Editorial Commentary: Glenoid Bone Loss Measurements in Shoulder Instability—Precise but Not Accurate

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Abstract: Glenoid defects are important to consider when choosing the surgical stabilization technique in shoulder instability patients. Several measurement methods to determine the extent of glenoid bone loss have been proposed and their reliability or precision proved. However, it must be considered that these defect extent measurements are only surrogate parameters trying to express the loss of biomechanical stability generated by a glenoid defect, which in fact they do not do accurately. Current defect measurement techniques are either linear based (1-dimensional) or area based (2-dimensional) but do not take into account the 3-dimensional shape of the glenoid concavity, which creates stability by means of the concavity-compression effect. Furthermore, none of the current measurement methods take into account the native glenoid concavity shape, which significantly differs between patients and therefore also affects the biomechanical consequence a glenoid defect generates. To improve the accuracy of current glenoid defect measurement techniques in expressing the loss of biomechanical stability generated by a glenoid defect, measurements should take into account the concave shape of the glenoid (3-dimensional measurements) and account for the baseline shape of the native glenoid (4-dimensional measurements).

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Since glenoid bone loss was first identified in 2000 as a major risk factor for recurrence of instability after soft-tissue stabilization surgery of the shoulder,[1] a respectable number of research articles have been published on different imaging modalities and measurement methods, as well as the threshold value for critical glenoid bone loss. Thanks to scientific efforts, over the years, we have certainly become more precise in measuring glenoid bone loss. The technique has evolved from arthroscopic probe measurements and radiographs to modern 3-dimensional (3D) computed tomography scans, from qualitative descriptions to relative area measurements, and from vague estimations of the critical size to strict thresholds beyond the decimal point. However, we have to keep in mind what we actually want to find out when measuring glenoid bone loss. Indeed, we do not want to know how much bone the glenoid is missing. We actually want to know how much stability a patient has lost owing to the glenoid bone defect to be able to decide whether a typically less invasive soft-tissue stabilization procedure would be enough to treat the patient. Indeed, glenoid bone loss extent measurements in the setting of shoulder instability are a surrogate parameter used to express the biomechanical loss of stability due to glenoid defects.

Why is this distinction important? The main reason is that current glenoid defect extent measurements do not correlate linearly with the biomechanical effect of the defect.[2] The likely reason is the fact that even though current measurement techniques are often performed on 3D images, none of these techniques take into account the third dimension; rather, they involve either linear or area measurements. Because the glenoid generates stability by means of the concavity-compression effect, future measurements of the glenoid defect extent should be 3D measurements and take into account the glenoid concavity as well.

The second reason is that native glenoid shapes vary significantly between patients.[2,3] These shape differences create different levels of baseline stability generated by the native glenoid that obviously also need to be

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taken into account when determining the biomechanical effect of glenoid defects.[2] Therefore, measurements should take into account the concave shape of the glenoid (3D measurements) and account for the baseline shape of the native glenoid (4-dimensional measurements). By doing so, defect extent measurement techniques would become more accurate by more closely resembling the actual loss of biomechanical stability generated by the glenoid defect, which helps to determine whether bony glenoid reconstruction surgery is necessary.

In a sense, the article "Accuracy of Currently Available Methods in Quantifying Anterior Glenoid Bone Loss: Controversy Regarding Gold Standard—A Systematic Review" by Verweij, Schuit, Kerkhoffs, Blankevoort, Van Den Bekerom, and Van Deurzen[4] supports these considerations. The article identified 17 (!) different measurement methods for glenoid bone loss on 6 different imaging modalities. The measurement techniques were compared with each other in the analyzed original studies and mostly showed strong correlations, giving the impression of high accuracy. However, as correctly outlined by Verweij et al. in this systematic review, the accuracy of the measurement techniques cannot be determined because of the lack of a gold standard for defect extent measurements to use as a reference.

According to Verweij et al.,[4] the best available test to measure glenoid bone loss under reasonable conditions should be the gold standard. However, I would take this assertion even further: To be clinically relevant, this gold standard needs to accurately resemble the measure actually important for clinical decision making—the amount of biomechanical stability lost owing to the glenoid defect. To do so, we should consider the concave shape of the glenoid with our measurements and take the baseline shape of the native glenoid into account.

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