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BACKGROUND

- Glenoid bone loss increases the risk of recurrent shoulder dislocation
- In shoulder instability surgeries, bone loss constitutes a risk factor for inferior clinical outcomes and may be an indication for an osseous augmentation procedure
- While traditionally reserved for patients with percent bone loss (PBL) greater than 25%, more recent studies have suggested that bony augmentation procedures may be considered in lieu of a soft tissue stabilization when glenoid bone loss is greater than 13.5%
- PBL can be evaluated using plain radiographs, MRI, 3D MRI, CT and 3D CT
- In the chord method, a circle drawn over an en face view of the glenoid and a chord is added based on the location of bone loss, and bone loss (B) is calculated using $r^2/2 ([\pi + 180C] - \sin(C))$, and then PBL is calculated using $(B/A) \times 100$ where A is the area of the circle
- In the percent diameter method, a best fit circle is drawn based upon the posteroinferior glenoid contour with $PBL = \text{width}/D \times 100\%$, with D as the max diameter of the circle
- An intraoperative probe method of PBL includes a 3mm probe to approximate bone loss from the central bare area to the anterior (A) and poster (P) rim of the glenoid using $PBL = P-A/P \times 2$
- Finally, the gold standard Pico method uses the contralateral glenoid as a reference comparing best fit circles at the lower glenoid margin, but requires contralateral imaging

PURPOSE

While 3D CT and the Pico method have been previously described as the gold standard in bone loss evaluation, it is unclear how most orthopedic surgeons evaluate for bone loss in their practice. The purpose of this study is to investigate how orthopedic surgeons measure glenoid bone loss.

METHODS

Study Design

- A 16-question survey was sent out to members of AOSSM and AANA to evaluate use of four common methods glenoid bone loss measurement
- The survey investigated surgeon demographic information, relevant surgical volume such as number of instability/osseous augmentation procedures performed per year, and how surgeons evaluate glenoid bone loss. Surgeons were asked what imaging modalities they typically use and how frequently they utilized previously published and validated methods
- A scale of 1 to 5 was used to assess how frequently people used bone loss measurement techniques; 1 representing never, 2 representing rarely, 3 representing occasionally, 4 representing routinely, and 5 representing always

RESULTS

Table 1. Demographic Information of the 172 Orthopedic Surgery Survey Respondants

Years in Practice	Number
< 5	33
5 - 9	36
10 - 14	24
15-19	18
20 - 24	11
25 - 30	18
> 30	11
Subspecialty	Number
Sports Medicine	137
Shoulder Elbow	18
Sport/Shoulder Elbow	10
Sports/Trauma	1
Sports/Peds ports	1
Location	Number
Northeast	44
Midwest	51
South	35
Mountain	17
West Coast	17
Other	4
Practice Setting	Number
Private practice	79
Academic	58
Hospital Based	27
Military	4
Private/Academic	3

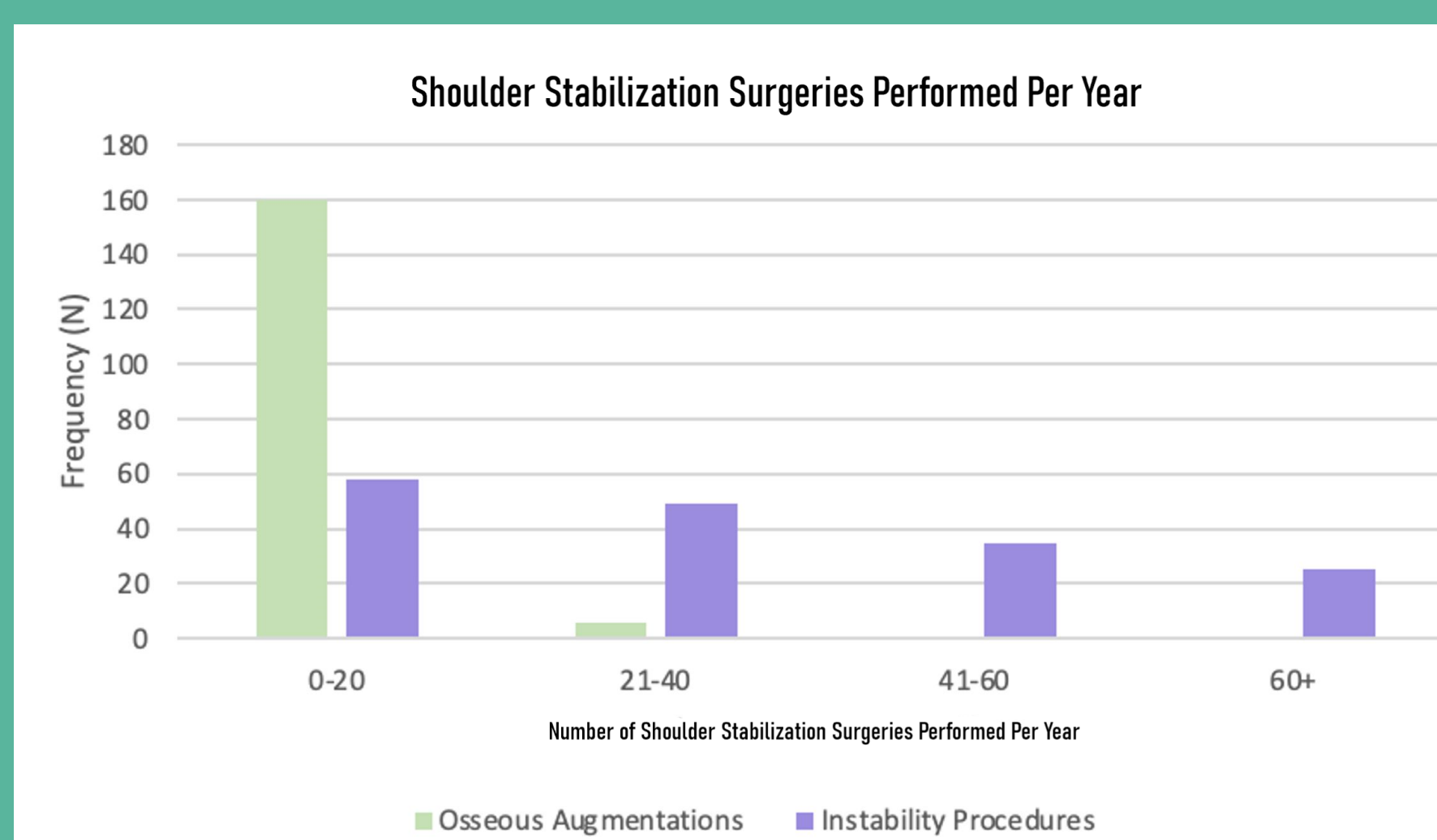


Figure 1. Number of osseous augmentations and instability procedures performed annually.

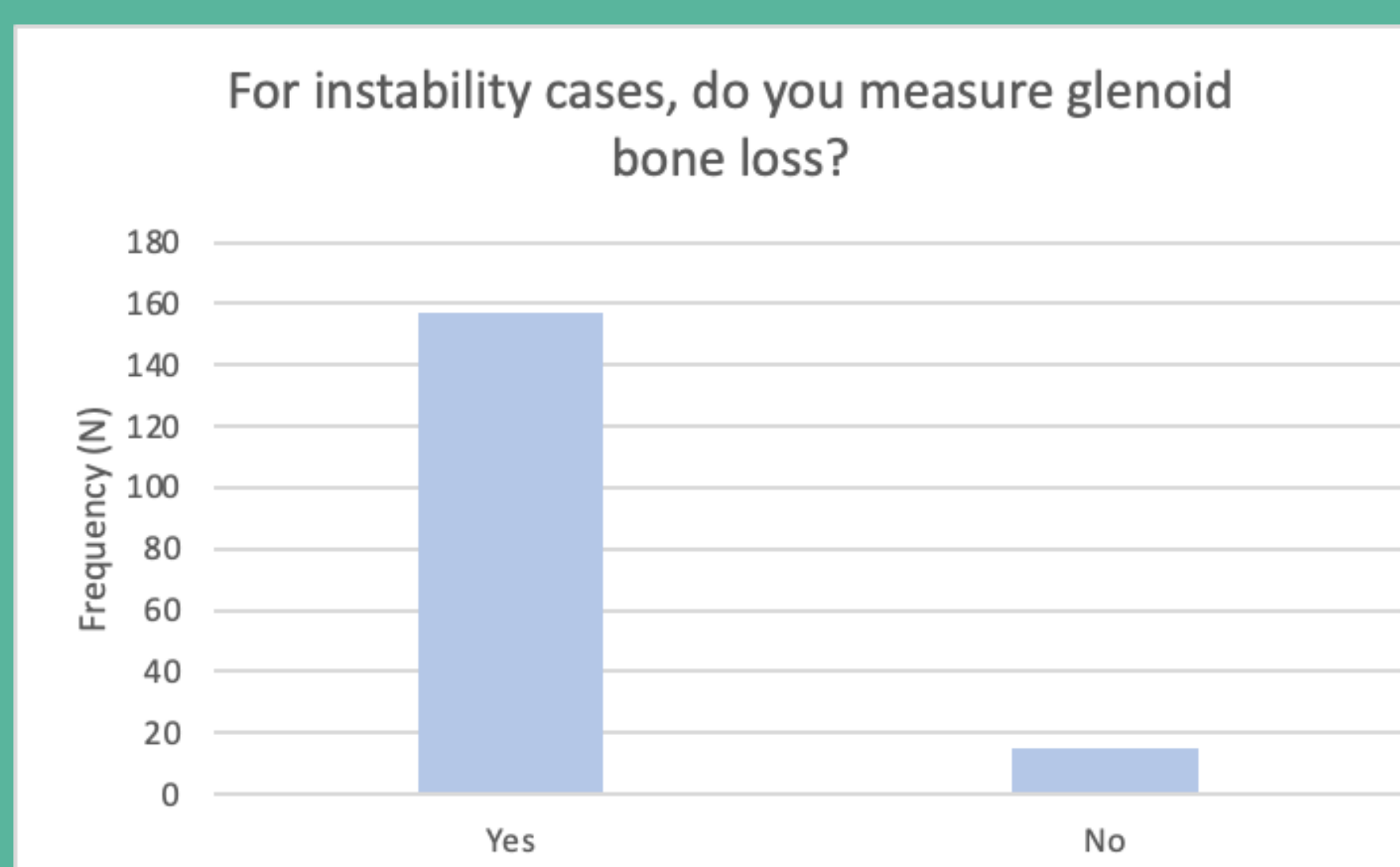


Figure 2. Percent of surgeons who measure glenoid bone loss for instability cases.

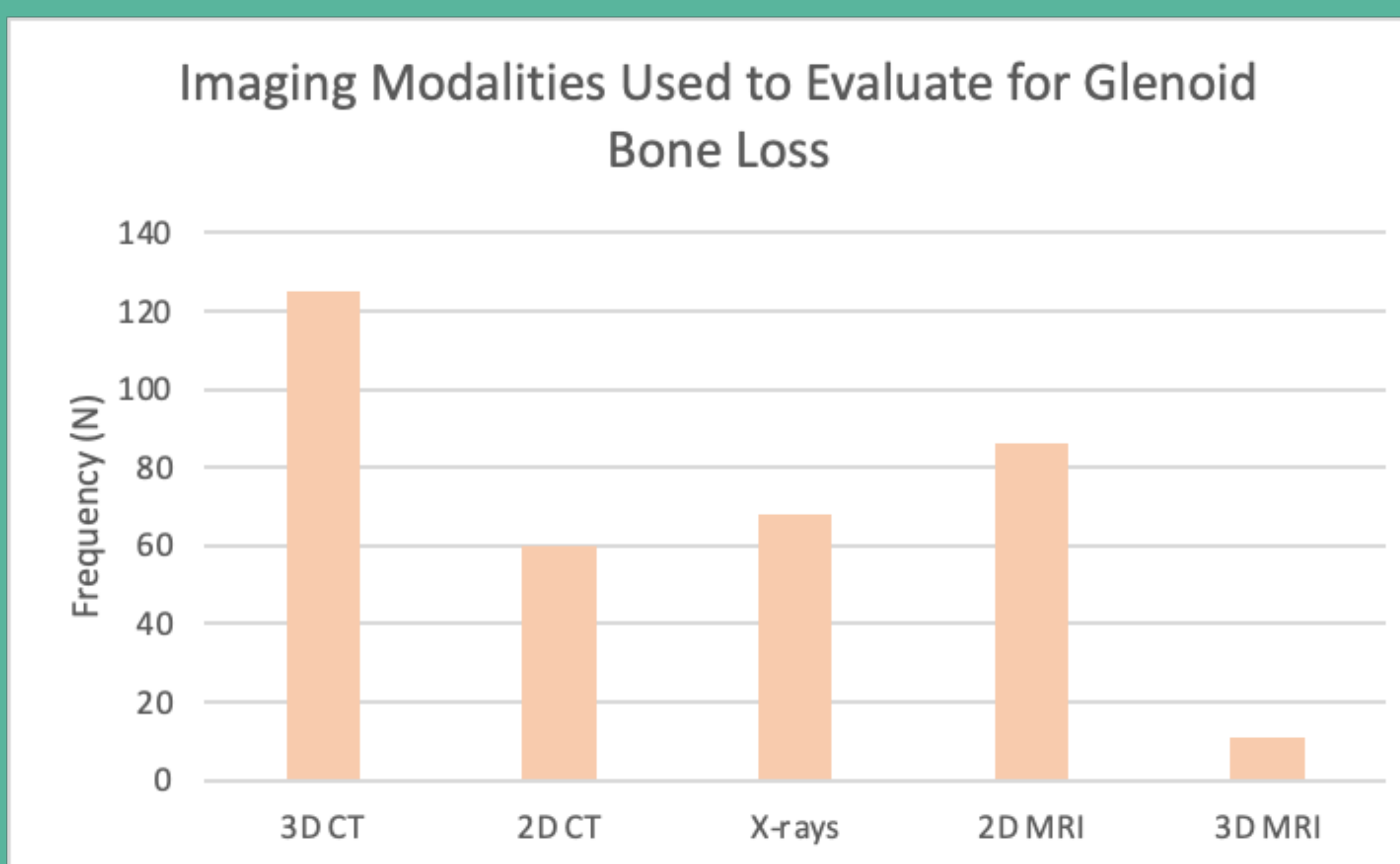


Figure 3. Imaging modalities used by the surgeons to detect glenoid bone loss

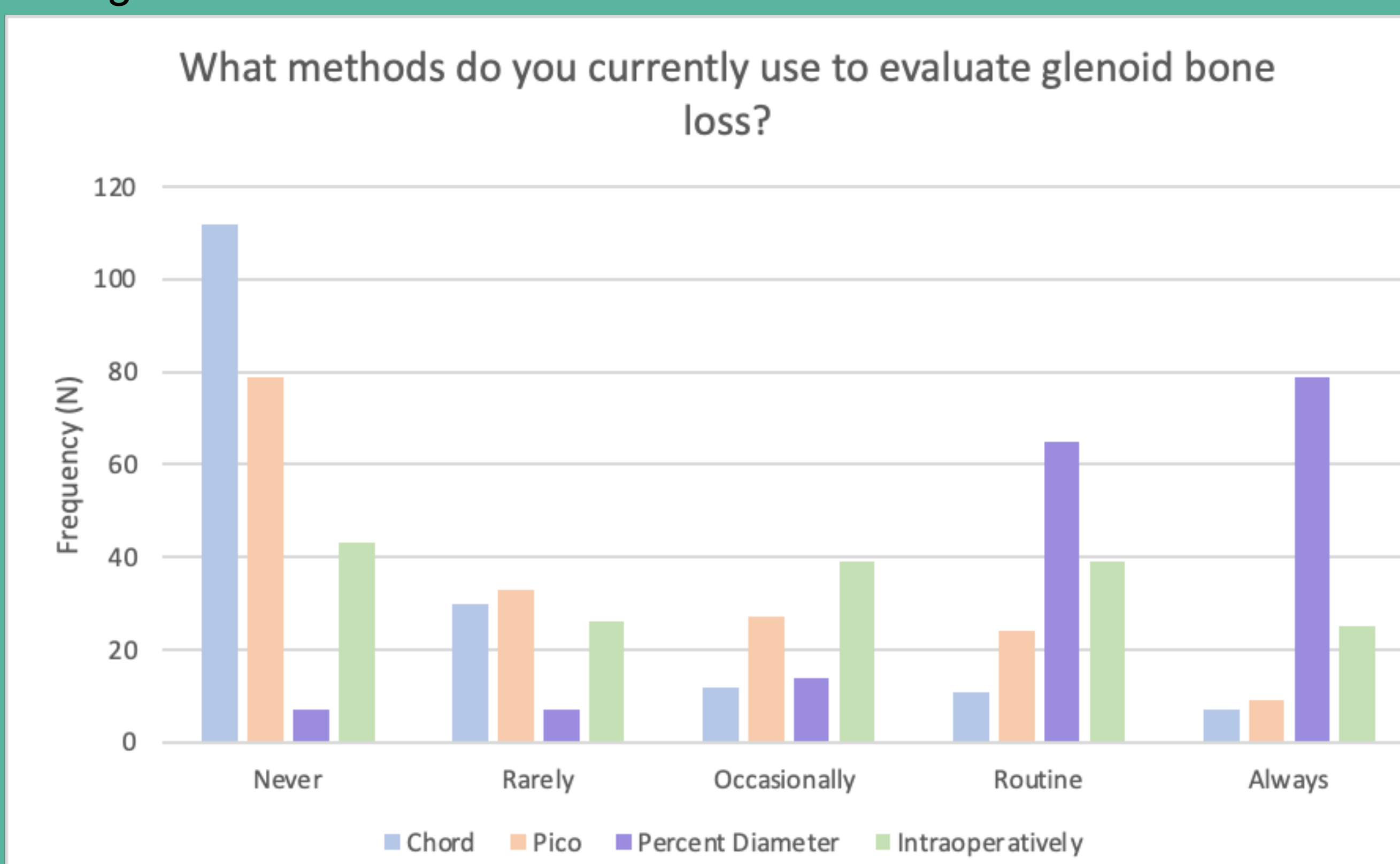


Figure 4. Frequency of each of the four methods (chord length, percent diameter, Pico method, and intraoperative probe method)

RESULTS

- 172 orthopedic surgeons participated in the survey with a mean of 13.4 years in practice from various subspecialties, locations, and practice types as illustrated in **Table 1**
- The mean number of instability surgeries performed each year was 31.2 ± 35 ; arthroscopic soft tissue stabilization 88.12 ± 20.1 percent of the time and osseous augmentation procedures reported as 7.27 ± 7.96 percent of procedures (**Figure 1**)
- 55% of respondents reported performing osseous augmentation procedures when the mean PBL was $17.35 \pm 16.37\%$.
- 91.3% of respondents routinely measure glenoid bone loss (**Figure 2**)
- In response to the imaging modality used to determine severity of bone loss, 3D CT was cited most often (**Figure 3**).
- The most frequently reported method for determining glenoid bone loss was the percent diameter loss method, which was used routinely (mean: 4.2 ± 1.0) (**Figure 4**), followed by the intra-operative probe length method, which was used occasionally (mean: 2.9 ± 1.4). Less frequently used methods included the Pico method, which was used rarely (mean: 2.1 ± 1.3) and the chord length method, which was used never (mean: 1.7 ± 1.1).
- There were no significant demographic factors affecting choice of measurement technique except for a significant relationship between private practice and medical groups using the intraoperative probe method

CONCLUSION

- The results of this study suggests that there is significant inconsistency in how orthopedic surgeons evaluate and measure glenoid bone loss in the setting of shoulder instability, with approximately 10% of surgeons not even routinely measuring glenoid bone loss when dealing with shoulder instability despite clear evidence of its importance on outcomes
- Furthermore, the most scientifically investigated methods for evaluating bone loss (i.e. Pico method and percent bone loss diameter) and are used the most seldom
- It is important to consider the methodology for measurement of glenoid bone loss when applying results of clinical outcome studies to clinical practice, as the misapplication of bone loss estimation techniques may lead to inaccurate methods and a soft-tissue stabilization in a high-risk patient or alternatively an unnecessary osseous augmentation procedure in a lower risk patient
- Future research is necessary to determine what percentage bone loss constitutes "critical" bone loss for surgical decision making using the various techniques, as it likely varies by technique
- Additionally, future research needs to understand the limiting factor for orthopedic surgeons to incorporate validated glenoid bone loss measurements into their practice and to develop new automated methods to improve overall utilization