

Hand and wrist configurations in patients with Carpal Tunnel Syndrome

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Abstract

The association between hand and wrist configurations was investigated in this study. The hand and wrist dimensions of sixty patients with carpal tunnel syndrome and sixty healthy control subjects were measured using specific anatomical landmarks. The palm width was significantly greater in the patient group. There was no significant difference in the hand length between the two groups. Both the wrist width and wrist depth were significantly greater in the patient group. The hand ratio and the wrist ratio were significantly smaller in the patient group indicating that the latter had squarer hands and wrists than the control group respectively. This suggests that the anatomy of the hand and wrist may predispose to carpal tunnel syndrome.

Key words

Carpal tunnel syndrome, hand dimensions, wrist dimensions.

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Background

Carpal tunnel syndrome (CTS) can be associated with several conditions such as rheumatoid arthritis, hypothyroidism, diabetes mellitus and wrist injuries. However, most cases are idiopathic. Several studies attempted to find an explanation for idiopathic CTS. Some authors suggested that body mass index, stature and body weight are risk factors.¹⁻³ Others reported that the cross-sectional area of the carpal tunnel⁴ and even wrist dimensions are important factors in the development of idiopathic CTS.⁵

In this study we investigated whether there is a correlation between hand and wrist configurations and idiopathic CTS in patients prior to carpal tunnel decompression surgery.

Patients and methods

Sixty consecutive patients with typical symptoms of carpal tunnel syndrome and nerve conduction evidence of severe carpal tunnel syndrome scheduled for carpal tunnel decompression surgery were included in the study. Patients who suffered from diabetes mellitus, rheumatoid arthritis, hypothyroidism, had a past history of trauma or wrist fracture, or were pregnant were excluded from the study. Their mean age was 55.8 (range 24-84) years. Another sixty healthy volunteers with no symptoms or signs of CTS formed the control group. Their mean age was 55.3 (range 25-85) years. Thirty-eight were females and twenty-two were males. Both groups were matched for age, gender and hand - dominant or non-dominant - where the examination was carried out. The occupation of all patients and subjects was recorded. The study was carried out in the six month period April 2005 to September 2005. Informed consent was obtained from all patients and subjects and the study was approved by the local research ethics committee.

The hand dimensions measured were:

- Palm length - distance from the distal flexor crease of the wrist to the proximal crease at the base of the third digit,
- Third digit length - distance from the proximal crease at the base of the third digit to the tip of the latter, and
- Palm width - the maximal distance between the medial and lateral borders of the palm at the level of the little finger and the index finger metacarpal heads (Figure 1)

The wrist dimensions measured were:

- Wrist depth – the anterior-posterior depth of the wrist at the level of the distal wrist crease, and
- Wrist width – the wrist width at the level of the distal wrist crease (Figure 1)

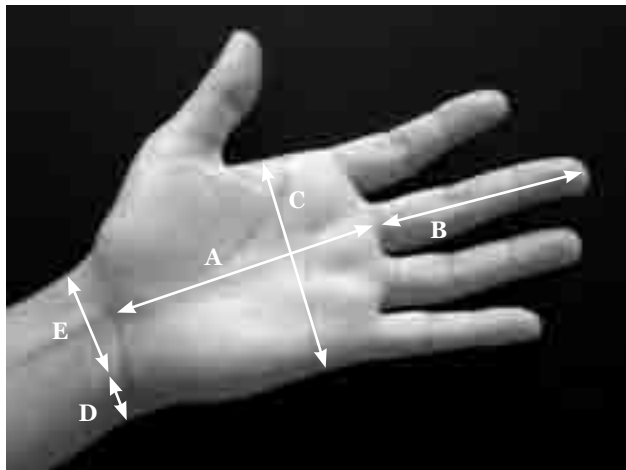
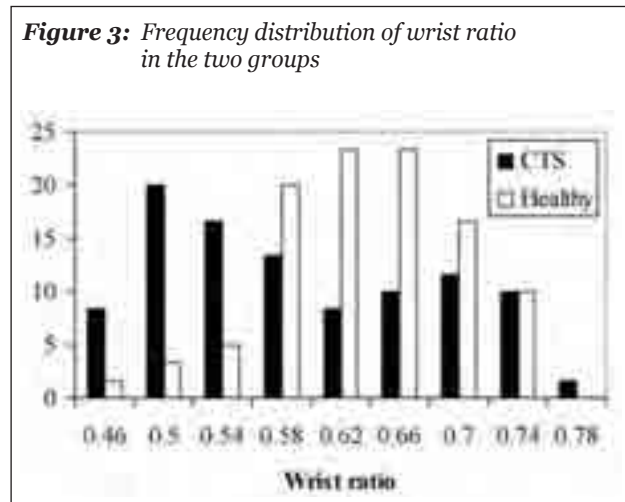
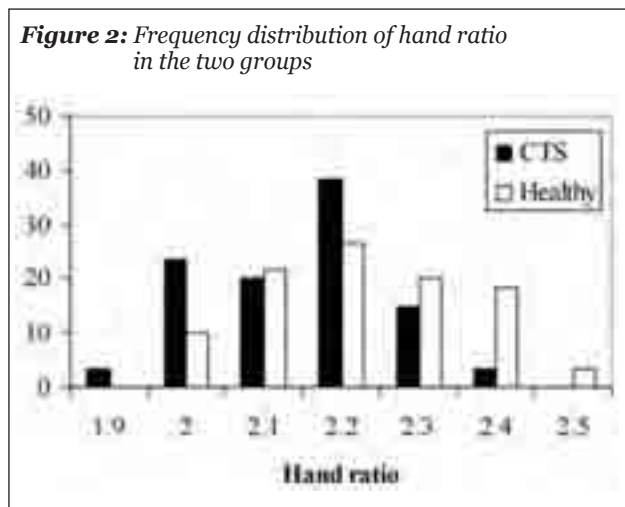


Figure 1: Anatomical landmarks for measuring hand and wrist dimensions. Palm length (A), third digit length (B), palm width (C), wrist depth (D) and wrist width (E).



These measurements were performed by a single author using a standard engineering Vernier callipers. Using these measurements, the hand ratio was calculated as palm length plus third digit length, that is hand length divided by the palm width ($A+B/C$); and the wrist ratio was calculated as wrist depth divided by the wrist width (D/E).

Statistical analysis of the data was carried out using SPSS statistical software version 12.0. The standard Student t-test and the Chi squared test were used for comparison of means between the patient and control groups. Statistical significance was assumed if the p value was less than 0.05.

Results

There was no statistically significant difference in gender, age and hand dominance between the two groups (Table 1). In each group approximately half of the females were homemakers, the others had various occupations including hospital staff, clerical workers and machine operators. Most of the males in each group were manual workers such as carpenters, farmers and machine operators. Some of the male healthy controls were hospital staff.

In the patient group the palm width was significantly larger than that of the control group. However, there was no statistically significant difference in the hand length between the two groups. The hand ratio that reflects the differences of both length and width dimensions of the hand was significantly lower in patients compared to controls (Table 2). This shows that the hands of the CTS group were squarer than those of the control group. Figure 2 shows the frequency distribution of the hand ratio in both groups. There is a clear shift toward the lower values of the hand ratio in the patient group as opposed to the healthy controls.

In the patient group the wrist depth and the wrist width were significantly shorter than that in the control group. The

Table 1: Demographic data of the CTS and control groups

	CTS group (n=60)	Control group (n=60)	p value
Mean age (years)	55.8 (13.8)	55.3 (14.3)	NS ^a
Gender (M:F)	22:38	22:38	NS ^b
Hand Domnant:Nondominant	40:20	40:20	NS ^b

Values are expressed as mean (SD)

^a Student's t-test, ^b Chi squared test NS: Not significant

Table 2: Mean (SD) of hand length, palm width and hand ratio in patients with CTS and controls

	Hand length (cm)	Palm width (cm)	Hand ratio
Patients	17.5 (1.3)	8.0 (0.5)	2.20 (0.13)
Controls	17.2 (1.2)	7.6 (0.7)	2.26 (0.14)
p value	NS	<0.01	<0.05

wrist ratio was significantly lower in patients with CTS than that in the control group (Table 3). In figure 3, the frequency distribution of the wrist ratio in the patient group shows a shift toward the lower values compared with the distribution in the control population.

Discussion

Our findings support the association of CTS with hand and wrist configurations. Only patients with symptoms of CTS and severe nerve conduction abnormality were included in the study. Subjects with occasional symptoms of CTS were excluded from the control group. So the two groups were comparable not only demographically but also as regards symptoms and signs of CTS.

The hand ratio estimated from the hand length and width measurements was lower in patients than in controls. This shows that patients had squarer hands. This contrasts with the findings of Armstrong and Chaffin⁶ who found no difference between subjects with CTS and controls. This may have been due to the small numbers included in the groups (eighteen subjects in each group) and due to the fact that they relied only on clinical grounds of CTS, that is women with numbness or pain in the median nerve distribution or thenar atrophy without neurophysiological confirmation of CTS. Chroni *et al*¹ demonstrated that the smaller the hand ratio the slower the sensory and motor median nerve conduction velocities.

Our patients had a wrist ratio that was significantly lower than that of the controls. So patients with CTS had squarer wrists than the healthy volunteers. The first study that correlated wrist dimensions with CTS was carried out by Johnson *et al*.²

Although it is difficult to provide an obvious explanation for the significant correlation between the squarer hands and wrists in CTS, it is probably related to biomechanical factors. Idiopathic CTS has been reported to be due to repetitive and excessive use the hands.^{7,8} During frequently performed daily activities such as writing, knitting and operating machinery; the relative position of the wrist, palm and digits, and therefore, the force exerted on the hand, depends to a certain extent on the hand dimensions. The squarer the hand, the greater volar extension of the wrist required for a given motion and as has

Table 3: Mean (SD) of wrist depth, wrist width and wrist ratio in patients with CTS and controls

	Hand length (cm)	Palm width (cm)	Hand ratio
Patients	4.1 (0.4)	6.9 (1.1)	0.61 (0.09)
Controls	3.6 (0.4)	5.6 (0.9)	0.65 (0.07)
p value	<0.001	<0.001	<0.01

been shown⁶, may lead to median nerve compression. Squarer wrists may reflect squarer carpal tunnel dimensions. This may in turn cause more median nerve compression during flexion and extension movements of the digits and wrist.

In conclusion, our findings suggest that the anatomy of the hand and wrist may be important in the development of idiopathic carpal tunnel syndrome.

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