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ORIGINAL STUDY

Negative ulnar variance has prognostic value in progression of Kienböck's disease

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The radiographic files of 70 patients with Kienböck's disease were analyzed. Ulnar variance, carpal height and Kienböck stage were determined. A significant difference in ulnar variance was seen between early and late stages of the disease. In later stages there is a marked negative ulnar variance, not caused by bone apposition on the radius. We hypothesize that negative ulnar variance encourages further progression of the collapse of the lunate, while neutral or positive ulnar variance seems to protect the lunate against deformation.

Keywords : Kienböck's disease ; ulnar variance ; wrist ; avascular necrosis.

INTRODUCTION

The relationship between ulnar variance and Kienbock's disease remains controversial. Although some authors have demonstrated that there is no significant difference between the ulnar variance in Kienbock patients and sex and aged-matched control groups (*5,6,9,20,22,26,28,41,45,47*), one cannot simply disregard several previous publications on this subject (*2,14,17,25,29,38,40,49*). The lack of standardized radiographs and proper technique (*12,21,32,39*) and the lack of a non hospitalized sex/age matched control group can be held responsible for some but not all of these contradictory publications. Another hypothesis is that although there is no aetiological link between a shorter ulna and the occurrence of Kienböck, the shorter ulna is responsible for further progression of the disease. With more precise diagnostic tools such as bone scintigraphy and MRI, the diagnosis can now be made earlier. In older publications, clear diagnosis was only possible in stage 2 and 3. Recent papers include a substantial number of stage 1 patients.

The finite element analysis recently reported by Ledoux *et al* (*23*) points in the same direction : negative ulnar variance contributes to further progression of the lunate fracture.

We reviewed a series of radiographs of wrists with Kienbock's disease and measured ulnar variance, carpal height, lunate collapse and scaphoid rotation in correlation with the stage of the disease.

MATERIAL AND METHODS

A series of 70 good-quality anteroposterior radiographs of the wrists in patients with proven Kienböck's disease were analyzed (fig 1). Lateral films were not standardized and could not be used in this analysis. Clinical data were lacking. A sex and age matched control group could not be established.

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Fig. 1. — Different measurements in a typical wrist. (UV = ulnar variance, p = carpal height ; c = capitate length ; l = lunate height, s = scaphoid length).

The ulnar variance was measured according to Gelberman (*14,39*). The carpal height was calculated based on Natrass' method (*30*). Similarly the height of the lunate and scaphoid were normalized by dividing them by the height of the capitate, in order to avoid any differences in size between different examinations. All measurements were made with a hand held measurement device with a precision up to 0.01 mm.

The wrists were staged by the senior author according to Lichtman's classification (*24*).

The group was divided into two distinct subgroups : stage 1 and 2 (without collapse) versus stage 3 and 4 (with collapse).

The ulnar variance, carpal height and lunate height were compared between the two groups.

The groups were further divided between wrists with (stage 3B and 4) and without rotation of the scaphoid (stage 1, 2, 3A). The same measurements were compared.

A Student's t-test was performed, with significance level set at $p < 0.05$.

Table I. — Distribution of the various Kienböck stages

Stage 1	13
Stage 2	26
Stage 3A	14
Stage 3B	15
Stage 4	2

RESULTS

The distribution of the various stages is summarized in table I.

The values of the different measurements comparing the groups without (stage 1 and 3) and with collapse of the lunate (stage 3A, 3B and 4) are summarized in table II. Similar comparisons were made between the groups without rotation of the scaphoid (stage 1, 2, 3A) and with rotation (stage 3B and 4).

A significant difference in ulnar variance was found between group 1 + 2 and group 3 + 4. The non-significant difference in ulnar variance between group 1 + 2 + 3A and group 3B + 4 can be explained by the fact that only 17 patients were included in the latter group and one of them had a severe ulna plus (> 4 mm), which has an important influence on the mean and standard deviation. With removal of this "outlier" wrist, the difference becomes significant. In this group the carpal height was decreased compared to the normal value described by Natrass, i.e. 1.57 ± 0.05 (*30*).

The differences between groups with or without lunate collapse and with or without scaphoid rotation were significant. The same is true for the lunate and scaphoid dimensions (normalized by dividing them by the capitate length).

DISCUSSION

Since Hulten (*17*) described negative ulnar variance (UV) in Kienböck's disease, this became the main point of discussion. Some authors confirmed these findings (*2,14,17,25,29,38,40,49*), others opposed it (*5,6,9,20,22,26,28,41,45,47*). Measuring UV requires a standard X-ray technique with standard positioning of the arm because UV changes with pronation and supination (*21*). A standard technique of measurement is also required. Many techniques were

Table II. — Comparison of the groups without and with lunate collapse. * = significant

	Stage 1 + 2 (N = 39)	Stage 3 + 4 (N = 31)	p value
Ulnar variance	-0.76 (1.44)	-1.96 (2.07)	0.006*
Carpal height	1.34 (0.08)	1.25 (0.12)	< 0.001*
Lunate/capitate	0.36 (0.05)	0.27 (0.06)	< 0.001*
Scaphoid/capitate	0.94 (0.11)	0.84 (0.14)	0.001*

Table III. — Comparison of the groups without and with scaphoid rotation.
* = significant, NS = not significant

	Stage 1 + 2 + 3A (N = 53)	Stage 3B + 4 (N = 17)	p value
Ulnar variance	-1.13 (1.61)	-1.79 (2.41)	0.2 (NS)
Carpal height	1.31 (0.09)	1.23 (0.14)	0.007*
Lunate/capitate	0.34 (0.06)	0.27 (0.06)	< 0.001*
Scaphoid/capitate	0.93 (0.11)	0.79 (0.13)	< 0.001*

described, with comparable results (*12*). Nakamura *et al* found a significant difference between males and females, and an increasing UV with advancing age (*28*). We have reported similar observations (*9,41*).

Negative UV does not appear to be a risk factor for the development of Kienböck's disease (*6,9,28,47*). The good results of joint levelling procedures (*1,3,4,7,8,10,11,13,15,18,19,27,31,33-37,42,43,46,48*) may be attributed to the altered pressure and force transmission rather than to the elimination of a risk factor (*16,44*). The greater negative UV seems to play a role after the development of Kienböck, with more collapse of the lunate if the ulnar compartment is giving less containment. This was already suggested by Ledoux *et al* (*23*) based on experimental work with finite element analysis. This survey is only an indirect method but the trend is obvious : in stages before lunate collapse, there is no significant difference in UV compared to control groups previously reported (*9*) but the UV is significant different in the groups with lunate collapse.

The other values were more or less expected since lunate collapse and scaphoid rotation lead to decreased carpal height, flatter lunates and shorter scaphoids.

Longitudinal observation on the evolution of diseased lunates and their evolution to healing or collapse is mandatory to achieve final validation of this hypothesis.

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