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Original Article

Prevalence of carpal tunnel syndrome symptoms and its determinants among the dental staff of Al-Azhar University in Cairo, Egypt

Community and Occupational Medicine

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is the most frequent disorder affecting the median nerve. It is common work-related musculoskeletal disorder among dentists, with significant social and economic implications.

Objectives: This study aimed to investigate the prevalence of CTS symptoms as well as its personal and occupational determinants among dental staff.

Methodology: A cross-sectional study was conducted among 141 dental staff of Al-Azhar University. We used a self-administered questionnaire, including work history, demographic data, and the Boston Carpal Tunnel Questionnaire (BCTQ) to survey CTS symptoms in addition to clinical examination.

Results: The prevalence of CTS symptoms among the participants was 29.8%, of which 24.1%, 4.3%, and 1.4 % had mild, moderate, and severe symptoms, respectively. It was found that uncomfortable posture (OR= 4.9 95%, CI: 1.6 - 15.2), sex (OR = 4.0, 95% CI: 1.2 -12.6), and the lake of performing stretching exercises (OR=3.7, 95% CI: 1.1 -12.4), were significant predictors of CTS among our participants (P value<0.05). However, there was no association between CTS and age, body mass index (BMI), dominant hand, and smoking.

Conclusions: CTS symptoms were about 30% among dentists, and they more prevalent among female and with certain factors such as uncomfortable posture. This study highlights the role of stretching exercises in reducing the risk of CTS. Preventive measures such as ergonomic training and periodic examination are recommended.

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INTRODUCTION

Carpal tunnel syndrome (CTS) is the most frequent disorder affecting the median nerve. It has been observed that it accounts for over 60 percent of upper limb work-associated musculoskeletal conditions in Europe [1]. It frequently presents in working-aged adults with subsequent negative impacts. It can affect workability by reducing the upper limb's motor and sensory functions, in addition to sleep quality through nocturnal waking. Also, it has a significant adverse effect on the financial status in terms of lost work time, restricted workdays, and rehabilitation [2].

CTS is a clinical syndrome due to median nerve compression at the wrist below the carpal ligament. It is mainly a sensory disorder, leading to loss or impairment of superficial sensation that affects the palm, palmar aspect of the thumb, index, and middle fingers. The symptoms include tingling, numbness, or pain that usually worsens at night. In severe conditions, CTS can substantially weaken pinch grip and impede motor function [3].

CTS occurrence varies widely in the literature; it was ranging from 6 to 19% according to case definition in the general population with a significantly higher prevalence among the working population than the non-working population [1]. In Egypt, it was 1.7% and 3.1 % in two population-based surveys conducted in Assiut and Qena Governorate, respectively [4, 5].

The etiology of CTS is not precisely known; it is multifactorial and typically induced by multiple personal, occupational, environmental, medical, and social risk factors. It sometimes occurs secondary to disorders such as hypothyroidism, acromegaly, rheumatoid arthritis, or diabetes. Other risk factors, such as obesity and pregnancy, have been implicated in CTS [6, 7]. Moreover, CTS is correlated with multiple work-related factors such as forceful manual exertion, hand-arm vibration, repetitive movements, and frequent wrist twisting [8]. Consequently, people with certain types of occupation are more likely to have CTS, including grocery store checkers, violinists, carpenters, computer users, and dentists [9].

Dentistry is a profession where clinical, operational skill is restricted to a small area (the mouth) and requires repeated, precise force application while delivering dental procedures. Additionally, dental tools usually vibrate. These situations demand a fixed posture and require precise finger and wrist muscle performance, which can create occupational hazards for the dentist [10, 11]. Moodley et al. [12] in their review illustrated that work-related musculoskeletal disorders are common occupational hazards among dentists.

Several studies revealed the prevalence of CTS among dentists from different countries as KSA [13], Iran [14], India [15] and Libya [16]. In our community, limited studies [17, 18, 19] demonstrate musculoskeletal disorders in general among Egyptian dentists without any evidence regarding CTS. There is a need to understand the magnitude of CTS and related ergonomic practices among Egyptian dentists. Therefore, this study aimed to assess CTS symptom prevalence among the dental staff of Al-Azhar University, Cairo, Egypt, and to determine the occupational, personal and ergonomic factors related to CTS among them.

SUBJECTS AND METHODS

Study design and place of the study:

A cross-sectional study was performed during the interval between February and June 2022 at the Dentistry faculty of Al-Azhar University for Girls, Cairo. The target population for this study was dental staff who deals with patients and practicing the dentistry (N: 191). Our participants were recruited according to the following inclusion criteria: Dental staff that worked for at least one year and agreed to participate in the study. Full-time academicians and dental staff that had diabetes, rheumatoid arthritis, thyroid disease, hand trauma history as well as pregnant female were excluded from the study.

Sample size and sampling technique:

The sample size was calculated according to a particular statistical formula [20], assuming that expected prevalence of CTS symptoms was 50%, 5% margin of error and 95% confidence level, the minimum required sample size was 128. We added 10% and finally, 141 participated in the study. The sample was proportionally allocated to both males and females. Then, participants were selected through stratified random sampling, considering their proportion in each specialty.

Tool of the study:

A self-administered questionnaire was used for the collection of data. It consisted of three parts; the first part included personal data such as age, sex, marital status, height and weight. Body mass index (BMI) was calculated by dividing the weight in Kg over the square height in meter [19]. The second part included occupational history as a dental specialty, years of occupation, working hours per week. It also included work practices, as well as some ergonomic factors as: uncomfortable working posture (bending or awkward postures), strenuous hand positions like working with hands in excessively tight grip, exposure to vibration and uncomfortable work tool, repetitive movements of the wrist (repeat the same action over a period of time) and performance of stretching exercise of the hand and wrist in between patients; that was assessed using yes/no questions. The third part included the Boston Carpal Tunnel Questionnaire (BCTQ) utilized for surveying CTS symptoms as well as the impacts on function among our dentists. BCTQ is as useful in predicting CTS as electro-diagnostic testing [21, 22, 13]. It consists of two sections, the functional status scale (FSS) as well as the symptom severity scale (SSS). SSS includes eleven questions that evaluate symptoms (pain, tingling, and numbness) regarding severity, frequency, and time. FSS includes eight questions evaluating how the syndrome impacts daily activities (e.g., bathing and dressing, holding a grocery basket, doing household chores, opening jars, grabbing a telephone hand, writing, and buttoning clothes). For each question, a 1–5 rating scale was utilized, with 1 indicating no symptoms or functional problems and 5 indicating very severe symptoms or an inability to perform the activity. According to the overall score which is the calculated mean of all eleven questions for SSS and the mean of all eight responses for function status, we categorized the participants in to normal (1-1.8), mild (1.8- 2.6), moderate (2.6- 3.4) and sever (3.4 -4.2). There was no participant with very severe score.
Also, clinical examinations including provocation tests were done for all participants [3, 8]. The participants who had positive Tinel's sign (increased tingling or numbness to percussion of the median nerve at the carpal tunnel or positive Phalen sign (1- minute flexion of the wrist) with the presence of symptoms are considered to have CTS.

Ethics approval

All methods were carried out in accordance with relevant guideline and ethical standards. The ethical approval was obtained from the ethical committee of the Faculty of Medicine for Girls, Al-Azhar University (2022091531). Participation in the study was voluntary. Informed consent was obtained from each participant after clarification of the study objectives and ensuring the confidentiality of data.

Statistical analysis

Statistical analysis was carried out utilizing the 20th version of the SPSS. Quantitative variables were reported as means and standard deviations or median and interquartile ranges (IQR) for that were not normally distributed, whereas categorical variables were summarized as frequencies and percentages. Additionally, the chi-square test or fisher's exact test for categorical variables and Student's t-test or Mann-Whitney for quantitative variables was used to determine the association of CTS symptoms among the participants and different variables. Binary logistic regression was performed for multivariate analysis. The significance level was set at $p < 0.05$.

RESULTS

In this study, a total number of 141 dental staff was enrolled. Their age were ranging between 24-64 years, with a mean of 34.8 ± 6.7 years. Most participants were female (78%) and from urban residences (76.6%), and more than half of them were married (59.6). About 38.3% had been working only in the governmental work while the rest were working in both government and private. There was a wide distribution of dental specialties among subjects. The years of dental practice ranged from 1 to 35 years with median 11. The median of working hours/week was 30 as presented in table (1).

Table (1): Demographic and occupational characteristics of respondents

Characteristic	Mean ± SD	Range
Age	34.8 ± 6.7	24 - 64
Body mass index (BMI)	27.6 ± 4.7	20.0 - 45.2
Duration of work in year#	11 (6-15)	1-35
Working hours /week#	30 (20-40)	12 - 80
	Categories	**no. (%)**
Sex	- Male - Female	31 (22) 110 (78)
Residence	- Urban - Rural	108 (76.6) 33 (23.4)
Marital status	- Single - Married - Divorced	50 (35.4) 85 (60.3) 6 (4.3)
Working place	- Governmental - Both governmental and private	54 (38.3) 87 (61.7)
Dental specialty	- Prosthodontics - General practitioner - Maxillofacial surgery - Pediatric dentistry - Endodontic dentistry - Restorative dentistry - Orthodontics - Periodontics	28 (19.9) 26 (18.4) 24 (17) 17 (12.1) 15 (10.6) 13 (9.2) 10 (7.1) 8 (5.7)

SD: standard deviations **#:** presented by median and (Interquartile range)

Table (2): Prevalence of carpal tunnel syndrome symptoms and signs among participant

Variable	Carpal tunnel syndrome symptoms n = 141 (%)			
	No symptoms no. (%)	**Mild no. (%)**	**Moderate no. (%)**	**Severe no. (%)**
Symptom Severity scale	99 (70.2)	34 (24.1)	6 (4.3)	2 (1.4)
Functional status scale	103 (73)	25 (17.7)	9 (6.4)	4 (2.8)
	Carpal tunnel syndrome signs			
Clinical examination	Negative	Tinel's sign	Phalen sign	Both signs
	99 (70.2)	36 (25.5)	31 (22.0)	27 (19.1)

Table (2) depicts the prevalence of CTS symptoms among our participants as 29.8, with 24.1%, 4.3%, and 1.4 % having mild, moderate, and severe symptoms, respectively. Regarding the functional status scale, approximately 27% had varying degrees of difficulty (17.7%, 6.4%, and 2.8% as little, moderate, and intense difficulty, respectively). By clinical examination, it was found that all participants with CTS symptoms had positive either one sing (Tinel's or Phalen) or both signs. Table (3) shows no significant association between CTS symptoms and age, BMI, years of work, marital status, dominant hand and smoking. CTS symptoms were more frequent among prosthodontics, general practitioner, endodontic and orthodontics

without significant difference. However, there was a statistically significant association between CTS symptoms and sex, as it is more prevalent among females than males. In addition, participants with CTS symptoms had significantly longer weekly working hours than those without symptoms (p <0.05).

Table (3): Prevalence of carpal tunnel syndrome according to demographic data

Variable	CTS		Stat. test	p-value
	Yes (n =42) no. (%)	No (n =99) no. (%)		
Sex				
- Male	5 (11.9)	26 (26.3)	X^2 = 3.54	0.045*
- Female	37 (88.1)	73 (73.7)		
Marital status				
- Single	13 (31.1)	37 (37.4)	FE = 1.65	0.463
- Married	26 (61.9)	59 (59.6)		
- Divorced	3 (7.0)	3 (3.0)		
Dominant hand				
- Right	41(97.6)	94 (94.9)	FE = 0.57	0.669
- Left	1 (2.4)	5 (5.1)		
Smoking				
- Yes	2 (4.8)	7 (7.1)	FE = 0.27	0.725
- No	40 (95.2)	92 (92.9)		
Dental specialty				
- Prosthodontics	10 (23.8)	18 (18.1)	FE = 10.16	
- General practitioner	8 (19.1)	18 (18.2)		
- Maxillofacial surgery	4 (9.5)	20 (20.2)		
- Pediatric dentistry	4 (9.5)	13 (13.1)		0.168
- Endodontic dentistry	7 (16.7)	8 (8.1)		
- Restorative dentistry	4 (9.5)	9 (9.1)		
- Orthodontics	5 (11.9)	5 (5.1)		
- Periodontics	0 (0.0)	8 (8.1)		
	Mean ± SD or Median (Interquartile range)			
Age	35.2 ±7.7	34.7 ± 6.3	t = 0.41	0.676
BMI	27.6 ± 5.6	28.7 ± 4.5	t = 0.17	0.865
Duration of work / year	12 (8-15)	11(5-14)	MW =1.11	0.509
Working hours/ week	35 (23-40)	30 (18-40)	MW = 2.03	0.049

CTS: carpal tunnel syndrome, BMI: Body mass index, X^2: Chi-square test, FE: Fisher's Exact, t: Student t-test, MW Mann-Whitney, *: Significant p value (<0.05)

Table (4) Prevalence of carpal tunnel syndrome according to ergonomic factors

Ergonomic Factors at work	Total (n =141) no. (%)	CTS		Stat. test	p-value
		Yes (n =42) no. (%)	No (n =99) no. (%)		
Working with comfortable tool					
- Yes	71 (50.4)	22 (52.4)	49 (49.5)	X^2= 0.09	0.754
- No	70 (49.6)	20 (47.6)	50 (50.5)		
Working with vibrating tools					
- Yes	105 (74.5)	30 (71.4)	75 (75.8)	X^2= 0.29	0.590
- No	36 (25.5)	12 (28.6)	24 (24.2)		
Uncomfortable posture					
- Yes	101 (71.6)	37 (88.1)	64 (64.6)	X^2= 7.97	0.005*
- No	40 (28.4)	5 (11.9)	35 (35.4)		
Repetitive tasks					
- Yes	90 (63.8)	35(83.3)	55 (55.6)	X^2= 9.85	0.002*
- No	51 (36.2)	7 (16.7)	44 (44.4)		
Strenuous hand positions					
- Yes	102 (72.3)	37 (88.1)	65 (65.7)	X^2= 7.42	0.004*
- No	39 (27.7)	5 (11.9)	34 (34.4)		
Performing stretching exercises					
- Yes	34 (24.1)	4 (9.5)	30 (30.3)	FE =6.95	0.006*
- No	107 (75.9)	28 (90.5)	69 (69.7)		

CTS: carpal tunnel syndrome, FE: Fisher's Exact, X^2: Chi-square test, *: Significant p value (<0.05)

Table (5) Multivariate logistic regression analysis of potential predictors of carpal tunnel syndrome

Variable	β	Wild	Odds ratio	95% CI	p- value
Working in uncomfortable posture - Yes - No*	1.59	7.70	4.94	1.60 - 15.29	0.005*
Sex - Female - Male*	1.39	5.77	4.0	1.29 - 12.6	0.01*
Lake of performing stretching exercises - Yes - No*	1.31	4.62	3.7	1.1 - 12.4	0.03*
Working hours/ week	0.04	4.80	1.04	1.004 - 1.07	0.02*
Working in strenuous hand positions - Yes - No*	0.94	2.78	2.56	0.84 - 7.77	0.09

CTS: carpal tunnel syndrome, *Reference group; CI: confidence interval, *: Significant p value (<0.05)

Regarding the work and ergonomic practices, working in an uncomfortable posture, repetitive tasks, and strenuous hand positions were significantly higher among participants with CTS symptoms compared to asymptomatic. Moreover, participants with CTS symptoms had a significantly lower prevalence of performing stretching exercises compared to asymptomatic ($p < 0.05$) as presented in (table 4).

The multivariate logistic regression model was developed based on factors substantially associated with CTS symptoms. It was found that uncomfortable posture (OR= 4.9 95%, CI: 1.6 -15.2), sex (OR = 4.0, 95% CI: 1.2 -12.6), the lake of performing stretching exercises (OR=3.7, 95% CI: 1.1 -12.4), working hours/ week (OR= 1.04, 95% CI 1.0-1.07) were statistically significant predictors of CTS symptoms among our participants (p value <0.05). In contrast, the strenuous hand positions showed no significant association with CTS symptoms ($p > 0.05$), as showed in (table 5).

DISCUSSION

Dentists are exposed to a variety of occupational risk factors that can lead to occupational diseases, including musculoskeletal disorders. Previous studies from different nations demonstrated that CTS is frequent among dentists. However, up till now no data is available regarding the prevalence of CTS among Egyptian dentists. Consequently, this study aimed to determine CTS symptom prevalence among the dental staff of Al-Azhar University, Cairo, Egypt, and its impact on functional status. In addition, it is essential to identify the personal, work-related, and ergonomic risk factors responsible for such symptoms among dentists. Therefore, suitable interventional measures can be developed to reduce the risk.

CTS symptom prevalence among the participants was nearly 30%, which aligns with a previous study conducted in Riyadh, KSA, where clinical CTS symptoms were 30.5% [13]. In India, it was 25.7% [15]. Abdelnabi et al. [16] reported a higher prevalence (61.3%) among dentists in Benghazi City, Libya. A lower prevalence than the current study was reported in Iran (16.7%) [14], Pakistan (10.3%), and Malaysia (21.2%) [23, 24]. This variation might be attributed to the difference in race, job category, as well as CTS diagnostic methods between our subjects and those of the other studies.

Regarding functional status that evaluates how the CTS affect daily life activities, we found that one quarter of our participants suffered from different degrees of difficulty. In agreement with these results, Inbasekaran et al. [15] reported that 18 % and 3% had mild and moderate disability as an effect of CTS among dentists in India. Furthermore, Feng et al. [25] found that between 4.3 and 18.5% of those diagnosed with clinical CTS reported difficulty performing daily activities among office workers in China. This result could emphasize the negative impacts of CTS on daily activities and work productivity.

In the current study, there was a significant association between CTS symptoms and sex as it is more prevalent among females than males (P value<0.05), and female was four times more likely to be more prone to experience CTS than male (OR = 4.0, 95% CI: 1.2 - 12). These findings agree with other studies [7, 13, 26, 27]. It can be attributed to females having smaller carpal tunnel passageways as well as smaller wrists [28]. There are additional female-specific factors, including pregnancy, parity, and hormonal changes [6]. Also, females' participation in housework resulted in additional biomechanical loads, which would increase the risk of CTS [29]. Nevertheless, this finding is incompatible with another study, which revealed that there is an equal risk between genders in relation to CTS when the job tasks are identical [8].

Regarding other personal factors, there was no significant association between CTS symptoms and BMI, dominant hand, marital status, smoking, and age. This finding is in agreement with El-Helaly et al. [27]. Ghasemi et al. [30] showed no substantial relationship between BMI and CTS symptom severity. In addition, no significant difference between the dominant and non-dominant hand regarding CTS occurrence,

reported by Borhan et al. [31] who explained that aside from the instrument used and the hand utilized, the pressure applied, and the position of the wrist contribute to CTS symptoms. Contrary to the present work, BMI was identified as a risk factor for developing CTS. Multiple studies revealed that CTS prevalence is more elevated in individuals with increased BMI [2, 13]. Even though the direct relationship between a high BMI and CTS is disputed, it may be connected to an increase in adipose tissue in the carpal canal, hence enhancing the median nerve's compression.

As expected, the prevalence of CTS increased with increasing working hours. The median of working hours/week were significantly higher among dental staff with CTS symptoms compared to asymptomatic one (p value <0.05). However, the working hours/week was statistically significant weak predictors (OR= 1.04, 95% CI 1.0-1.07) of CTS symptoms among our participants. This finding agrees with Alhusain et al. [13], Shetty et al. [32] in KSA, and Haghighat et al. [14] in Iran that dentists who worked more hours were more prone to CTS. In addition, Ghasemi et al. [30] demonstrated a significant relationship between CTS symptom severity with experience and active working hours among butchers in Hamadan, Iran.

In the current study, CTS symptoms were not significantly related to dental specialty. Same finding was reported by Alhusain et al. [13] and Meisha et al. [33]. This finding may be attributed to the same work environment and sharing the general work practices rather than dental specialties. However, in-depth studies are needed to analyze the nature of work and working environment in each specialty.

As evident in the present study, workplace ergonomics is a significant risk factor of work-related musculoskeletal disorders, including CTS. There was a significant association of CTS symptoms with working in uncomfortable posture (OR= 4.9 95%, CI: 1.6 - 15.2). This finding is in agreement with Liao et al. [34] in which uncomfortable posture (OR =2.067, 95% CI: 1.075-3.974) was identified as the risk factor of CTS pain symptoms in automobile manufacturing workers in china.

In the current study, repetitive tasks and strenuous hand positions were significantly associated with CTS symptoms. This finding is consistent with other meta-analyses as well as prior research that concluded that there is a positive correlation of CTS with work that involves tasks necessitating prolonged, repetitive, extensive, and forceful use of hands and wrists [8, 27, 35].

The dentists' work-related activities, including vibratory tools, place these practitioners at risk for CTS [8, 10]. However, this study's results demonstrated no significant association between CTS prevalence and exposure to vibrating tools. In alliance with this finding Aljunaid N. et al. [36] found no relation between CTS with vibrating instruments among dental students. This difference may be related to the duration of using vibratory tools that varied according to the dental specialty.

Moreover, we found that CTS symptom prevalence was significantly lower among dentists who performed stretching exercises compared to those who did not, and lack of performing stretching exercises (OR=3.7, 95% CI: 1.1 -12.4) was a statistically significant predictor of CTS symptoms among our participants. Consistent with these findings, a previous study revealed that performing stretching exercises after clinical practice is one of the ergonomic practices that decrease the odds of musculoskeletal disorders among dentists [33]. In addition, Liao et al. [34] found that work break (OR= 0.489, 95% CI: 0.282-0.849) was identified as a beneficial factor of CTS pain symptoms.

CONCLUSIONS

This study demonstrated that CTS symptoms were about 30% among the dental staff of Al-Azhar University. CTS symptoms were significantly more prevalent among female and with certain occupational factors such as uncomfortable posture. In addition, this study highlights the role of performing stretching exercises to reduce the risk. Therefore, it is essential to draw particular attention to CTS and its risk factors among dentists through awareness, education. Also, analytical studies were needed for further identification of risk factors. The application of ergonomics (work tool, working postures and training) in dentistry is another recommended intervention to prevent CTS occurrence among dentists.

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الملخص العربي

إنتشار أعراض متلازمة النفق الرسغي ومحدداته بين أطباء الأسنان بجامعة الأزهر بالقاهرة، مصر

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ملخص البحث:

الخلفية: متلازمة النفق الرسغي هي الاضطراب الأكثر شيوعًا الذي يصيب العصب المتوسط. وهي اضطرابات عضلية هيكلية شائعة مرتبطة بالعمل بين أطباء الأسنان ، ولها آثار اجتماعية واقتصادية كبيرة.

الهدف: هدفت هذه الدراسة إلى معرفة مدى انتشار أعراض متلازمة النفق الرسغي بالإضافة إلى محدداتها الشخصية والمهنية بين طاقم طب الأسنان.

الطرق: أجريت هذه الدراسة على 141 من طاقم طب الأسنان بجامعة الأزهر. حيث تم استخدام استبيانًا ذاتيًا، يشمل تاريخ العمل والبيانات الديموغرافية، واستبيان نفق بوسطن الرسغي لمسح وجود أعراض متلازمة النفق الرسغي بالإضافة إلى الفحص السريري.

النتائج: بلغ معدل انتشار أعراض متلازمة النفق الرسغي بين المشاركين 29.8٪، من بينهم 24.1٪، و 4.3٪، و 1.4٪ يعانون من أعراض خفيفة ومتوسطة وشديدة على التوالي. وتبين أن الوضع غير المريح أثناء العمل (OR = 4.9 95٪، CI: 1.6 -15.2)، الجنس (OR = 4.0، 95٪CI: 1.2 -12.6)، و عدم ممارسة تمارين التمدد (OR = 3.7، 95٪CI : 1.1 -12.4)، كانت عوامل تنبئًا مهمًا بمتلازمة النفق الرسغي بين المشاركين(P <0.05). ومع ذلك، لم يكن هناك ارتباط بين متلازمة النفق الرسغي والعمر ومؤشر كتلة الجسم واليد المسيطرة والتدخين.

الاستنتاجات: كانت أعراض متلازمة النفق الرسغي حوالي 30٪ بين أطباء الأسنان، وهي أكثر انتشارًا بين الإناث ومع بعض العوامل مثل الوضع الغير المريح أثناء العمل . وتسلط هذه الدراسة الضوء على دور تمارين التمدد في تقليل مخاطر الإصابة بمتلازمة النفق الرسغي. كما يوصى باتخاذ تدابير وقائية مثل التدريب المريح والفحص الدوري.

الكلمات المفتاحية: متلازمة النفق الرسغي، طاقم طب الأسنان، التكيف مع بيئة العمل، مخاطر مهنية

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