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Investigation of Risk Factors for the Carpal Tunnel Syndrome in Healthy Young Population

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Abstract: In this study, it was aimed to investigate the prevalence of CTS (Carpal Tunnel Syndrome) risk factors in the young population by studying in Cukurova University Faculty of Medicine. For this purpose, 300 students (150 males and 150 females) aged between 18 and 25 years studying at Cukurova University Faculty of Medicine were evaluated for hand and wrist. Hand and wrist measurements of the students were made by using digital caliper. These measurements include wrist depth, wrist width and palm length. Depending on these measurements, the wrist rate and the wrist palm ratio were calculated. SPSS 20.0 program was used for statistical analysis. When all individuals were evaluated together, a statistically significant difference was found in terms of wrist width, wrist depth, palm length and wrist palm ratio by gender ($p < 0.001$). The wrist rate does not show a statistically significant difference between men and women. In this study, we investigated the risk factors of CTS. It is thought that the study findings obtained by investigating the risk factors of CTS will contribute to the evaluation of the prevalence of CTS in a active young population.

Key words: Risk Factor · Wrist · Wrist Palm Ratio · Wrist Ratio

INTRODUCTION

The hand is an organ that can be injured in most industrial accidents. Some anthropologists have stated that the human hand is instrumental in the human brain's current state and over-development [1, 2]. It can be said whether the individual is prone to CTS by looking at some ratios in the hand and wrist. Wrist ratio and wrist palm ratio are above certain values poses a risk for CTS [3-7].

CTS is a very common upper extremity entrapment neuropathy. Most cases of CTS are idiopathic. In some cases, CTS may occur due to obesity, pregnancy, thyroid dysfunction, osteoarthritis, rheumatoid arthritis and wrist fractures. Age, sex and body mass index are risk factors for CTS. There are also anthropometric properties that pose a risk. Some of these anthropometric features are the wrist ratio and the palm ratio of the wrist [8, 9].

The aim of this study was to investigate the prevalence of CTS factors in Turkish young population and to evaluate the relationship between carpal tunnel risk factors. The data obtained in our study will provide a guide for all kinds of designs by determining the hand and wrist structure of healthy young population. Moreover, it is hoped that the results of the research can be used to increase the probability of success of surgical interventions by determining the normal values of the hand and wrist.

MATERIALS AND METHODS

In this study, hand measurements were performed in 150 male and 150 female population between 18-25 years of age from Cukurova University Medical Faculty students. In order to make measurements in individuals, the approval of the Non-Interventional Clinical Trials Ethics Committee was obtained. Before the measurements, 'Informed Consent Form' was signed. It was taken into consideration that there were no diseases (rheumatoid arthritis, uremia, amyloidosis, vascular abnormalities and tendonitis) that could cause CTS (Carpal Tunnel Syndrome). Information about demographic characteristics was obtained from individuals. The measurements of the students were taken when the individual was in the sitting position,

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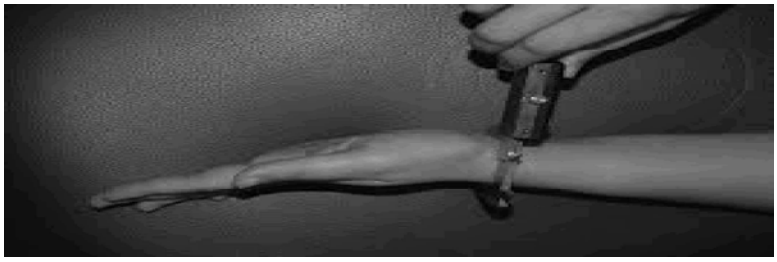

Fig. 1: Hand wrist depth measurement.

Fig. 2: Wrist width measurement.

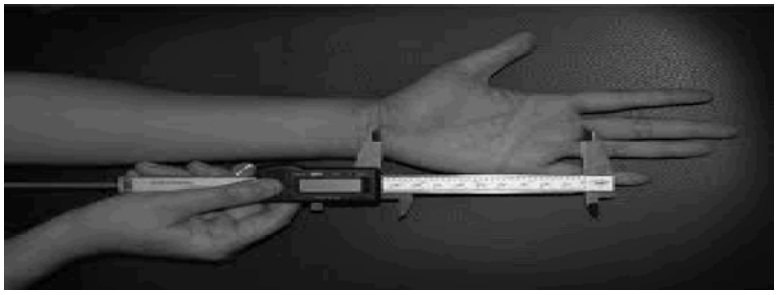

Fig. 3: Palm length measurement.

the elbow was 90 flexed and the hands were in the loose position. A single researcher using a sliding digital caliper (Fig. 1, 2, 3) made all measurements.

Commonly measured using a digital caliper, wrist and hand anthropometrics, include: (i) wrist width: maximum distance at the level of the distal flexor wrist crease; (ii) wrist depth: anterior-posterior depth at the level of the distal flexor wrist crease; (iii) palm length: distance between the distal flexor crease of the wrist to the proximal crease of the middle finger [10]. Depending on these measurements, the wrist ratio (wrist depth / wrist width) and wrist palm ratio (wrist depth/ palm length) were calculated. Body mass index is calculated by dividing weight (kg) by height (m^2).

Statistical Analysis: For statistical analysis of the data obtained from the study, "Statistical Package for Social Sciences for Windows 20.0" program was used. Descriptive statistical methods (mean, standard deviation and percentage) were used for the evaluation of the data. Pearson correlation coefficient is used to evaluate the linear relationship between two continuous variables. The strong or weak relationship is expressed in the magnitude of the correlation coefficient. If the value is 0.00 - 0.25, it shows very weak correlation, 0.25 - 0.50 indicates moderate correlation, 0.50 - 0.75 indicates strong correlation and 0.75 - 1.00 shows very strong correlation [11]. Independent samples t test was used to compare the quantitative data between the groups and chi-square test was used to evaluate the qualitative data. Results were evaluated at 95% confidence interval. $p < 0.05$ was considered statistically significant.

Ethical Consideration: In order to make measurements in individuals, the approval of the "Non-interventional Clinical Research Ethics Committee" and permission from the Cukurova University Faculty of Medicine, the study to be conducted, was obtained. " Informed Consent Form " was signed to the individuals before the measurements.

RESULTS

Hand measurement values of 300 students (150 males, 150 females) who participated in our study were recorded on pre-prepared forms. Of 150 men, 125 were right-handed and 25 were left-handed; Of the 150 women, 140 were recorded as right hand and 10 as left hand dominant. The measured and calculated values of the participants were given in Tables 1, 2, 3 and 4.

DISCUSSION

CTS is affected by many factors such as age, sex, body mass index, diabetes mellitus, anthropometric characteristics and occupation. CTS has been studied in various occupational groups. In these studies, the profession of the individual was found to be associated with CTS [12-15]. Some anthropometric data on hand and wrist were found to be related to CTS. The two most important of these are the wrist ratio and the palm ratio [10, 16-18]. As can be seen in Table 2, in this study, the wrist width, wrist depth, palm length and wrist palm ratio values were found to be significant in favor of women when compared with the independent t test.

In various studies [7, 17, 19], it was reported that the wrist ratio above 0.7 and the wrist palm ratio above 0.342 are a risk factor for carpal tunnel syndrome. Komurcu *et al*. [20] noted that the body mass index had a positive correlation between age and waist circumference and a weak positive correlation was found between body mass index and wrist ratio and a moderately positive correlation between body mass index and wrist palm ratio.

Similarly, our study showed a good positive correlation of wrist depth with both wrist ratio and palm ratio as showed by El-Emary [21].

In a study of 858 hands in 429 people, it was stated that body mass index is the most important risk factor for CTS and wrist ratio is also a risk factor for body mass index [14]. A moderate similar positive correlation was found between wrist ratio and body mass index and a moderate positive correlation was found between wrist palm ratio and body mass index.

In the study investigating the incidence of CTS in the American army, they found that the incidence value was 3.98 per 1000 people and that women had a higher incidence of CTS than men [22]. These values coincide with our findings.

Table 1: General distributions of the anthropometric measurements of the participants

Measurements	n	Median±SD	Minimum	Maximum
Length (m)	300	1.71±0.089	1.52	1.92
Weight (kg)	300	68.4±15.6	43	150
Body Mass Index	300	23.0± 4.2	16.2	50.7
Wrist Depth (mm)	300	37.2±4.1	29.0	56.1
Wrist Width (mm)	300	53.3±4.52	34.50	69.1
Length of palm (mm)	300	103±7.3	85.1	122.6
Wrist Ratio	300	0.69±0.058	0.56	0.89
Wrist/Palm Ratio	300	0.36±0.032	0.245	0.470

Table 2: Comparison of the mean values of wrist depth, wrist width, palm length, wrist ratio and wrist palm ratio of the participants in the study with independent t test

Measurements		Mean±SD	p
Wrist Depth (mm)	Male	34.9 ±3.48	<0.001 *
	Female	39.6 ±3.40	
Wrist Width (mm)	Male	50.1 ±3.11	<0.001 *
	Female	56.5 ±3.34	
Length of palm (mm)	Male	97.8 ±5.07	<0.001 *
	Female	108.1 ±5.42	
Wrist Ratio	Male	0.68 ±0.056	0.092
	Female	0.69 ±0.06	
Wrist/Palm Ratio	Male	0.354 ±0.031	<0.001 *
	Female	0.366 ±0.032	

*Correlation is significant at the 0.05 level.

Table 3: Pearson correlation values of anthropometric measurements of height, weight and body mass index (BMI)

Measurements	Length (m)	Weight (kg)	BMI
Length (m)		r= 0.67 < 0.001*	r= 0.22 < 0.001*
Weight (kg)	r= 0.67 <0.001*		r= 0.85 < 0.001*
BMI	r= 0.22 < 0.001*	r= 0.85 <0.001*	
Wrist Width (mm)	r= 0.72 < 0.001*	r= 0.74 <0.001*	r= 0.481 <0.001*
Wrist Depth (mm)	r= 0.53 < 0.001*	r= 0.6 <0.001*	r= 0.44 <0.001*
Length of palm (mm)	r= 0.79 <0.001*	r= 0.59 < 0.001*	r= 0.24 < 0.001*
Wrist Ratio	r= 0.05 = 0.350	r= 0.123 = 0.033	r= 0.129 = 0.025
Wrist/Palm Ratio	r= 0.076 = 0.189	r= 0.336 < 0.001*	r= 0.385 < 0.001*

*Correlation is significant at the 0.05 level. r: 0.00-0.25 weak correlation. r: 0.25-0.50 moderate correlation. r: 0.50-0.75 good correlation. r: 0.75-1.00 very good correlation.

Table 4: Wrist ratio and wrist palm ratio anthropometric measurements Pearson correlation values

Measurements	Wrist Ratio	Wrist/Palm Ratio	Wrist Width (mm)
Wrist Depth (mm)	r= 0.619 <0.001*	r= 0.736 < 0.001*	r= 0.531 <0.001*
Wrist Width (mm)	r= - 0.10 = 0.083	r= 0.223 < 0.001*	
Length of palm (mm)	r= 0.035 = 0.550	r= - 0.073 = 0.208	r= 0.71 < 0.001*

*Correlation is significant at the 0.05 level. r: 0.00-0.25 weak correlation. r: 0.25-0.50 moderate correlation. r: 0.50-0.75 good correlation. r: 0.75-1.00 very good correlation.

In a study conducted in Saudi Arabia on 100 individuals (50 patients of CTS and 50 as control group), it was found that wrist ratio of body mass index significantly correlated with CTS [23]. In this study, there was a positive correlation between body mass index and wrist ratio and wrist palm ratio, which are risk factors of CTS.

Bland [24], in his study of 2005, stated that body mass index was a risk factor for CTS in individuals under 63 years of age. He suggested that there might be other underlying mechanisms in the formation of CTS in individuals older than 63 years. Similar to these results, we found a positive correlation between the wrist ratio and body mass index, which are the risk factors of CTS and a positive correlation between the wrist palm ratio and body mass index.

In 2010, Zambelis *et al*. [25] in 260 individuals (130 right-handed CTS, 130 left-handed CTS) in the study of the left hand is dominant and the possibility of the development of body mass index in the left hand is dominant in the right hand and CTS in the right hand is significantly more high. In addition, it was reported that body mass index in right hand was more frequent in young individuals and women. In our study, no correlation was found between body mass index and dominant hand. This difference may be the result of the unbalanced distribution of right and left hand dominance of the individuals included in our study.

In a study conducted in 1979, it was found that there was no relationship between the external shape and size of the hand and CTS [26]. The reason for lack of relationship may be due to the fact that the number and characteristics of the researchers (18 healthy women, 18 CTS women doing the same job as healthy women) were different.

In 2001, Chroni *et al.* [27] in a study of 100 people (50 healthy women, 50 CTS women), it was found that the palm length in the patient group was significantly shorter than the control group. In our study, no significant correlation was found between palm length and carpal tunnel risk factors (wrist ratio, wrist palm ratio). This difference; Chroni *et al*. [27] and the fact that the number of individuals included in the assessment is different from both the scarcity and the qualifications and that we only work with healthy individuals.

It is possible that some simple external hand and wrist measurements can be used to predict the tendency of CTS [28].

CONCLUSIONS

Significant results were obtained in favor of women when the means of wrist width, wrist depth, palm length and wrist palm ratio were compared with independent t test. Therefore, it can be said that the incidence of carpal tunnel risk factor is higher in women than men. In addition, there is a positive correlation between wrist ratio, wrist palm ratio and body mass index, but there is no correlation between palm length and wrist ratio and wrist palm ratio.

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