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Pathological or Physiological? An Analysis of Bone Resorption after Arthroscopic Anatomic Glenoid Reconstruction

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Disclosures

Nick Dawe – Nothing to Disclose
Jie Ma – Nothing to Disclose

Dr. Ivan Wong

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Anterior Shoulder Instability with Glenoid Bone Loss

- Anterior shoulder instability is the most common type of joint dislocation and often has associated glenoid bone loss (GBL)[1]

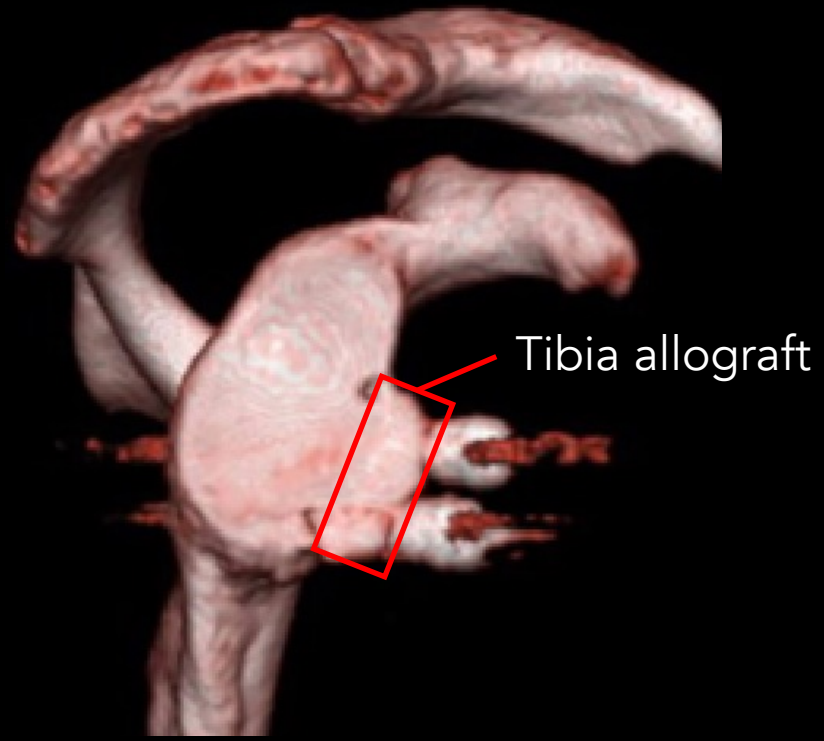
- Glenoid reconstruction is preferred over soft tissue stabilization when significant GBL is present[2]

(*Amar et al., 2018*)[3]

Arthroscopic Anatomic Glenoid Reconstruction

- Arthroscopic Anatomic Glenoid Reconstruction (AAGR) using distal tibia allograft is one glenoid reconstruction technique

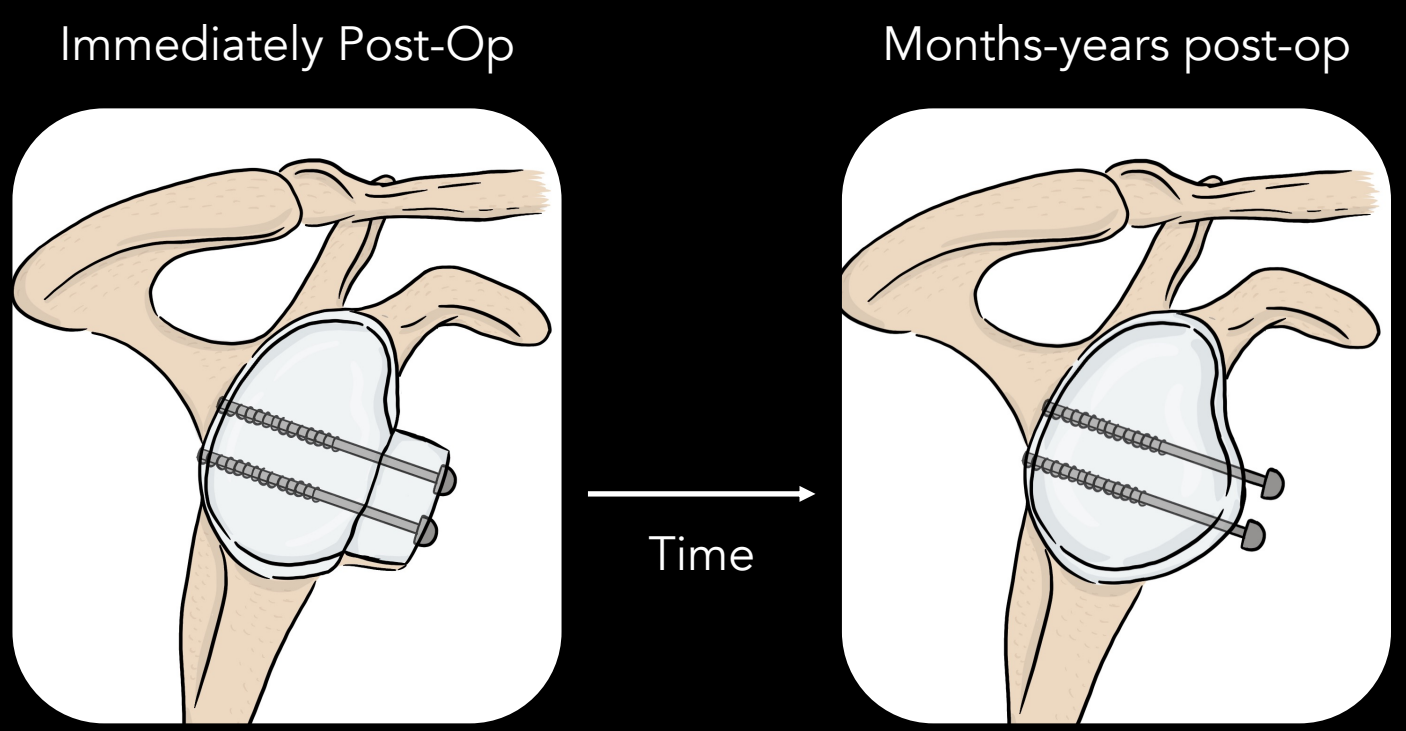
- AAGR has been shown to have several benefits over other glenoid reconstruction procedures, along with a high safety profile and excellent clinico-radiographic outcomes at 2-year follow-up[2]



(*Amar et al., 2018*)[3]

Tibia Allograft Remodels Post-AAGR

- One concern with AAGR is allograft resorption[2,3]
- The tibia allograft is inserted as a rectangular bone block on the anterior aspect of the glenoid where bone loss was present



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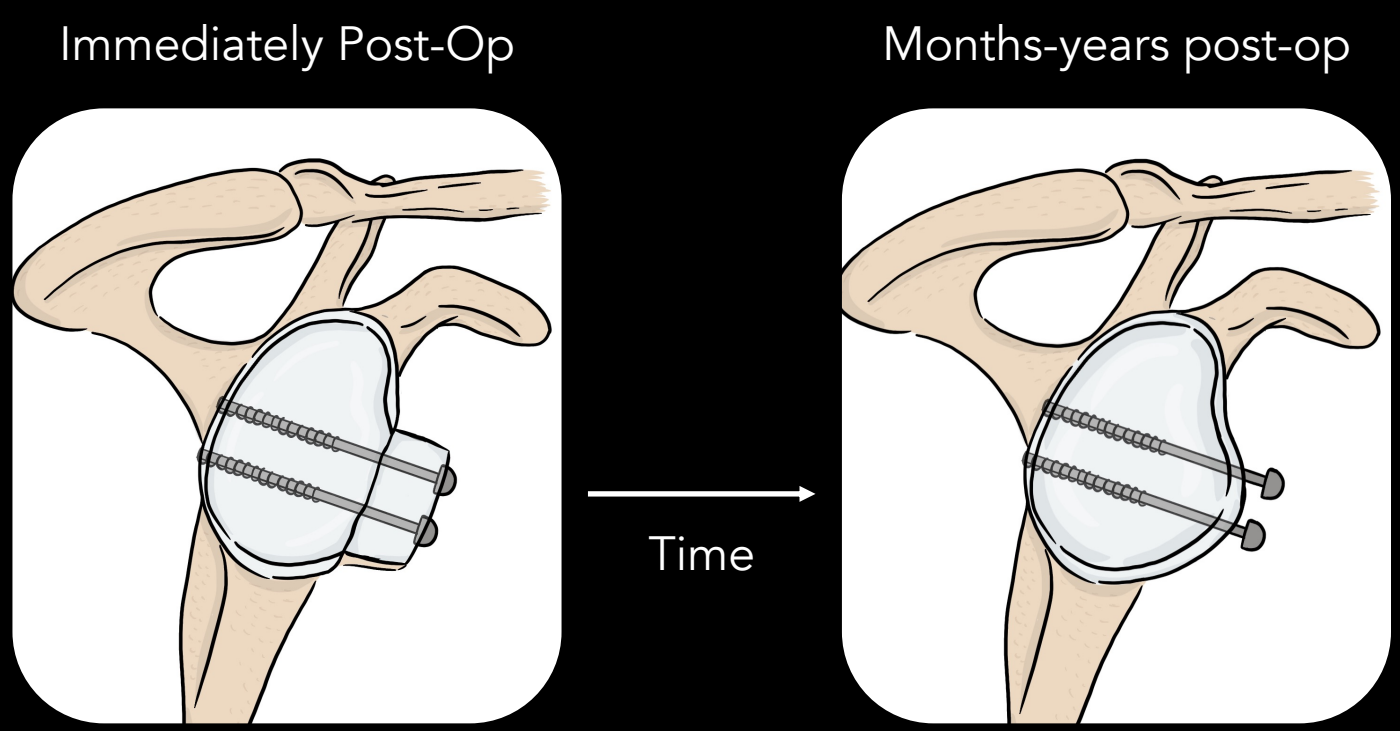
Tibia Allograft Remodels Post-AAGR

- The allograft is then incorporated into recipient bone of the glenoid, followed by remodeling, which includes resorption, and the rectangular allograft becomes more rounded and triangular over time[4]



Purpose and Hypothesis

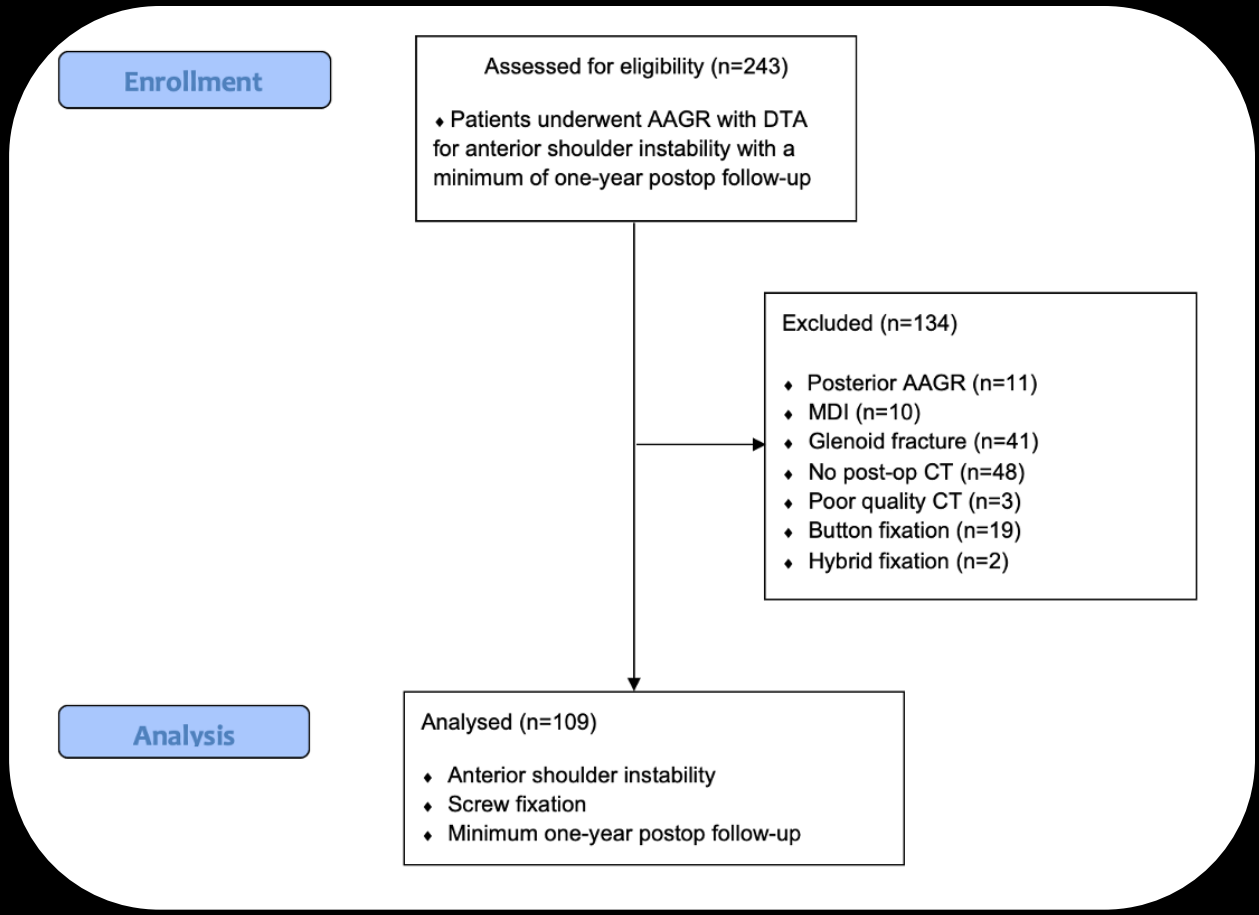
The purpose of this study was to determine if the allograft remodels according to Wolff's Law to restore the natural architecture of the glenoid following AAGR

We hypothesized that the resorption that is seen in the short-term follow-up post-AAGR is part of the normal graft incorporation and remodeling process and will restore the native width of the glenoid after a certain amount of time post-op

Methods – Subject Selection

- 243 patients had undergone AAGR with DTA using screw fixation for anterior shoulder instability and had ≥1-year clinical follow-up

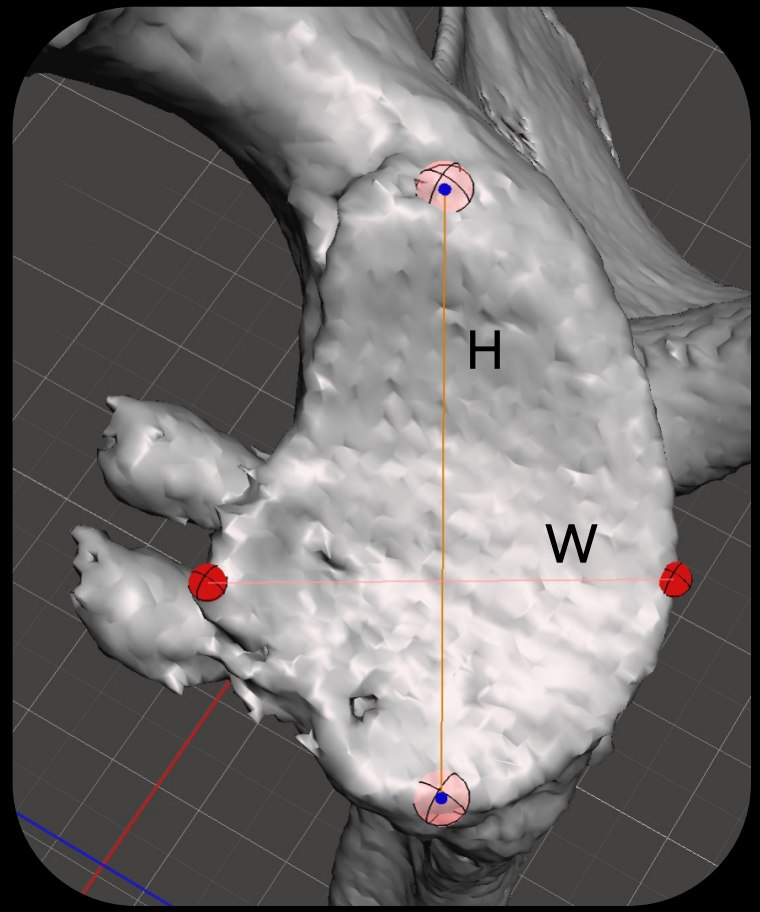
- 109 patients were included in our analysis after applying inclusion and exclusion criteria



Modeling and Measuring the Glenoid

- After identifying patients to be analyzed in this study, we anatomically modeled their post-op glenoid by 3D CT reconstruction using Horos and Meshmixer software

- Glenoid models were positioned *en face* for glenoid height (SI) and width (AP) measurements



Predicting Native Glenoid Width

Knee Surgery, Sports Traumatology, Arthroscopy (2023) 31:169–176
https://doi.org/10.1007/s00167-022-07020-4

SHOULDER

Calculating glenoid bone loss based on glenoid height using ipsilateral three-dimensional computed tomography

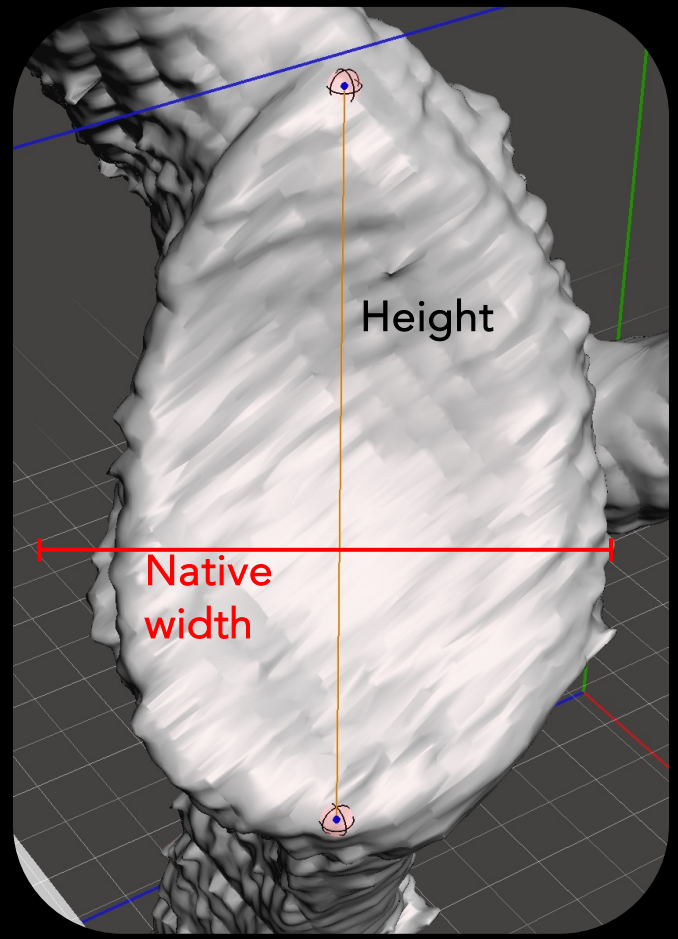
Johnny Rayes[1] · Jian Xu[1] · Sara Sparavalo[1] · Jie Ma[1] · Lauren Jonah[1] · Ivan Wong[1,2]

- A 2022 study by Rayes et al[5] found that native glenoid width can be predicted using glenoid height according to equation pW=2.53+0.71*H

Predicting Native Glenoid Width

- Using equation pW = 2.53 + 0.71*H, we plugged in the measured glenoid height to obtain the predicted native glenoid width

- We then compared how closely the measured and predicted glenoid widths matched post-AAGR



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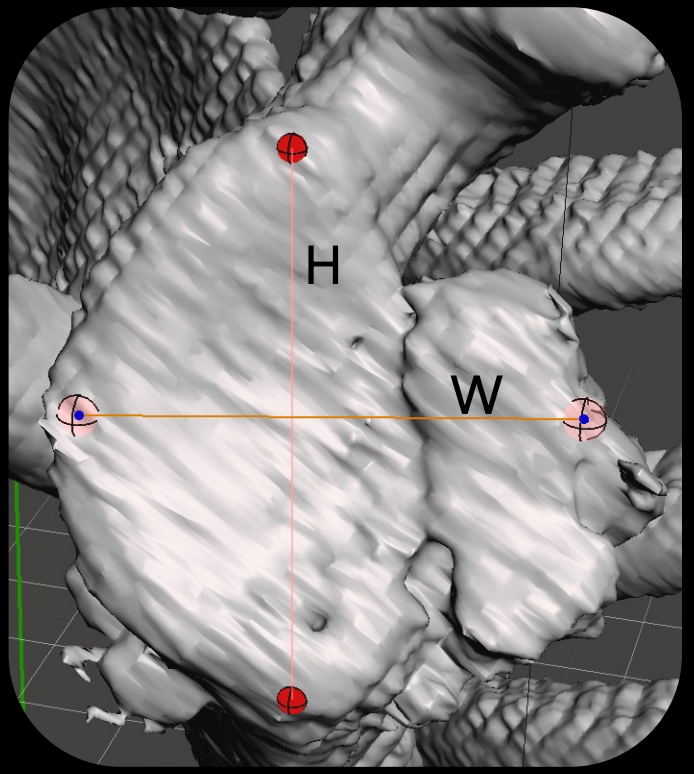
Post-op Glenoid Width was Significantly Greater than Predicted Width in N=109

- In all 109 patients analyzed in this study, the average post-op glenoid width was significantly greater than the predicted glenoid width

- Mean post-op width (W) = 30.7 ± 4.2mm
- Mean predicted width (pW) = 28.5 ± 2.5mm
  - $p<0.001$
- W > pW in 73.4% of patients
- Mean post-op CT follow-up = 1.0 ± 1.1 years



W=34.804mm; H=37.978mm
pW=2.53+0.71(37.978)=29.494mm

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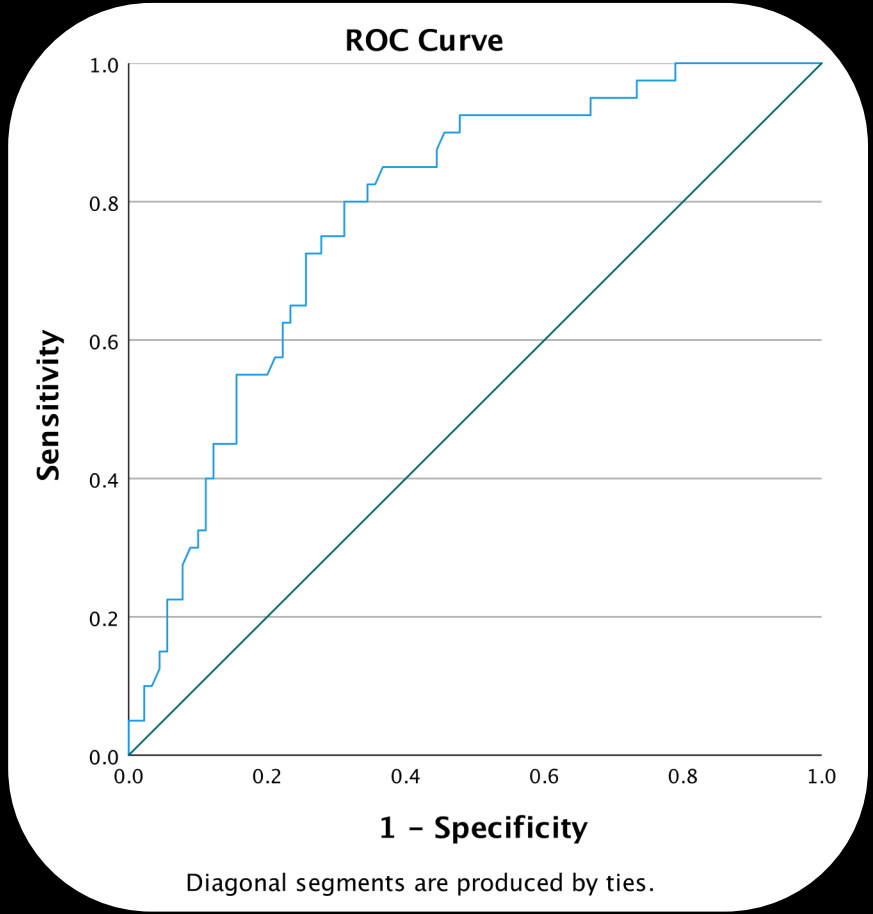
Mean pW > W at ≥6.9-Month Post-Op CT Follow-Up

- Interestingly, there was a negative correlation between post-op CT follow-up time and the difference between W and pW ($r = -0.325$, $p<0.001$)

- We performed ROC curve analysis to determine the optimal cut-off point for post-op CT that changed from a greater to a smaller glenoid width compared to the predicted width



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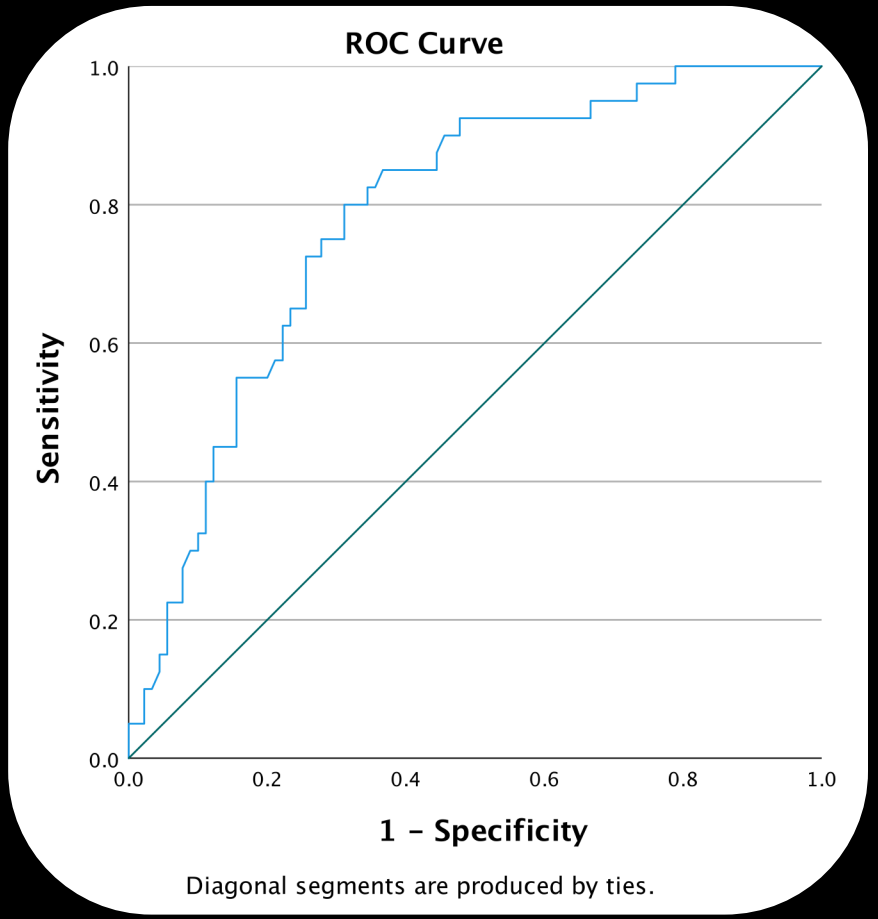
Mean pW > W at ≥6.9-Month Post-Op CT Follow-Up

- The optimal cut-off point is one that minimizes the misclassification rates, and the area under the curve (AUC) is a measure of accuracy of a given cut-off point[6]
- AUC between 0.7-0.8 is considered good and acceptable, and progressively better as it approaches 1.0[6]
- Our ROC curve analysis found that the optimal cut-off point for post-op CT was 6.9 months and the area under the curve at this cut-point was 0.759



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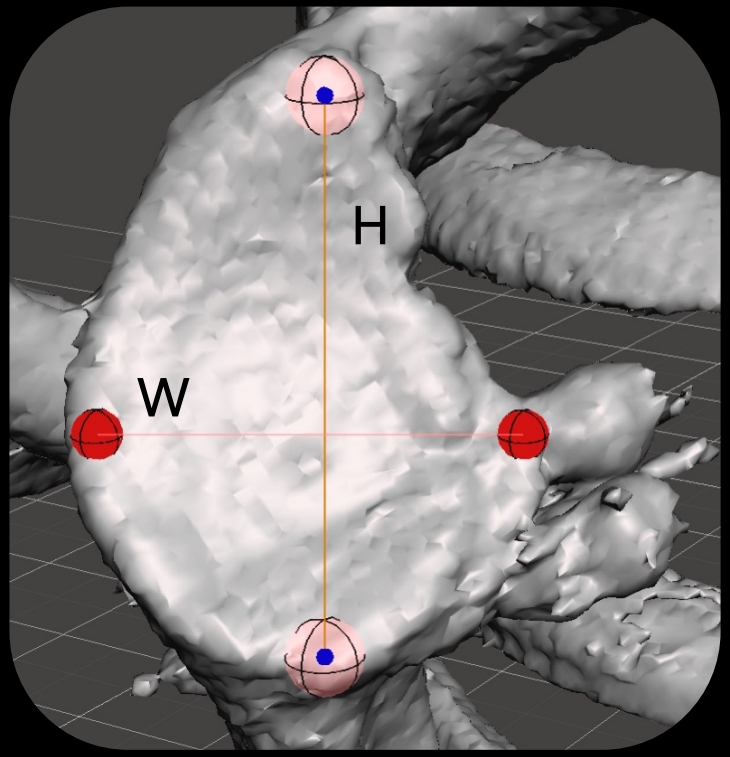
No significant difference between W and pW at ≥6.9-month post-op CT



W=27.58mm; pW=28.00mm
16-month post-op CT follow-up

- Using this cut-off, 65 patients with at least 6.9-month post-op CT showed no significant difference between the average post-op glenoid width (29.4±3.7mm) and predicted glenoid width (28.6±2.6mm) (p=0.099)

- For example, this patient had a 16-month post-op CT and the actual and predicted glenoid widths differed by less than 0.5mm

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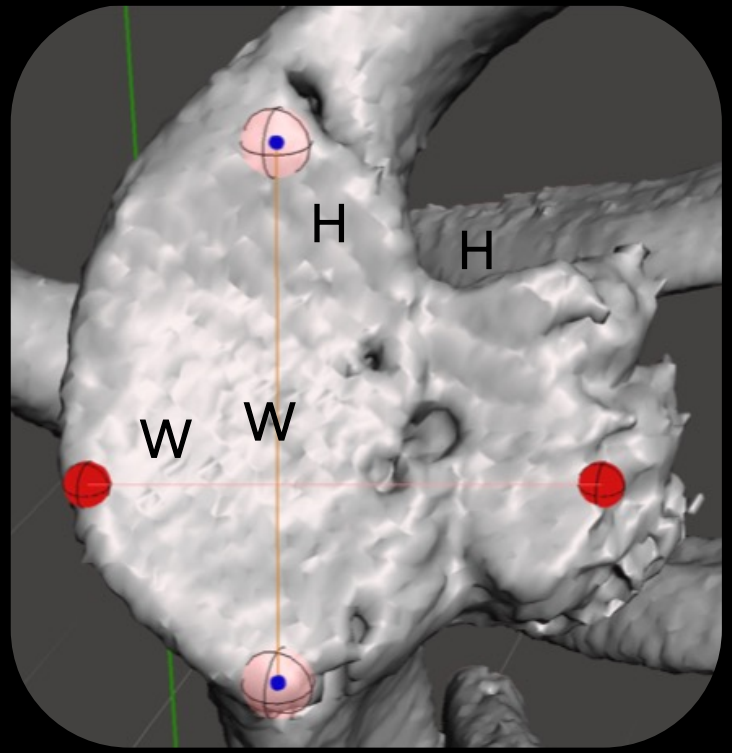
W is significantly greater than pW at <6.9-month post-op CT



W=33.77mm; pW=27.41mm
3-month post-op CT follow-up

- In 44 patients with less than 6.9-month post-op CT the average post-op glenoid width (32.7 ± 3.9mm) was significantly greater than the average predicted glenoid width (28.4 ± 2.3mm) ($p<0.001$)
- For example, this patient had a 3-month post-op CT, and the post-op glenoid width was over 6mm greater than predicted

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Discussion

- These findings help explain the similar degree of resorption at 1- and 2-year post-op following AAGR with DTA that has previously been documented[2]

- The large amount of graft remodeling that occurs during the short-term follow-up period after AAGR could be due to the oversized bone blocks that have been used in this procedure

Arthroscopic Anatomic Glenoid Reconstruction Using Distal Tibial Allograft for Recurrent Anterior Shoulder Instability

Clinical and Radiographic Outcomes

Ivan Wong,*† MD, MAcM, Dip Sports Med,
Rakesh John,† MBBS, MS (Orth), DNB (Orth), MRCS (England), MNAMS, Dip (SICOT),
Jie Ma,† BSc, MES, and Catherine M. Coady,‡ MD
Investigation performed at Queen Elizabeth Health Sciences Center, Halifax, Nova Scotia, Canada

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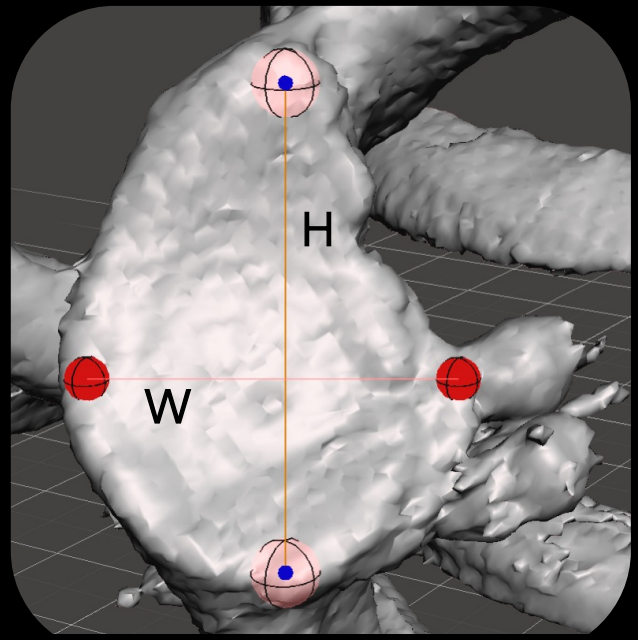
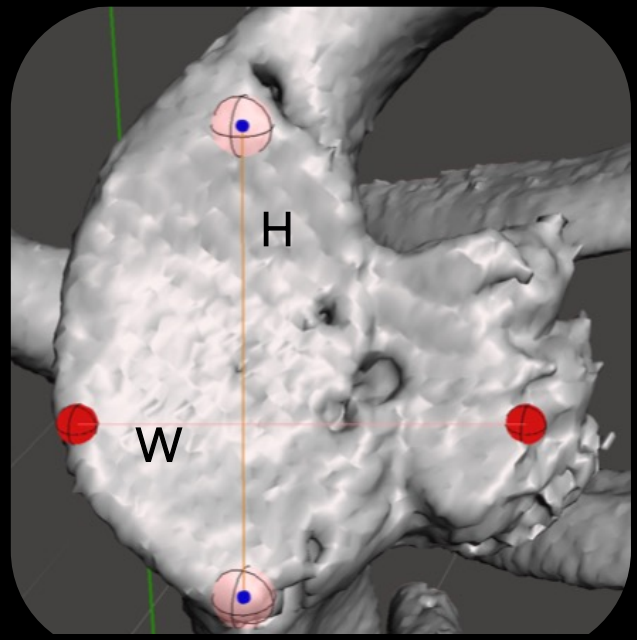
Conclusion

- The native glenoid width is restored after 6.9 months of remodeling following AAGR with DTA using screw fixation, restoring native architecture according to Wolff's Law



≥6.9-month CT; W≅pW



<6.9-month CT; W>pW

- These findings further support the use of AAGR with DTA to treat cases of anterior shoulder instability with glenoid bone loss and will help direct size of bone blocks used in the future
- Strengths: Large number of patients included in the analysis, formula used to calculate predicted glenoid width is ideal for patients with GBL
- Limitations: retrospective study design, single surgeon single center

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