# *Editorial Commentary:* Distal Tibia Allograft as an Option for Glenoid Reconstruction in Recurrent Shoulder Instability—It's All About the Bone?

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**Abstract:** Bony defects in recurrent shoulder instability can lead to the failure of soft tissue reconstruction. Many techniques have been developed to address glenoid defects in an attempt to prevent recurrent instability. However, the high complication rates with the Latarjet procedure have led surgeons to identify other sources of bone graft, including the distal tibia allograft (DTA). The DTA appears to be a suitable option for anterior glenoid reconstruction, highlighting the importance of reconstructing all bony defects and the versatility and efficacy of allograft bone blocks.

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Glenohumeral instability is common, affecting approximately 2% of the general population, with anterior dislocations occurring 95% to 98% of the time.[1,2] Soft tissue reconstruction in the form of both open and arthroscopic capsulolabral repairs is the most common surgical repair for patients with ongoing instability issues. Although success rates have been high, some patients continue to have instability issues and soft tissue repair does not seem to be sufficient.[3-7] The orthopaedic literature now recognizes that one of the major causes of failure in these patients is the presence of bone defects, which needs to be addressed. With anterior dislocations, bony defects of the anterior glenoid (bony Bankart) and posterosuperior aspect of the humeral head (Hill-Sachs) occur relatively frequently. These osseous injuries clearly lead to recurrent instability as they alter the joint contact area and congruency and function of the static restraints.[2,8-11] Itoi and colleagues, in their biomechanical study, found that anterior bone defects greater than 20% of the glenoid length or ≥6 mm of bone loss led to significant decreases in stability ratios.[12] Similarly, Kaar et al.[13] found that on the humeral head side, bone defects greater than five-eighth of the humeral head radius caused a significant decrease in stability. In addition, we evaluated stability in the setting of combined glenoid and humeral bony defects and found the critical defect size of a humeral head lesion to be 19%.[14] Thus, restoration of normal articular geometry should be considered when critical bone loss is observed, especially in cases of failed soft-tissue stabilization procedures. This has led to a search for techniques that could improve success rates with regard to recurrent instability and better outcomes. We need to ensure that the solutions chosen solve these problems and do not create new ones.

In a retrospective case series titled "Distal Tibia Allograft Glenoid Reconstruction in Recurrent Anterior Shoulder Instability: Clinical and Radiographic Outcomes," Provencher, Frank, Golijanin, Gross, Cole, Verma, and Romeo report on their clinical and radiographic outcomes after using a novel distal tibia allograft (DTA) for anterior glenoid reconstruction.[15] A total of 27 men (67% active military duty) underwent the procedure, with an average follow-up of 45 months, and all but 2 had follow-up computed tomographic scans. American Shoulder and Elbow Surgeons score, Western Ontario Shoulder Instability index, and Single Assessment Numeric Evaluation outcome scores improved postoperatively without any statistically significant decrease in motion, and no patient experienced recurrent instability. Most important was the computed tomographic examination of this cohort. Although the healing and resorption rates were impressive, we found the data on allograft fixation angles to be most insightful. Allografts fixed at angles less than 15° had superior healing and incorporation

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*0749-8063/161246/$36.00*
*http://dx.doi.org/10.1016/j.arthro.2017.01.018*

rates. Thus, surgeon technique and experience are critical in achieving healing.

The authors highlight the need for recognizing bone defects in recurrent instability while also providing an anatomic and congruent solution for glenoid bone defects.[16-18] Several studies have now shown that the presence of bony defects is associated with the failure of isolated capsulolabral repair.[5-7] This, in turn, has led to an increase in the popularity of the Latarjet procedure to address bony glenoid defects.[14,19] Anterior bone block procedures such as the Latarjet can be considered revision procedures in the setting of failed soft tissue surgeries or primary options as in some hands.[20,21] However, as Provencher et al. point out, the Latarjet procedure is associated with a unique set of complications, failures, and reoperations. Our previously published systematic review of the complications associated with Bristow/Latarjet procedures showed a 30% complication rate that included coracoid fractures, recurrent instability, bone-block migration, screw migration/breakage/prominence, nonunion, infection, osteolysis, hematoma, osteoarthritis, subscapularis rupture, loss of external rotation, and neurovascular injury.[22] The DTA seems a viable option to reduce the risks of coracoid fracture and neurovascular injury during dissection as well as issues related to incongruency.

The distal allograft appears to be an excellent choice for glenoid reconstruction, allowing the surgeon to tailor the size of the graft to the patient's defect. In this series, the threshold for DTA was 15% of the anterior glenoid, with defects of up to 36.2% being successfully treated. With a coracoid, the glenoid augmentation is limited to the size of the coracoid regardless of the orientation of the graft. Therefore, allograft may have some inherent advantages in being able to treat larger defects more successfully. However, the authors fail to mention some of the technical intricacies of using this graft that should be considered by all surgeons. Some of these include (1) the difficulty in obtaining a size-matched DTA, (2) graft preparation time in the operating room, (3) ensuring screw holes are in the proper position, and (4) the screw trajectory in the graft and glenoid neck. The authors do recognize the importance of allograft angle and fixation, so that the joint surface is anatomically reconstructed; however, they fail to describe a reproducible method of maintaining a flat angle ($<15°$), which seems to affect the healing of the graft.

Despite inconsistent repair of the soft tissue structures, including the capsule and the labrum, this sample did not have any recurrent instability at the final follow-up, which is an interesting observation. It seems to question the importance of the soft tissue structures and emphasizes the significance of the bony anatomy. Especially in the midranges of motion when the soft tissue structures are lax, the osseous anatomy is critical in providing stability.[12,23] Some would argue that the capsulolabral complex is important, but this article implies otherwise.[24-27] We must also subsequently question the importance of the sling effect provided by the conjoined tendon in a Latarjet procedure. Proponents of this operative procedure suggest that the sling is the more important component of the Latarjet procedure. In fact, some Latarjet equivalents (e.g., Bristow and Helfet) have used smaller or no blocks as alternatives to a larger coracoid bone graft to reconstruct these patients. Yamamoto et al.[24] found that the sling effect contributed up to 51% to 76% of the stabilizing force depending on the arm position. How is it, therefore, that a DTA prevents recurrent instability if there is no sling effect? Further research is certainly needed to investigate this, but in our biomechanical study of combined bony defects treated with an anterior bone block procedure, stability ratios were normalized when bony defects alone were addressed, and the soft tissues would enhance that stability but are probably not necessary if the glenoid bone anatomy is reconstructed.[14] However, we have determined that even after an anterior bone block reconstruction, a significant humeral head defect left unaddressed can lead to persistent recurrent instability. Thus, we consider the sling effect more important in the setting of unaddressed humeral head defects, as the soft tissue tether limits external rotation and likely limits or prevents engagement of the humeral head defect on the anterior glenoid and stressing the glenoid bone graft. The engagement of an unrecognized or untreated humeral head defect is an interesting theoretical discussion as we believe it may be another factor in some of the bone graft failures and hardware complications reported with Latarjet repairs. Recognition of the bony anatomy, therefore, is crucial in dealing with all the pathology that might be present in these patients. In spite of the advances in imaging, we probably do not estimate the amount of bone damage on either the humeral head or on the glenoid.[28,29] We are a bit better at measuring glenoid defects but it is interesting to note that the most sensitive technique, the 3-dimensional PICO method, of measuring these defects is not widely used.[30] We believe it is important to recognize the pathology accurately because consideration should be given to reconstructing the humeral head as well when the defect is greater than 25%. If the complete bone anatomy is dealt with by reconstructing both glenoid and humeral head defects, then it may circumvent the need for the soft tissue sling of the Latarjet.[14]

In our opinion, the increasing awareness of bony defects must not be unipolar as lesions typically do not occur in isolation.[28,29] Humeral head defects are present up to 70% to 100% of the time in cases of recurrent instability, with arthroscopy often identifying lesions not appreciated on imaging.[31,32] The authors note a pre- and intraoperative assessment of the humeral head to rule out any clinically significant or engaging humeral head defects. Furthermore, underappreciated (i.e., incomplete visualization through subscapularis split) humeral head defects might not cause recurrent instability but could lead to undue stress on the graft/hardware, resulting in some of the hardware failures and nonunions that have been previously reported.[22,33] Similarly, graft reabsorption may be linked to the stresses from unaddressed humeral head defects on the graft, although this is not known and further research is certainly needed.

Our previous biomechanical data along with these clinical and radiographic data point to the importance of addressing bony defects in glenohumeral instability. The DTA as presented by Provencher et al. seems to work well. They chose this graft because the curvature closely matched the glenoid; however, there are other reports of allograft uses with similar results and healing.[34] The location of the allograft source, thus, is not likely an important component of this operative procedure affecting the outcome. The findings do demonstrate, however, that allograft is certainly a good alternative to the traditional Latarjet procedure and has the potential to reduce complications related to the coracoid harvest. An ideal allograft for the glenoid should be congruent and easy to place and fixate. Better instrumentation is needed to allow for reproducible angles of screw and allograft fixation. Furthermore, techniques should allow for soft tissue repair of the capsule and labrum to most accurately restore all anatomy. The DTA in the hands of some very experienced surgeons has certainly demonstrated some exciting results that seem to be maintained over time and can be an excellent alternative to a Latarjet procedure. Recognizing and treating all pathology and restoring congruent anatomy are key to more successful outcomes going forward.

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