with this statement? If not, why not?
10. Q: Should a subscapularis split or partial/complete takedown be used in a Latarjet procedure?
    A: A subscapularis split should be used to access the glenohumeral joint in a Latarjet procedure.

    Do you agree with this statement? If not, why not?

Appendix Box 3. Group 5: Remplissage

Round 1

1. What are the indications for a remplissage procedure?
2. What are the contraindications for a remplissage procedure?
3. Should a remplissage procedure ever be indicated in isolation?
4. What prognostic factors should be considered in patients undergoing a remplissage?
5. To what degree are complications a concern following a remplissage procedure? How can complications be reduced?
6. How should the infraspinatus/posterior capsule be fixed to the Hill-Sachs defect?
7. If knotted anchors are used, should the sutures be tied under direct visualization in the subacromial space?
8. Should the addition of a remplissage procedure to a Bankart repair alter the postoperative rehabilitation protocol?

Round 2

1. Which of the following do you agree are indications for a remplissage procedure?
   a. Large Hill-Sachs lesions either a) off-track on preoperative imaging, or b) engaging at the time of arthroscopy
   b. Subcritical glenoid bone-loss
2. Which of the following do you agree are contraindications for a remplissage procedure?
   a. 15%-20% glenoid bone loss
   b. Small Hill-Sachs lesions, either on-track on preoperative imaging or nonengaging at arthroscopy
   c. Infraspinatus compromise
   d. Preoperative stiffness
   e. Epilepsy
   f. Connective tissue disorder
3. A remplissage may only be indicated in isolation in the setting of a previous Latarjet procedure with recurrent instability where there is a large Hill-Sachs lesion? Do you agree with this statement? If not, why not?
4. Which of the following do you agree are prognostic factors that should be considered in patients undergoing a remplissage?
   a. Age
   b. Activity level
   c. Hill-Sachs size
   d. Hill-Sachs track
   e. Glenoid bone loss

f. Connective tissue disorder
g. Overhead sports

5. Loss of external range of motion is a small concern, and unlikely to be clinically significant in most patients. This can be minimized via fixing the tendon via the safe zone and not over medializing the fixation. Do you agree with this statement? If not, why not?
6. Sutures do no need to be tied under direct visualization in the subacromial space, do you agree with this statement? If not, why not?
7. The addition of a remplissage to a Bankart repair should not alter the postoperative rehabilitation protocol, do you agree with this statement? If not, why not?

Round 3

11. Q: What are the indications for a remplissage procedure?
    A: The primary indication for a remplissage procedure is in the setting of a large Hill-Sachs lesion either a) off-track on preoperative imaging, or b) engaging at the time of arthroscopy.

    Do you agree with this statement? If not, why not?
12. Q: What are the contraindications for a remplissage procedure?
    A: The contraindications for a Remplissage procedure are relative, but include a) small Hill-Sachs lesion, either on-track on preoperative imaging or nonengaging at arthroscopy, b) severe glenoid bone loss, c) preoperative stiffness, and d) infraspinatus compromise.

    Do you agree with this statement? If not, why not?
13. Q: Should a remplissage procedure ever be indicated in isolation?
    A: A Remplissage procedure may be indicated in isolation in the setting of a previous Latarjet procedure with recurrent instability where there is a large Hill-Sachs lesion?

    Do you agree with this statement? If not, why not?
14. Q: What prognostic factors should be considered in patients undergoing a remplissage?
    A: The prognostic factors that are important to consider specifically in those undergoing a remplissage procedure include a) activity level, b) Hill-Sachs size, c) Hill-Sachs track, d) glenoid bone loss, and e) connective tissue disorder.

    Do you agree with this statement? If not, why not?
15. Q: To what degree are complications a concern following a remplissage procedure? How can complications be reduced?
    A: Loss of external range of motion is a small concern, and unlikely to be clinically significant in most patients. This can be minimized via fixing the tendon via the safe zone and not over medializing the fixation.

    Do you agree with this statement? If not, why not?
16. Q: How should the infraspinatus/posterior capsule be fixed to the Hill-Sachs defect?
    A: There is no ideal fixation method for the infraspinatus/posterior capsule to the Hill-Sachs defect.

    Do you agree with this statement? If not, why not?
17. Q: If knotted anchors are used, should the sutures be tied under direct visualization in the subacromial space?
    A: Sutures do not need to be tied under direct visualization in the subacromial space.

    Do you agree with this statement? If not, why not?
18. Q: Should the addition of a remplissage procedure to a Bankart repair alter the postoperative rehabilitation protocol?
    A: The addition of a remplissage procedure to a Bankart repair should not alter the postoperative rehabilitation protocol; however, it is important to consider the infraspinatus and external rotation in the first few weeks.

    Do you agree with this statement? If not, why not?

Appendix Box 4. Group 6: Glenoid Bone-Grafting

Round 1

1. What are the indications for glenoid bone grafting? When would you consider performing glenoid bone grafting instead of a Latarjet procedure?
2. What are the contraindications for glenoid bone grafting?
3. What prognostic factors should be considered in patients undergoing glenoid bone grafting?
4. Is there a preferred bone graft for treating anterior shoulder instability?
5. Is autologous or allogeneic bone preferable for treating anterior shoulder instability?
6. To what degree are complications a concern following glenoid bone-grafting? How can complications be reduced?
7. Is resorption of the bone graft correlated with an inferior outcome after glenoid bone grafting?
8. What is the optimal method of fixation for a glenoid bone graft?
9. Is a capsular repair required with a glenoid bone graft?
10. Should a subscapularis split or partial/complete takedown be used with a glenoid bone graft?

Round 2

1. Which of the following do you agree are indications for glenoid bone grafting?
   a. 15-20% glenoid bone loss

   b. Failed prior Latarjet, or glenoid bone-grafting procedure
   c. Epilepsy
2. Which of the following do you agree are indications for glenoid bone grafting over a Latarjet procedure?
   a. Bone loss greater than can be treated with a coracoid graft
   b. Surgeon preference
   c. Failed prior Latarjet, or glenoid bone-grafting procedure
   d. Epilepsy
3. Which of the following do you agree are contra-indications for glenoid bone grafting?
   a. Minimal glenoid bone loss
   b. Infection
   c. Axillary nerve damage
4. >15-20% glenoid bone loss is when a glenoid bone-grafting procedure should be performed. Do you agree with this statement? If not, why not?
5. Which of the following do you agree are prognostic factors that in patients undergoing glenoid bone grafting?
   a. Age
   b. Activity level
   c. Hill-Sachs lesion
   d. Glenoid bone loss
   e. Hyperlaxity
   f. Prior surgeries
   g. Arthritic changes
6. There was considerable disagreement in the choice of optimal glenoid bone graft for treating anterior shoulder instability, and several participants noted it is dictated by surgeon preference. Do you agree with this statement? If not, why not?
7. Neither autologous or allogenic bone is preferable for treating anterior shoulder instability? Do you agree with this statement? If not, why not?
8. Complications are a concern following glenoid bone grafting over other approaches. Do you agree with this statement? If not, why not?
9. Which of the following do you agree should be done to reduce complications?
   a. Careful dissection
   b. Identifying the nerve
   c. Preventing overmedialization of the graft, and contour flush to native cartilage
   d. Tranexamic acid to reduce blood loss
   e. Implantless fixation (J-Bone graft)
   f. Vancomycin to reduce wound infection
10. Remodeling is normal, but true resorption is correlated with an inferior outcome after glenoid bone grafting. Do you agree with this statement? If not, why not?
11. There was considerable disagreement in the choice of optimal fixation method for glenoid bone grafting, which of the following do you agree with?
    a. Screws
    b. Suture button
    c. J-Bone graft
    d. Surgeon preference
12. Capsular repair is not required with a glenoid bone graft. Do you agree with this statement? If not, why not? If a capsular repair is not required with a glenoid bone graft do you think it may be beneficial in some cases. Do you agree with this statement? If not, why not?
13. A subscapularis split should be used with a glenoid bone graft. Do you agree with this statement? If not, why not?

Round 3

19. Q: What are the indications for glenoid bone grafting? When would you consider performing glenoid bone grafting instead of a Latarjet procedure?
    A: The primary indications for glenoid bone grafting are a) >15-20% bone loss, b) failed prior Latarjet procedure, and c) epilepsy. Additionally, the relative indications for glenoid bone grafting over a Latarjet procedure is a) bone loss greater than can be treated with a coracoid graft, b) surgeon preference, c) failed prior Latarjet, or glenoid bone-grafting procedure, and d) epilepsy.

    Do you agree with this statement? If not, why not?
20. Q: What are the contraindications for glenoid bone grafting?
    A: The primary relative contraindications for glenoid bone grafting are a) minimal glenoid bone loss, b) infection, and c) axillary nerve damage.

    Do you agree with this statement? If not, why not?
21. Q: What prognostic factors should be considered in patients undergoing glenoid bone grafting?
    A: The prognostic factors that are important to consider specifically in those undergoing a glenoid bone-grafting procedure include a) age, b) activity level, c) Hill-Sachs Lesion, d) extent of glenoid bone loss, e) hyperlaxity, f) prior surgeries, and g) arthritic changes.

    Do you agree with this statement? If not, why not?
22. Q: Is there a preferred bone graft for treating anterior shoulder instability?
    A: There is no optimal bone graft, and the choice should be based on surgeon preference.

    Do you agree with this statement? If not, why not?
23. Q: Is autologous or allogenic bone preferable for treating anterior shoulder instability?
    A: Neither autologous bone or fresh allogenic bone is preferable for treating anterior shoulder

instability. However, other sources of allogenic bone graft may be inferior.

Do you agree with this statement? If not, why not?

24. Q: To what degree are complications a concern following glenoid bone grafting? How can complications be reduced?
    A: Complications following glenoid bone grafting are less of a concern than following the Latarjet procedure. The following strategies may be used to reduce complications a) careful dissection and identification of neurovascular structures, b) prevention of overmedialization of the graft with contours flush to native cartilage.

Do you agree with this statement? If not, why?

25. Q: Is resorption of the bone graft correlated with an inferior outcome after glenoid bone grafting?
    A: Remodeling is normal, but true resorption is correlated with an inferior outcome after glenoid bone grafting.

Do you agree with this statement? If not, why not?

26. Q: What is the optimal method of fixation for a glenoid bone graft?
    A: The optimal fixation of glenoid bone graft is based on surgeon preference using either screw fixation or a J-bone graft.

Do you agree with this statement? If not, why not?

27. Q: What is the optimal number of anchors when performing a standard Bankart repair?
    A: A minimum of 3 anchors should be used when performing a standard Bankart repair; however, this may be greater in a more extensive labral tear.

Do you agree with this statement? If not, why not?

28. Q: Is a capsular repair required with a glenoid bone graft?
    A: It is unclear whether capsular repair is routinely required with a glenoid bone graft, but it may be beneficial in some cases.

Do you agree with this statement? If not, why not?

29. Q: Should a subscapularis split or partial/complete takedown be used with a glenoid bone graft?
    A: A subscapularis split should be used to access the joint with a glenoid bone graft.

Do you agree with this statement? If not, why not?