# 懷孕期間發生之腕隧道症候群 —
# 腕徑比例與身體質量比數之角色

# Carpal Tunnel Syndrome in Pregnancy:
# the Roles of Wrist Ratio and Body Mass Index

計畫編號：NSC 88-2314-B-002-280
執行期限：87 年 8 月 1 日至 88 年 7 月 31 日
主持人：張楊全　　國立台灣大學醫學院神經科

**中文摘要**

腕隧道症候群是常見的神經壓迫症候，與懷孕期的關係密切。許多因素，如水腫、內分泌變化、體重增加、與局部韌帶黏液囊發炎都有報告。但目前有些研究顯示個人體質因素，如腕徑比例及身體質量指數與腕隧道症候群的關係更密切，反而是決定會不會發生腕隧道症候群的主要因素。懷孕也是容易發生腕隧道症候群的原因之一，而懷孕期間身體產生的變化亦包括水腫與身體質量指數增加，因此如果系列追蹤懷孕婦女之腕徑比例與身體質量指數及其與正中神經傳導之改變，可以提供理想之實驗模式，用以檢視造成腕隧道症候群之病因。

本研究計畫前瞻性收集 66 名懷孕婦女，於懷孕期末三個月與產後三個月，評估其臨床症狀、腕徑比例與身體質量指數，並進行各式神經傳導檢查。結果發現有 24 名懷孕婦女診斷出腕隧道症候群，詳細分析具腕隧道症候群與不具腕隧道症候群兩組之間的差異，結果顯示體重改變、身體質量指數、腕徑比例、水腫有無皆沒有統計意義。但比較產前與產後之神經傳導結果發現有顯著差異。

本研究計畫證實懷孕期間腕隧道症候群之發生與水腫、體重改變與身體質量指數增加有關，雖然造成腕隧道症候群之原因不只一端，腕徑比例與身體質量指數的確扮演一定角色。

**關鍵詞**：腕隧道症候群，正中神經，懷孕，神經傳導檢查，腕徑比例，身體質量指數

**Abstract**

Carpal tunnel syndrome (CTS) is closely associated with pregnancy. The pathophysiology of CTS in pregnancy is controversial. It has been attributed to redistribution of fluids, hormonal changes, tenosynovitis and vulnerability of nerves. There are also evidences that personal factors, such as wrist ratio and body mass index (BMI), are positively correlated with the development of CTS irrespective of patients' occupation or illness. The onset of carpal tunnel syndrome during pregnancy occurs most frequently during the third trimester, when weight and total blood volume are typically maximal. It is thought that the changes in wrist ratio and BMI in pregnancy are obvious, and may be correlated with the development of CTS. We prospectively collect 66 pregnant women, to evaluate at the third trimester and three months after delivery. The evaluation includes clinical profiles, wrist ratio, BMI and nerve conduction studies. There were 24 women having electrodiagnostic findings of CTS, which are correlated with clinical symptoms of CTS. There was no statistic

significance between the two groups in terms of BMI, weight-gain, wrist ratio, and edema. However, significant changes did exist between the findings of nerve conduction studies before and after delivery. The development of CTS in pregnancy is related to the changes of body mass or wrist ratio in the same individual. Further investigation is necessary.

**Keywords**: carpal tunnel syndrome, median nerve, pregnancy, nerve conduction study, wrist ratio, body mass index

## Introduction

Carpal tunnel syndrome (CTS) is an entrapment neuropathy involving the nerve at wrist. Conditions associated with CTS include rheumatoid arthritis, diabetes mellitus, hypothyroidism, post-traumatic wrist deformities and pregnancy [1]. The incidence of CTS during pregnancy has variously been reported from 2 to 25% [2,3,4]. The syndrome is most frequently diagnosed in the second and third trimesters [3,4]. Since CTS can result in permanent disability if undiagnosed or left untreated, it is essential to recognize the syndrome when it occurs during pregnancy. The pathophysiology of CTS in pregnancy is controversial. It has been attributed to redistribution of fluid, hormonal changes, tenosynovitis and vulnerability of the peripheral nerves [2,3,7]. The onset of carpal tunnel syndrome during pregnancy occurs most frequently during the third trimester, when weight gain and attendant total blood volume are typically maximal. The changes in wrist ratio and BMI in pregnancy are obvious, and thus provide a human model for the theory [10,11,12].

## Subjects and Methods

*Subjects*

Pregnant women followed-up at the department of obstetrics were recruited for the study. Subjects with history of diabetes mellitus, thyroid disease, rheumatoid arthritis, work or cumulative trauma of hands were excluded. Subjects had clinical and electrophysiological evaluation for CTS at the third trimester and three months after delivery.

*Clinical evaluation*

Demographic data and clinical profiles were recorded at each visit. These include age, height, body weight, edema, proteinuria, numbness of hand, nocturnal paresthesia, thenar weakness, thenar wasting, Tinel's sign, Phalen's sign and two-point discrimination. Wrist anteroposterior (AP) and mediolateral (ML) diameters were measured. The wrist ratio was expressed as AP divided by ML. The BMI was expressed as body weight/(body height)$^2$ (Kg/m$^2$).

*Nerve conduction studies*

All the nerve conduction studies were undertaken with a Viking IV electromyography (Nicolet, USA). The room temperature was controlled at 25 – 30 °C, and the hand temperature at 32 – 34 °C. The methods of median nerve conduction study followed the standard procedures previously described in the literature. The following parameters were recorded: (1) median nerve motor distal latency, (2) median nerve sensory latency between wrist and digit, (3) comparison of median and ulnar motor distal latency, (4) comparison of median and ulnar sensory conduction between wrist and ring finger.

*Statistical analysis*

All the clinical profiles, BMI, wrist ratio and results of nerve conduction studies were analyzed statistically. Simple regression analysis was used to determine the correlation of the wrist ratio and BMI with the various parameters of nerve conduction studies. Student's paired t-test was used to compare the parameters of NCV at the third trimester and after delivery.

## Results

Sixty-six pregnant women were recruited for this study. The age ranged from 24 to 41 with a mean of 33.3. The mean BMI at the third trimester was 26.7 $Kg/m^2$ and mean weight gain was 11.2 Kg. There was no correlation between the wrist ratio and findings of NCV. Twenty-three women had electrodiagnostic findings of CTS. Comparison between the two groups of subjects with and without CTS showed no significant difference in terms of BMI, weight gain, presence of edema, and wrist ratio (Table 1).

Twenty-one women had serial examinations at the third trimester and 3 months after delivery. The BMI, weight changes, left wrist ratio showed significant changes before and after delivery. The parameters regarding to the diagnosis of CTS, i.e. median distal motor latency (MDML), difference between median and ulnar distal motor latency (M-U DML), median sensory latency (MSL), and difference between median and ulnar sensory latency (M-U SL), also showed significant changes before and after delivery (Table 2).

## Discussion

In a study of survey of hand symptoms in pregnancy [5], 35% reported hand symptoms. Only 20% of the affected patients had classic median-nerve symptoms (CTS), while 12% of patients described an ulnar-nerve distribution and in 68% of patients a generalized hand symptoms. The facts that the diagnosis of CTS based solely on the symptoms may be misleading and may pose a diagnostic uncertainty. However, the previous reported studies of incidence of CTS in pregnancy were mostly made by questionnaire and review of symptoms [3,4,5,6,7]. No systematic, prospective cohort study of CTS in pregnant women, based on electrodiagnosis, has yet been reported. Our evaluations were made by both clinical symptoms and electrodiagnostic findings.

The pathophysiology of CTS in pregnancy is controversial. It has been attributed to redistribution of fluid, hormonal changes, tenosynovitis and vulnerability of the peripheral nerves [2,3,7]. The most important risk factor for CTS in pregnancy is edema, followed by pre-eclampsia and hypertension. While maternal and fetal age, parity and weigh change did not correlate with the development of symptoms [3,4,6].

In a recent study of 1472 patient with and without work-related upper extremity complaints, the results showed an almost identical covariation between the right median minus ulnar palmar latency difference and the patient's right wrist ratio and body mass index [9]. The likelihood of median slowing was related to age, body mass index and average wrist ratio, and are regardless of patient occupation and illness. It seems that personal factors play a vital role in the development of CTS than was thought before.

The onset of carpal tunnel syndrome during pregnancy occurs most frequently during the third trimester, when weight gain and attendant total blood volume are typically maximal. The changes in wrist ratio and BMI in pregnancy are obvious, and thus provide a human model for the theory [10,11,12]. In the present study changes in the observed parameters regarding to the development of CTS are related to the changes of body mass and wrist ratio. Though CTS is a syndrome of multiple causes, BMI and wrist ratio are important causative factors in the same individual.

The natural history of CTS during pregnancy is usually that of the resolution of symptoms 4 - 6 weeks after delivery. The findings from present study confirmed resolutions of electrodiagnostic abnormalities after delivery. This favorable outcome has led to a widely accepted conservative treatment. However, some of the women do not recover, or show recurrent CTS symptoms later on. More aggressive treatment or surgical approach may be

appropriate in such cases [7,8]. It is also possible that adequate controls of body weight and edema may in some way help to treat CTS symptoms.

## References


1. Spinner RJ, Bachman JW, Amadio PC. The many faces of carpal tunnel syndrome. Mayo Clin Proc 1989;64:829-836.
2. Massey EW. Carpal tunnel syndrome in pregnancy. Obst Gynecol Survey 1978;33:145-147.
3. Voitk AJ, Mueller JC, Farlinger DE, Johnston RU. Carpal tunnel syndrome in pregnancy. Can Med Assoc J 1983;128:277-281.
4. Ekman-Ordeberg G, Salgeback-Stig, Ordeberg G. Carpal tunnel syndrome in pregnancy: a prospective study. Acta Obstet Gynecol Scand 1987;66:233-235.
5. Mclennan HG, Oats JN, Walstab JE. Survey of hand symptoms in pregnancy. Med J Austral 1987;147:542-544.
6. Wand J. Carpal tunnel syndrome in pregnancy and lactation. J Hand Surg (Br) 1990;15:93-95.
7. Stahl S, Blumenfeld Z, Yarnitsky D. Carpal tunnel syndrome in pregnancy: indications for early surgery. J Neurol Sci 1996:136:182-184.
8. Al Qattan NM, Manktelow RT, Bowen CVA. Pregnancy-induced carpal tunnel syndrome requiring surgical release longer than 2 years after delivery. Obster Gynecol 1994;84:249-251.
9. Radecki P. A gender specific wrist ratio and the likelihood of a median nerve abnormality at the carpal tunnel. Am J Phys Med Rehabil 1994;73:157-162.
10. Werner R, Albers JW, Franzblau A, Armstrong TJ. The relationship between body mass index and the diagnosis of carpal tunnel syndrome. Muscle Nerve 1994;17:632-636.
11. Radecki P. Variability in the median and ulnar nerve latencies: implications for diagnosing entrapment. J Occup Environ Med 1995;37:1293-1299.
12 Radecki P. Personal factors and blood volume movement in causation of median neuropathy at the carpal tunnel: a commentary. Am J Phys Med Rehabil 1996;75:235-238
13 AAEM Quality Assurace Committee: Jablecki CK, Chair, Andary MT, So YT, Wilkins DE, Williams FH. Literature review of the usefulness of nerve conduction studies and electromyography for the evaluation of patients with carpal tunnel syndrome. Muscle Nerve 1993;16:1392-1414.
14 Stevens JC. AAEE minimonograph #26: the electrodiagnosis of carpal tunnel syndrome. Muscle Nerve 1987;10:99-113.
15 Uncini A, Di Muzio A, Awan J, Manente G, Tafuro M, Gambi D. Sensitivity of three median-to-ulnar comparative test in diagnosis of mild carpal tunnel syndrome. Muscle Nerve 1993;16:1366-1373.

Table 1. Comparison between pregnant women with and without CTS

| | With CTS (n=23) | Without CTS (n=43) |
|---|---|---|
| *Mean age* | 34.8 (± 3.2) | 32.6 (± 3.6) |
| *Mean weight before pregnant* | 56.8 (± 9.5) | 56.6 (± 8.7) |
| *Mean weight at the 3rd trimester* | 67.4 (± 5.9) | 68.1 (± 9.5) |
| *Mean weight gain* | 10.6 (± 4.9) | 11.5 (± 4.1) |
| *BMI* | 27.0 (± 2.6) | 26.6 (± 3.2) |
| *Edema* | 9 | 14 |
| *Right wrist ratio* | 0.72 (± 0.04) | 0.72 (± 0.04) |
| *Left wrist ratio* | 0.76 (± 0.04) | 0.73 (± 0.04) |

Table 2. Weight changes, BMI, wrist ratio and findings of NCV before and after delivery

| | At the 3rd trimester | 3 months after delivery | *p* |
|---|---|---|---|
| *Mean weight* | 67.6 (± 10.4) | 59.0 (± 10.5) | <0.001 |
| *BMI* | 26.4 (± 3.0) | 23.1 (± 3.33) | <0.001 |
| *Right wrist ratio* | 0.72 (± 0.04) | 0.71 (± 0.03) | 0.06 |
| *Left wrist ratio* | 0.74 (± 0.03) | 0.73 (± 0.03) | 0.01 |
| *R MDML* | 4.12 (± 1.0) | 3.78 (± 0.75) | <0.01 |
| *L MDML* | 3.62 (± 0.53) | 3.60 (± 0.42) | 0.33 |
| *R M-U DML* | 1.38 (± 1.02) | 0.99 (± 0.78) | <0.01 |
| *L M-U DML* | 0.88 (± 0.55) | 0.81 (± 0.46) | 0.13 |
| *R MSL* | 2.72 (± 0.57) | 2.5 (± 0.42) | <0.01 |
| *L MSL* | 2.51 (± 0.33) | 2.37 (± 0.22) | <0.01 |
| *R M-U SL* | 0.61(± 0.66) | 0.35 (± 0.59) | <0.01 |
| *L M-U SL* | 0.34 (± 0.44) | 0.23 (± 0.33) | 0.04 |

MDML: median distal motor latency (MDML)
M-U DML: difference between median and ulnar distal motor latency
MSL: median sensory latency
M-U SL: difference between median and ulnar sensory latency (M-U SL)