

Determinants of upper extremity functions in dentists with chronic neck pain

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ABSTRACT

Dentistry is a profession that requires mental and physical attention due to the nature of the work performed. Especially manual dexterity, psychomotor skills and long-term static stay in the same position due to procedures in a small area can disrupt the symmetry of the body and cause neck pain and disability in upper extremity functions over time. The aim of this study was to identify the determinants of upper extremity functions in dentists with chronic neck pain. A total of sixty dentists with chronic neck pain were included in the study. The sociodemographic characteristics of participants were recorded. Right and left upper trapezius pain pressure threshold (PPT), neck disabilities, upper extremity functions of the participants were evaluated by algometry, neck disability index (NPI) and the disabilities of arm, shoulder and hand (DASH), respectively. The mean age of the participants was 35.30±4.16 and the number of women and men was 45 and 15, respectively. A significant relationship was found between DASH and NDI ($r=0.449$, $p=0.009$), right trapezius PPT ($r=-0.470$, $p=0.005$) and left trapezius PPT ($r=-0.354$, $p=0.043$) of the participants. After regression analysis, only NDI was found to be significant as a determinant of upper extremity functions. This can be explained by the fact that disabilities of the proximal parts of the body can be a determining factor in the development of disabilities in the distal parts. In this context, giving these patients exercises that will reduce neck region disability will improve upper extremity functions.

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INTRODUCTION

Musculoskeletal disorders (MSD) are a wide range of conditions that affect the tendons, muscles, nerves, ligaments and other tissues of the body. MSD can result from a single event or from cumulative trauma and lead to substantial physical and functional limitations among affected individuals. Among professions in healthcare area, dentists are at high risk of developing occupation-related musculoskeletal problems (Pancholi et al., 2018).

Previous studies have indicated that pain and functional limitations are most prevalent in the neck, lower back, shoulder, chest, wrist, knee, elbow, and ankle, respectively (Kawtharani et al., 2023; Ohlendorf et al., 2020).

The Disabilities of the Arm, Shoulder and Hand (DASH) is used to assess upper extremity functions (Hudak et al., 1996). It is a reliable and valid tool to use in patients with chronic neck pain (CNP) (Sigirtmac & Oksuz, 2021). Previous studies have shown that DASH is affected



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by CNP and an increase in disability has been observed in patients with CNP (Osborn & Jull, 2013). A study has assessed the relationship between DASH and NDI in patients with non-specific neck disorders. The correlation was found to be moderate-high ($\rho = 0.669$; $p < 0.001$) (Osborn & Jull, 2013).

The increase in DASH questionnaire points may be associated with pain or neck disability index (NDI). The determination of the predictors of upper extremity functions, and the development of solutions for these predictors, may be beneficial to prevent disabilities and to facilitate daily activities. A study conducted by Mairi Mclean et al. (2011), indicated that upper limb disability was reported by patients with neck pain/disability. However, it has not been studied in dentists with CNP (McLean et al., 2011).

Review of the literature reveals a lack of evidence on this issue. The aim of this study was to investigate the determinants of upper extremity function in dentists with chronic neck pain (CNP).

MATERIAL AND METHODS

Study Design

This study is descriptive research. It was conducted between May 2023 and January 2024. Approval was obtained from the Dokuz Eylul University Ethics Committee for Non-Invasive Research (7681-GOA). Before the study, all participants provided written informed consent.

Participants

A survey was conducted at local clinics and universities to identify dentists with non-specific neck pain, who were subsequently invited to participate in the study through face-to-face interviews. A total of sixty dentists with chronic neck pain volunteered to take part in the study. Individuals with any vascular or neurological disease, a history of upper extremity surgery, or regular participation in exercise or training programs were excluded from participation.

Outcome Variables

Demographic characteristics (gender, age, body mass index (BMI), weight, height) of participants were recorded.

Pain-Pressure Threshold

A Baseline Dolorimeter (Wagner Instruments, Greenwich, CT) was used to assess pain pressure threshold (PPT). The Baseline Dolorimeter has been

identified as a valid and reliable instrument to assess PPT and has been successfully used in the evaluation of individuals with neck pain (Ylinen et al., 2005). Measurements were taken from the midpoint of the bilateral upper trapezius muscle while the participants were seated with their knees and hips at 90° of flexion. The measurements were conducted three times for each side, and the mean value was recorded in kg/cm².

The Disabilities of the Arm, Shoulder and Hand Questionnaire

DASH was used to evaluate the functionality of the upper extremities. Validity and reliability of the DASH in Turkish was conducted and is used to evaluate symptoms and functional status in upper extremity musculoskeletal disorders (Düger et al., 2006). The results of the survey were expressed as a number between 0 and 100, with 100 representing the highest level of disability and 0 indicating no disability.

Neck Disability Index

The Neck Disability Index (NDI), a tool designed to assess disability specific to neck pain, was employed for this study. The validity of the NDI in Turkish has been previously established, with an intraclass correlation coefficient (ICC) range of 0.96-0.98 (Aslan et al., 2008). The questionnaire comprises 10 parameters, including pain intensity, personal care, carrying, headache, reading, concentration, working, sleeping, driving and recreational activities. For each parameter, a score of A or 0 is recorded for the absence of disability, while a score of F or 5 is assigned to indicate total disability (Aslan et al., 2008). An increase in the score shows a higher level of disability.

Statistical Analyses

Statistical Package for Social Sciences software (IBM Corporation, version 24.0 for Windows) was used to analyze all data. Descriptive statistics were presented as frequencies and percentages for categorical variables, whereas continuous variables were presented as mean and standard deviation. Histograms and Shapiro-Wilk test were used to analyze the normality of the data. Additionally, box plots were employed to ascertain the presence of any outliers. The homogeneity of within-groups variances was analyzed with the M test. The Pearson correlation coefficient was used to investigate correlations between the variables since the data was normally distributed. The correlation coefficient (r) between 0.20 and 0.39 is a weak correlation, between 0.40 and 0.59 is moderate, between 0.60 and 0.79 is strong, and

between 0.80 and 1.0 is a very strong correlation. A multiple linear regression analysis with the enter model was conducted to ascertain the independent variables that exerted the strongest effect on DASH. The significance level was accepted as 0.05 or below.

RESULTS

A total of 60 dentists followed up with CNP were included in our study. Of the dentists, 45 (75%) women and 15 (25%) men and the mean age was 35,30±4,16 years. All the variables are presented in Table 1.

Table 1: Participants' characteristics

Dentists with CNP (n=60)	
	Mean ± SD
	%
Age (years)	35.20±4.16
Height (cm)	167.34±7.14
Weight (kg)	66.70±10.58
Gender	
Female	45 (75%)
Male	15 (25%)
BMI (kg/m ²)	23.74±2.98
PPT (R)	1.40±0.38
PPT (L)	1.28±0.38
DASH	25.81±15.81
NDI	15.95±3.65

CNP, chronic neck pain, SD, standard deviation, BMI, body mass index, PPT, pain-pressure threshold, DASH, disabilities of arm, shoulder and hand, NDI, neck disability index

According to correlation analyses performed, there was a moderate correlation with NDI ($r = 0.449$, $p = 0.009$), right trapezius PPT ($r = -0.470$, $p = 0.005$). Additionally, a weak correlation was found with left trapezius PPT ($r = 0.374$, $p = 0.043$). There was no significant correlation with age, height, weight or BMI (Table 2).

Both the NDI and PPT measurements were considered in a multiple linear regression enter model. Only the NDI was found to be a determinant of upper extremity functions accounting for 25,9% of the DASH ($F=5,928$, $p=0,006$, Table 3).

Table 2. Correlation of upper extremity functions with patients' characteristics

Parameter	DASH	
	r	p
Age (years)	0.011	0.935
Height (cm)	-0.076	0.582
Weight (kg)	-0.057	0.682
PPT (R)	-0.470	0.005
PPT (L)	-0.354	0.043
BMI (kg/m ²)	-0.012	0.933
NDI	0.449	0.009

CNP, chronic neck pain, SD, standard deviation, BMI, body mass index, PPT, pain-pressure threshold, DASH, disabilities of arm, shoulder and hand, NDI, neck disability index

Table 3. Determinants of upper extremity functions in dentists with CNP

Parameter	DASH	
	Unstandardized B (95% CI)	p
Constant	22.781 (0.357, 45.205)	-
PPT (R)	-12.395 (-30.554, 5.763)	0.177
PPT (L)	-3.363 (-21.671, 14.946)	0.714
NDI	1.554 (0.463, 2.646)	0.006*

CNP, chronic neck pain, DASH, disabilities of arm, shoulder and hand, PPT, pain-pressure threshold, NDI, neck disability index, * $p < 0.05$ $R = 0.508$, $R^2 = 0.259$, ($F = 5,928$, $p = 0,006$).

DISCUSSION

The aim was to conduct an investigation into the determinants of upper extremity functions in dentists with CNP. The main results of this study show that NDI and both PPT measurements were correlated with upper extremity functions and NDI is a determinant of upper extremity functions in dentists with CNP.

Dentistry is one of the healthcare professions that inevitably necessitates a combination of mental and

physical attention. In the course of their work, dentists are often obliged to perform tasks in positions that are not ergonomically optimal, whether that be standing or sitting, with rare opportunities for rest (Ohlendorf et al., 2020). Additionally, repetitive and squeezing movements of the arm, wrist and fingers during their work can lead to neurogenic inflammation and increase sensitivity. In addition to these, inadequate lighting, stress and hereditary factors can contribute to the development of various musculoskeletal disorders in dentists (Bhatia et al., 2024). All these reasons lead to contracted upper trapezius muscle and facilitating a chemical sensitization process and leading to a decrease in PPT measurements (Rojas et al., 2021). Moreover, as the time passes, it leads to disabilities in both neck and upper extremity functions. These reasons can explain why both PPT measurements have a negative correlation with DASH. However, after regression analysis PPTs have not been found as a determinant factor of upper extremity functions. Therefore, PPT may not be the direct cause of the disability but a consequence of pain-related factors such as stress, poor sleep as shown in the literature (Rojas et al., 2021).

The available studies indicate that there is a moderate-high positive correlation between NDI and DASH in patients with CNP (Gurav & Panhale, 2017; Osborn & Jull, 2013). Nevertheless, to our knowledge, there is no study that investigated the relationship in dentists with CNP. The results of the present study indicate a positive, moderate correlation between the two variables. After the regression analysis, NDI was found to be a determinant factor for disabilities in upper extremity functions. It has been demonstrated that individuals who adopt a forward head posture as a result of their working conditions can experience a reduction in the activation of the stabilizing muscles in the neck area, which may subsequently lead to a loss of strength over time (Çobanoğlu et al., 2024). The loss of strength causes deterioration in stabilization and therefore the natural appearance of the spine, causing neck pain (Çobanoğlu et al., 2024). As a result of strains and sprains from overexertion or bad posture, disabilities of shoulder and other upper extremities start to increase. This can be explained by the fact that disabilities of the proximal parts of the body can be a determining factor in the development of disabilities in the distal parts.

It should be noted that the set is derived from a single-city sample, which limits the generalizability of the findings. A further limitation of the study is that the duration

and intensity of the pain experienced by the participants could not be assessed.

This is the pioneering study to examine the interrelationships between pain sensitivity, NDI and DASH in dentists with CNP. The utilisation of an objective methodology for the assessment of pain represents a further strength of this study.

In conclusion, DASH was found to be correlated with NDI and bilateral upper trapezius muscles' PPT. The NDI score was identified as a significant predictor of DASH. Future studies should focus on reducing neck disability and improving upper extremity function in dentists with chronic neck pain.

ETHICAL APPROVAL

Approval was obtained from the Dokuz Eylül University Ethics Committee for Non-Invasive Research (7681-GOA).

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