RADIOLOGICAL INVESTIGATION OF RELATIONSHIP BETWEEN LUNATE TYPE AND ULNAR VARIANCE

AHMED ELSAFTAWY

Department of General Surgery, Subdepartment of Limb Replantation, Microsurgery and Hand Surgery, St Hedwig Hospital in Trzebnica
Ordynator: prof. dr hab. J. Jabłecki

Some variances and anatomical proportions of the wrist may contribute to development of avascular necrosis of the lunate. Kienböck’s disease is more often encountered in young males, who suffer, among others, from type II of the lunate (with two joint surfaces for the capitate and hamate) and/or negative variance of ulna in relation to radius.

The aim of the study was to investigate whether there exists interdependence between the simultaneous occurrence of individual types of the lunate with one of the variances of ulna in both genders.

Material and methods. A retrospective analysis of 394 (n=394) radiological tests of the wrist in 174 (44%) women and 220 (56%) males aged 18-83 years (average age 39 years). From the entire pool, 265 X-rays were educed in 104 females and 161 males, and no fractures or wrist instability features were could be observed. The X-rays were obtained from computer lab and archive data base at St Hedwig Hospital in Trzebnica from the beginning of January 2011 to the end of December 2012.

Results. 196 cases (74%) were found with type I of the lunate and 69 cases (26%) with type II. Ulnar variance amounted to from +4.7 mm to –4.2 mm (mean value +0.9 mm). Positive ulnar variance was stated in 44 patients (16.6%), negative in 63 (23.7%) and neutral accounted for the biggest group of other 158 (59.7%) patients.

Conclusions. Neutral variance of ulna is the one that occurs most often in the Polish population. There is no correlation between gender and ulnar variance. There is also lack of direct connection between occurrence of individual lunate types and ulnar variance.

Key words: ulnar variance, lunate types, Kienböck’s disease, avascular necrosis

Anatomical variances such as negative variance of ulna so-called „ulna minus”, excessive „falling out” of the lunate from radial surface or the presence of type II of the lunate may contribute to vascularity disorder and development of avascular necrosis of the lunate (fig. 1, 2). The concept of „lunate at risk” refers to lunate with singular vascularity (dorsal or palmar) without an advanced network of intraosseal vessels and with negative ulnar variance. Variance of ulna is the proportion of joint surface of the radius to ulna. Positive ulnar variance in turn may occur along with the following conditions:

1) scapholunate instability,
2) ulnar impeachment syndrome,
3) triangular fibrocartilage complex injury (TFCC),
4) lunate-triquetral ligament injury.

In addition, the presence of type II of the lunate with two joint surfaces both for the capitate and hamate may be connected to worse vascularity of the bone due to, among others, bigger joint surface, which is not permeated by the vessels.

Injuries like fracture of distal radius, epiphyses of distal bones of the forearm, radial head may also contribute to pathological setting of ulna in relation to radius, this is why this study has excluded patients with injuries of this kind. Position of the patient’s limb is also an important element when defining the ulnar variance. Position with excessive rotation of the wrist may show a false result of positive ulnar variance, and excessive supination of the wrist a false negative variance of
ulna. Correct position for defining ulnar variance should take into account 90° shoulder abduction, 90° flexion in ulnar joint with neutral position of the wrist with palmar side directed towards the X-ray cassette (1, 2, 3).

MATERIAL AND METHODS

Analysis of 394 (n=394) radiological tests of the wrist in 174 (44%) females and 220 (56%) males aged 18-83 years (average age 39 years). From the entire pool of radiological examinations there were distinguished 265 X-rays in 104 females and 161 males, which didn’t show any fractures or wrist instability features in order to eliminate a possibility of mistake in estimation of ulnar variance. These examinations were carried out based on archive sources and computer database at St Hedwig Hospital in Trzebnica. The tests were conducted at hospital lab from the beginning of January 2011 to the end of December 2012. These were patients admitted both in emergency mode as well as at hospital outpatient hand surgery clinic. The examinations were carried out both with 90° shoulder abduction and at 90° flexion of the ulnar joint with forearm in neutral rotation. Estimation of ulnar variance (proportion of joint surface of the radius to ulna) was done based on linear technique—distance between the line running from ulnar edge of joint surface of the radius in the direction of ulnar bone, and joint surface of ulna (fig. 3). However this technique shows a small proportion of mistake that amounts to approximately 0.6 mm (4), that is why in order to minimalize the possibility of mistake in the results, as neural variance are considered the results within the limits from –1 to +1 mm.

Evaluation of the lunate was done based on visible joint surfaces for the capitate and hamate (fig. 4, 5). Statistical tests were carried out in order to examine possible dependencies between gender, lunate type and ulnar variance.

RESULTS

Radiological tests of the wrist were performed in 104 females (~40%) and 161 males (~60%). Type I observed in 196 cases (74%) (one joint surface for the capitate) and 69
cases (26%) with type II of the lunate (with two joint surfaces for the capitate and hamate). Ulnar variance amounted from +4.7 mm to –4.2 mm (mean value +0.9 mm). Positive ulnar variance was identified in 44 patients (16.6%), negative in 63 (23.7%), and neutral variance was observed in the biggest group of 158 (59.7%) patients.

The table below includes results of examining dependencies between lunate type and ulnar variance.

For the table above a Chi-squared test was conducted, its p-value of 0.8404 does not allow for rejecting the null hypothesis on independence between gender and ulnar variance. Therefore there is lack of statistically significant dependence between gender and ulnar variance. In the table below there are listed results of investigating dependencies between lunate type and ulnar variance.

For the table above the Chi-squared test was also performed. p-value of 0.35 does not allow for rejecting the null hypothesis saying that there is no dependence between lunate type and ulnar variance. The dependency is thus random. Figure 6 shows the occurrence of lunate type II in single ulnar variances.

DISCUSSION

Searching for a relationship between the co-existence of negative lunate variance and type II of the lunate is not coincidental. Radiological changes occurring in Kienböck's disease (avascular necrosis of the lunate) are more frequent among others with these anatomical variations of the wrist (5-8). A more frequent co-existence of negative lunate variance with the type II of the lunate increases the risk of incidence of the illness, which most often affects young males at productive age. Only early diagnosis and treatment (in early stages of the disease- up to IIIA°) may guarantee very
good long-term results (9, 10, 11). Changes in Kienböck's disease may be visible on a regular X-ray as early as from II degree of disease advancement based on Lichtman (1, 2, 7, 11). Non-typical pains of dorsal, central part of the wrist may occur much earlier. Knowledge of anatomical variances of the wrist, typical of Kienböck's disease may turn out to be very helpful in „detecting” the disease in its early stages, when the image of avascular necrosis may be visible only when performing MRI test (12, 13). As far as examining the ulnar variance alone, either in publications that study anatomical variances of the wrist or in works concentrating on characteristics of Kienböck’s disease, the literature is more than abundant. Ulnar variance average in these publications, among different populations ranged from −0.84 mm to +0.83 mm (14-21). Most authors exploring ulnar variance in Kienböck’s disease paid most attention to negative variance, where values were contained within the range from −3.1 mm to −1.22 mm. That is why results not exceeding the range −1 to +1 mm became considered as neutral variance in order to reduce the risk of mistake (22-26).

Literature is however very poor as far as works exploring the co-existence of both negative ulnar variance with type II of the lunate (27) are concerned; in the above-mentioned publications, this work included, statistically there is no difference in the simultaneous occurrence of type II of the lunate and negative lunate variance. In order to exclude false results of ulnar variance, a correct position of the patient during radiological examination of the wrist ought to allow for the 90º flexure of ulnar joint with forearm positioned in neutral rotation. Despite the lack of statistically significant difference in occurrence of any of the lunate type with individual ulnar variances, in half of the cases negative lunate variance co-occurred along with second type of the lunate. These are patients who need to be given special attention because „theoretically” they may be more prone to contracting the disease (3, 7, 9).

**CONCLUSIONS**

1. Neutral variance of ulna is the most frequently occurring one.
2. There is no correlation between gender and ulnar variance.
3. There is also no direct connection between occurrence of individual types of the lunate and ulnar variance.
4. Type I of the lunate is the most frequent.

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