Full length article

JHS(E)

The Journal of Hand Surgery
(European Volume)
38E(5) 496–499

DOI: 10.1177/1753193412469173
jhs.sagepub.com
SAGE

The association of Kienböck's disease and ulnar variance in the Iranian population

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Abstract
We retrospectively determined the distribution of ulnar variance in 60 patients with Kienböck's disease. We also measured the ulnar variances in 400 standard wrist radiographs in the normal adult population. The mean ulnar variance of the Kienböck's group was –1.1 mm (SD 1.7) and the mean ulnar variance of the general population was +0.7 (SD 1.5), which was significantly different. In the Kienböck's disease group there were 38 (63%) with ulnar negative, 16 (27%) neutral and six (10%) with ulnar positive variance. The preponderance of ulnar negative variance was statistically significant. There was an association between ulnar negative variance and the development of Kienböck's disease in this study.

Keywords
Kienböck's disease, lunatomalacia, avascular necrosis, ulnar variance

Date received: 17th August 2012; revised 29th October 2012; accepted 31st October 2012

Introduction

The aetiology of Kienböck's disease is still not clear and probably is multifactorial. Ulnar negative variance is the most mentioned risk factor for the development of Kienböck's disease (Dias and Lunn, 2010; Lluch and Garcia-Elias, 2011). Ulnar variance is defined as the difference between the lengths of the radius and ulnar at the distal radioulnar joint and radiocarpal joint (Beredjiklian, 2009). Hultén (1928) observed that 78% of 23 patients with Kienböck's disease had an ulnar negative variance. There were no cases of ulnar positive variance in Hultén's series (Chen and Shih, 1990; Hultén, 1928). However the disease has been reported in East Asian patients with ulnar positive variance (Bonzar et al., 1998; Nakamura et al., 1991b, 1993), which is a rare occurrence in Caucasians (Schuind et al., 2008).

Several authors from different areas around the world, including the USA, Europe, South Africa and East Asia have presented contradictory opinions about the probable association of ulnar negative variance and Kienböck's disease (Beckenbaugh et al., 1980; Bonzar et al., 1998; Chan and Huang, 1971; Chen and Shih, 1990; D`Hoore et al., 1994; Gelberman et al., 1975; Kristensen et al., 1986; Mennen and Sithebe, 2009).

The purpose of this study was to establish the distribution of ulnar variance in Iranian patients diagnosed with Kienböck's disease, to compare it with a group from the normal general Iranian population, and to find out whether there was a relationship between ulnar negative variance and Kienböck's disease in our patients.

Methods

This study included two groups. In the first group we retrospectively reviewed the radiographs and medical records of 60 consecutive patients with Kienböck's disease who had been treated in our department between 2002 and 2011. The diagnosis of avascular necrosis of the lunate was based on plain radiographs. There were 35 (58%) men and 25 (42%) women with mean age of 26.7 years (SD 8.2). All were in stage II (increased density of the lunate) or stage III (collapse and fragmentation of the lunate) of

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Table 1. The distribution of ulnar variance (mm) among 400 controls from the normal adult Iranian populations and 60 Iranian patients with Kienböck's disease

Ulnar variance (mm)	Number among the 400 from the normal population	Number among 60 Kienböck's disease cases
+6	2	0
+5	3	0
+4	8	2
+3	29	0
+2	67	2
+1	75	2
0	160	16
–1	32	8
–2	21	20
–3	2	7
–4	1	3
Mean	+ 0.7 (SD 1.5)	–1.1 (SD 1.7)

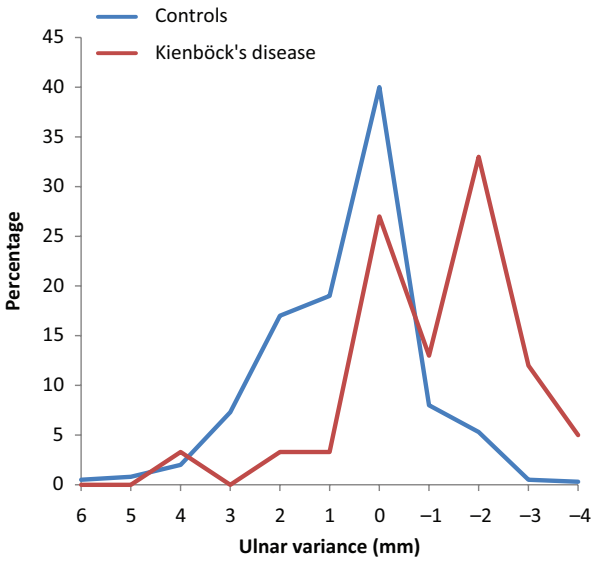

Figure 1. The percentage distributions of ulnar variance in patients with Kienböck's disease and the control group.

Lichtman's classification. The radiographs were taken in a wrist neutral position. The right side was affected in 30 patients and the left side was affected in 30 patients. For the second group, we collected 400 standard wrist radiographs of the normal adult population from our hospital outpatient clinic. The radiographs were taken for purposes other than this study. The following criteria were used in collecting the radiographs: age range between 20 to 40 years, because most reported cases of the Kienböck's disease are between 20 to 40 years old (Beredjiklian, 2009); the distal epiphyseal plates of the ulnar and radius had already closed; there was no historical and radiological evidence of previous injury or infection of the hand, wrist, forearm and elbow; and there was no evidence of any generalized musculoskeletal disorders (Chan and Huang, 1971; Chen and Shih, 1990; Kristensen et al., 1986). The institutional review board approved the study and informed consent was obtained from those in the control group to use their radiographs for the current study.

Standard posteroanterior wrist radiographs were obtained with shoulder abducted 90°, the elbow flexed 90° and the forearm in neutral position. A total of 208 (52%) radiographs were from the right side and 192 (48%) radiographs were from the left side. A total of 286 (72%) radiographs were from men and 114 (29%) were from women. The mean age was 28.9 years (SD 6.2). No significant differences were detected in age and sex in the control group.

The variance in millimetres was measured between a line drawn from the ulnar side of the articular surface of the distal radius to the ulna and the carpal surface of the ulna (Beckenbaugh et al., 1980; Gelberman et al., 1975; Steyers and Blair, 1989). The measurements were done by a ruler and could be made to an accuracy of 1 mm. Ulnar variance was classified by Hultén's classification: positive variance, the ulna was longer than the radius; negative variance, the ulna was shorter than the radius; neutral or zero, the ulnar length was equal to the radial length.

We used Student's *t*-test and the Chi-square test to compare the data in the two groups. *P* values less than 0.05 were considered to be statistically significant.

Ethical approval given by the Ethical Committee and Research Review Board of Urmia University of Medical Sciences.

Results

Table 1 and Figure 1 represents the distribution of the ulnar variances among the 60 patients with Kienböck's disease and in the 400 from the normal general population.

The mean ulnar variance of the Kienböck's disease group was –1.1 mm (SD 1.7) and the mean ulnar variance in the general population was +0.7 (SD 1.5). The difference between the frequencies of the ulnar variances between the two groups was statistically significant (Chi-square test, $p < 0.001$). The difference between the means of the ulnar variances between the two groups was statistically significant (Student *t*-test, $p < 0.001$).

There were 38 (63%) with ulnar negative, 16 (27%) with neutral and six (10%) with ulnar positive variance

Table 2. Relationships between ulnar negative variance and Kienböck's disease from different geographic regions

Authors	Number of Kienböck's cases	Number in normal control group	Geographic region	Association between ulnar negative variance and Kienböck's disease
Beckenbaugh et al. (1980)	42	—	USA	Positive
Bonzar et al. (1998)	44	99	USA	Positive
Chan and Huang (1971)	—	400	Hong Kong	Negative
Chen and Shih (1990)	18	1000	Taiwan	Positive
D`Hoore et al. (1994)	52	125	Belgium	Negative
Gelberman et al. (1975)	15	419	USA	Positive
Hultén (1928)	23	400	Sweden	Positive
Kristensen et al. (1986)	47	100	Denmark	Negative
Mennen and Sithebe (2009)	23	—	South Africa	Negative
Nakamura et al. (1991a)	41	325	Japan	Negative
Thienpont et al. (2004)	54	126	Belgium	Negative
Tsuge and Nakamura (1993)	41	66	Japan	Negative
This study	60	400	Iran	Positive

in the patients with Kienböck's disease and the preponderance of ulnar negative variance was statistically significant (Chi square test, $p = 0.027$).

There was a preponderance of ulnar positive variance among the control group; there were 56 (14%) with ulnar negative, 160 (40%) neutral and 184 (46%) with ulnar positive variance. Ulnar variance had no correlation with age or sex in the control group.

There was an association between ulnar negative variance and Kienböck's disease in this study (Chi-square test, $p < 0.001$).

Discussion

The association of Kienböck's disease and ulnar variance seems to vary between nationalities and countries (Table 2). Chung et al. (2001) concluded that there was insufficient data to support a significant association between ulnar negative variance and Kienböck's disease, based on their meta-analysis of three studies. However, there was a trend toward significance in their study.

We reviewed the data from Sweden, Hong Kong and Taiwan to determine the mean ulnar variance in the normal population (Chan and Huang, 1971; Chen and Shih, 1990; Hultén, 1928). The mean ulnar variance in our study was + 0.7 mm (SD 0.07). This is similar to the results of Chan and Huang (1971) from Hong Kong (+0.67 mm) and from Gelberman et al. (1975) in black Americans (+0.7 mm), but differs from the studies of Chen and Shih (1990) in Taiwan (+0.31 mm), Gelberman et al.(1975) in white Americans (+0.27 mm) and Hultén (1928) in Swedes (–0.06 mm).

A radioulnar difference of –2 mm or more is considered to be clinically significant (Chan and Huang, 1971; Chung et al., 2001; Gelberman et al., 1975; Hultén, 1928). There were 24 (6.1%) ulnar variances that were ≥–2 mm among the normal controls in our study; this is similar to the results of Chen and Shih (1990) (6%), Chan and Huang (1971) (6.3%) and close to the 7.8% in Hultén's (1928) study. However, our results differ from the 9% for US blacks and 13.2% for US whites in the study of Gelberman et al. (1975). These results show that racial differences may affect the ulnar variance in different populations. Gelberman et al. (1975) reported that the average ulnar variance was more positive in normal black Americans than in white Americans and the difference was statistically significant.

A negative ulnar variance has been considered to be a risk and prognostic factor in Kienböck's disease (De Smet, 1994; De Smet and Degreef, 2009; Goeminne et al., 2010; Raven et al., 2007). Ulnar variance has also been considered as an important factor for choosing a surgical procedure to treat Kienböck's disease (Lichtman et al., 2010). However, ulnar variance may change with age, sex and position of the wrist (Bonzar et al., 1998; Kim et al., 1995; Nakamura et al., 1991a). It has been suggested that increasing age has an influence on ulnar variance in patients with Kienböck's disease. This observation is explained by the occurrence of subchondral thickening and osteoarthritis of the radius secondary to Kienböck's disease that produces an appearance of ulnar negative variance (Bonzar et al., 1998; Kristensen et al., 1986; Nakamura et al., 1991a). Several authors around the world have questioned the importance of the ulnar negative variance in Kienböck's disease (Chan and

Huang, 1971; Kim et al., 1995; Kristensen et al., 1986; Nakamura et al., 1991a). The findings of this study support the hypothesis that there may be an association between the ulnar negative variance and development of Kienböck's disease.

Funding

This work was supported by Urmia University of Medical sciences [grant number 82 on 10 April 2012.].

Conflict of interests

None declared.

Ethical approval

Ethical approval given by the Ethical Committee and Research Review Board of Urmia University of Medical Sciences.

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