

A Clinical Comparison of Linear- and Surface Area-Based Methods of Measuring Glenoid Bone Loss: Letter to the Editor

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Dear Editor:

With interest we read the study of Bakshi et al,¹ and we are pleased to see that there is attention for the challenging topic of recurrent shoulder instability and how to determine recurrence risk. We applaud the authors for performing the study called “A Clinical Comparison of Linear- and Surface Area-Based Methods of Measuring Glenoid Bone Loss” to get more insight into this recurrence risk. However, we do have some comments regarding the study design and the clinical relevance of studying isolated glenoid bone loss. The investigators compared linear- and surface-based methods in measuring glenoid bone loss and included patients aged 15 to 58 years. Young age has been identified as an important prognostic factor for the risk of recurrent dislocation.¹⁵ Including patients of young age will introduce bias, as their risk of developing recurrence is already higher than that of older patients. The inclusion criteria should have included patients who were ≥ 18 years to prevent bias.^{2,5}

Moreover, the authors mentioned that for glenoid bone loss approaching 15% to 20% of anterior glenoid surface, a bony augmentation procedure should be strongly considered to reduce failure rates.¹ However, in some groups, the percentage to consider a bony augmentation procedure may even be $< 15\%$.¹¹ These numbers illustrate that there is still a lot of controversy regarding the cutoff values and measuring methods for glenoid bone loss.³ Everyone will agree that glenoid bone loss is an important factor in determining recurrence risk and that these percentages could contribute to determine increased recurrence risk. However, the conclusions presented in the current article have to be drawn in light of these comments. Numerous studies have focused on the correct cutoff values of glenoid bone loss. This raises the question, is this discussion ever going to end, or is there something that we are overlooking and not accounting for, because bone loss is probably not the only factor that plays a role in calculating recurrence risk? Damage to soft tissue and glenohumeral bony structures leads to a mechanical disruption of the shoulder joint, leading to inadequate centering of the humeral head relative to the glenoid.^{13,14} Next to bone loss, neuromuscular control, laxity, muscle strength, and a Hill-Sachs lesion are important factors in this dynamic mechanical disruption as well.^{6,7} Glenoid bone loss is often accompanied by one of

these factors. For example, a Hill-Sachs lesion is present in up to 93% of patients with instability.¹⁶

Achieving consensus with regard to measuring bone loss may be hampered by several other factors as well. Moroder et al⁸ showed that scapular tilt and best-fit circle placement have a significant effect on the calculated glenoid bone loss percentage. Furthermore, glenoid bone loss influences glenoid version, and the bone loss is not always at the same position.^{4,9} It is impossible to account for alterations in glenoid version if we continue using 2-dimensional measuring methods. This inevitably will introduce bias into glenoid bone loss measurements, even though interobserver reliability shows high agreement. In addition, creating a tool to use in clinical practice seems challenging, as these factors are difficult to standardize with the available measurements.

Furthermore, it was shown that not only glenoid bone loss but especially the interplay with the Hill-Sachs lesion is important with regard to recurrent instability.^{5,10} It was suggested that this can be evaluated only in a 3-dimensional dynamic setting.¹² Glenoid bone loss is a convenient predicament parameter, as treating surgeons are able to treat this parameter and restore the bony defect by performing a glenoid bony augmentation procedure. These procedures will remain incredibly valuable in the treatment of shoulder instability and reduction of recurrence risk. However, in our opinion, glenoid bone loss alone is inadequate, and we have to come up with an alternative solution.

In conclusion, glenoid bone loss measurement is difficult to standardize and is not the only factor that is important in determining recurrence risk. Is there a way to bundle these prognostic factors and calculate a recurrence risk? Shoulder instability is not a static problem but a dynamic one. A shoulder dislocation is literally a translation of the humeral head. This translation is visible only in a dynamic setting and is a derivative of the factors that are important to keep the humeral head in place. Three-dimensional measurement techniques offer the opportunity to measure humeral translation. Therefore, we propose (1) to focus on this translation to predict recurrence risk and (2) to consider glenoid to be an important prognostic factor.

Lukas P.E. Verweij, BSc
Derek F.P. van Deurzen, MD
Gino M.M.J. Kerkhoffs, MD, PhD
Michel P.J. van den Bekerom, MD, PhD
Amsterdam, the Netherlands

Address correspondence to Lukas P.E. Verweij (email: l.p.verweij@amc.uva.nl).

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A Clinical Comparison of Linear- and Surface Area-Based Methods of Measuring Glenoid Bone Loss: Response

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Authors' Response:

We appreciate the interest in our work titled "A Clinical Comparison of Linear- and Surface Area-Based Methods of

Measuring Glenoid Bone Loss."¹ The quantification and treatment of glenoid bone loss in patients with recurrent anterior shoulder instability have been examined and debated for years with little consensus reached in the literature. Therefore, we are grateful for the concerns raised by Dr Verweij and colleagues, as it stimulates discussion on an important topic in sports medicine and shoulder surgery. Furthermore, we recognize that there are several limitations to our study, with many of these included in the discussion of our article. In what follows, we address the multiple critiques discussed by Verweij et al.

Bias introduced by age range. Verweij et al presented concern that including patients <18 years old would introduce bias into our study, as younger patients were reported to have higher risk of recurrent instability.⁷ While this would be true if the measured outcome in our study was rate of recurrent instability, age should not introduce bias for the measurement of glenoid bone loss with a surface area or linear method of measurement.

Lack of consensus regarding the cutoff for bony augmentation of glenoid bone loss. Verweij et al discussed the controversy regarding the amount of glenoid bone loss that necessitates bony augmentation, with reports varying between 13.5% and 25%.^{3,4,6} We agree that there is no consensus cutoff of glenoid bone loss requiring bony augmentation, and we believe that the results of our study provide one reason for this. Our study demonstrates that different methods of measurement yield different results and would require different cutoff values. We found that different methods of measurement cannot be used interchangeably and may contribute to the variability in cutoffs reported in the literature.^{3,4,6}

Accuracy/reliability in measurement method. Verweij et al discussed the difficulty in measuring glenoid bone loss owing to variability in the utilized modality. They raised a concern that the use of 2-dimensional computed tomography (CT) does not account for glenoid version influencing the measurement of glenoid bone loss. We agree with this and used 3-dimensional CT as a result. Three-dimensional CT was reported in the literature to be the best modality for measuring glenoid bone loss.² We agree that use of 2-dimensional CT would result in less reliable and less accurate measurement of glenoid bone loss.

Furthermore, they stated that there is significant variation in placement of the best-fit circle, resulting in decreased reliability of glenoid bone loss measurement.⁵ We agree with this, as accurate placement of the best-fit circle is critical to accurate bone loss measurement. We also agree that variation in placement of the best-fit circle can decrease the reliability of glenoid bone loss measurement. However, the interobserver reliability in our study was extremely high (anteroposterior distance from bare area method, .953; Pico method, .969), demonstrating that our measurements are reproducible and reliable.

Other factors important to recurrence in anterior shoulder instability. Verweij et al cited several other factors that are important to the evaluation and treatment of anterior shoulder instability, including the presence of Hill-Sachs lesions, soft tissue damage, laxity, and neuromuscular factors. We completely agree with this, as there are