Measurement of Ulnar Variance From the Lateral Radiograph: A Comparison of Techniques

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Purpose To determine the reliability of measuring ulnar variance on lateral wrist radiographs and to compare this technique with previously described methods.

Methods Ulnar variance was measured in 100 normal wrist radiographs using the methods of perpendiculars, central reference point, and the lateral radiograph by 3 surgeons on 2 occasions. Intraobserver repeatability and agreement between raters and methods were assessed and compared.

Results Intra- and interobserver reliability and agreement were both excellent using all 3 methods within a ± 1.0-mm cutoff. However, there was substantial pairwise disagreement in measures of ulnar variance between all 3 methods.

Conclusions This study demonstrates that, for measurement of ulnar variance, the methods of perpendiculars, central reference point, and lateral radiographic measurement each have clinically acceptable intraobserver repeatability and interobserver agreement. Despite their independent reliability, each method of radiographic determination of ulnar variance had considerable disagreement with the other methods, indicative of inherent inaccuracies in the techniques. The lateral radiograph uniquely allows for visualization of the amount of ulnar head protruding proximal or distal to the concave lunate facet and allows for a rapid estimation of pronosupination, which is known to affect ulnar variance.

Clinical relevance Determination of ulnar variance can be an important component of surgical decision making in various pathological conditions of the hand and wrist. Traditionally, it has been measured through methods using the posteroanterior wrist radiograph, but there are potential shortcomings with these methods, and use of the lateral radiograph may provide a more clinically relevant picture of ulnar variance. This study shows that measurement from the lateral radiograph provides similar reliability to previously accepted techniques. *(J Hand Surg Am. 2014;39(6):1114–1121.*

Key words Ulnar variance, measurement, radiograph, lateral, comparison.

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ULNAR VARIANCE IS DEFINED as the relative length of the distal ulna to that of the distal radius. The accurate measurement of this length is clinically important because ulnar variance has been implicated in the pathogenesis of multiple disparate wrist pathologies, including Kienböck disease,[1–4] ulnocarpal impaction and impingement syndromes,[5,6] triangular fibrocartilage complex tears,[7,8] carpal instability,[9] and scaphoid fractures and nonunions.[10,11] In addition, a variety of commonly used surgical procedures have been developed to alter the ulnar variance.

Several methods of measuring ulnar variance have been proposed.[12–15] However, none have been universally accepted. Steyers and Blair[16] performed a comparative study between 3 original methods (project-a-line,[2] concentric circles,[12] and perpendiculars[13]) and found that there was minimal clinical difference between the methods and that each was a reliable means to measure ulnar variance. A common attribute of all previously described methods of measuring ulnar variance is that they are performed using the posteroanterior (PA) or anteroposterior radiographs. A potential shortcoming of these techniques is that they fail to account for the concave shape of the lunate facet of the distal radius. Because ulnar variance affects load sharing at the wrist,[17] particularly through the lunate, it is critical that the measurement be a true representation of the actual area of loading and compression of the wrist. In addition, the length relationship of the radius to the ulna is significantly affected by forearm pronosupination. As pronation increases, the radius will shorten relative to the ulna, increasing the likelihood that the wrist will appear as more ulnar positive than it actually is.[18–20] The lateral wrist radiograph addresses these shortcomings by allowing the measurement of ulnar variance to be based on the most proximal portion of the lunate facet of the radius and to provide a rapid means of determining the degree of wrist pronosupination.

The purpose of this study was to determine the reliability of measuring ulnar variance on lateral wrist radiographs and to compare this technique with previously described methods.

METHODS

All wrist radiographs taken over a 3-month span beginning in December 2012 in an urban health care system comprised the initial study set. Institutional review board approval for review of radiographs was obtained prior to the study. Over 700 radiographs were reviewed, and the first 100 radiographs to meet all inclusion criteria were selected.

For inclusion in the study, we required that the radiographs have both PA and lateral views of a skeletally mature subject with no radiological evidence of injury or pathology (current or prior) in the wrist. All radiographs were screened for the quality of wrist positioning in all planes. The PA projection was considered to be of good quality when the groove of the extensor carpi ulnaris tendon was radial to the midpoint of the ulnar styloid or preferably radial to the base of the ulnar styloid.[21] In the lateral projection, the scaphoid-pisiform-capitate relationship of the carpus was required to be present for acceptable imaging, with the volar surface of the pisiform lying between the volar cortex of the distal pole of the scaphoid and the volar cortex of the proximal convexity of the capitate.[15,22] A good quality lateral view also included a collinear relationship of the radius, lunate, capitate, and third metacarpal and overlap of the radius and ulna.

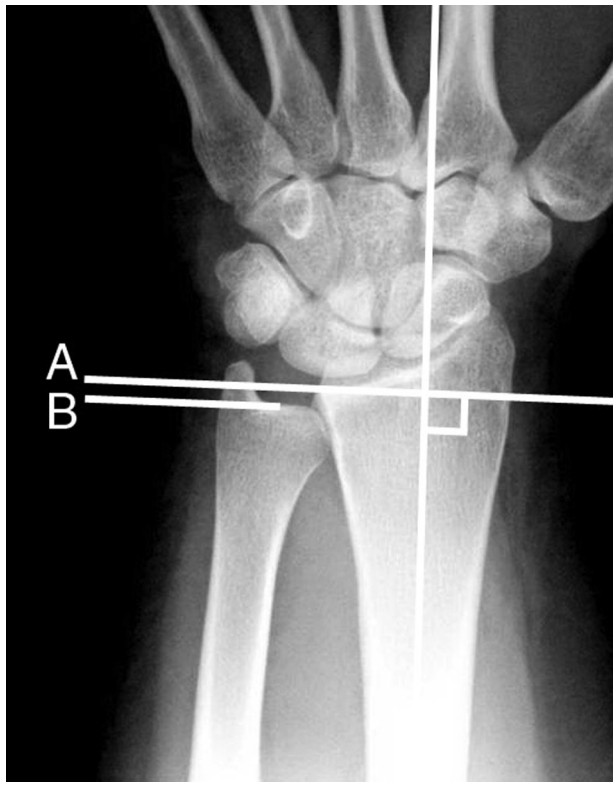

FIGURE 1: Method of perpendiculars. Line A is the line through the ulnar border of the distal subchondral sclerotic radial line, perpendicular to the radial shaft. Line B is the line through the most distal portion of the ulnar head, perpendicular to the ulnar shaft. Ulnar variance is the distance between A and B.

Reasons for exclusion included poor quality of the lateral projection (5%), poor quality of the PA projection (17%), poor quality of both PA and lateral projection (12%), evidence of wrist injury or pathology (43%), skeletally immature (8%), and incomplete wrist series (2%). The ulnar variance of each wrist was then measured independently using 3 separate methods (described later) by 3 surgeons on 2 occasions at least 1 week apart. The precision and accuracy of the Synapse PACS software (Fujifilm, Stamford, CT) used at our institution allowed the measurement accuracy to be set at 0.01 mm. The reviewers were free to use whatever magnification and contrast changes they desired because the measurement tools were calibrated to account for this variability.