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Research Article

Evaluation of Stress, Temporomandibular Disorder Symptoms, and Cortisol Levels in Dentistry Students During Prosthetic Dentistry Internship: A Pilot Study

Meryem Şahin[1], Figen Güzelgül[2]

[1]Tokat Gaziosmanpasa University, Faculty of Dentistry, Department of Prosthodontics, Tokat, Türkiye
[2]Tokat Gaziosmanpasa University, Faculty of Pharmacy, Department of Biochemistry, Tokat, Türkiye

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Abstract

Aim: Dental education, particularly during the prosthodontic internship, can be a demanding period characterized by high academic and clinical workload. These stressors may influence both psychological and physiological well-being, potentially contributing to the development or exacerbation of temporomandibular disorder (TMD) symptoms. Cortisol, a key biomarker of stress, provides an objective measure of the body's physiological response to these challenges. This pilot study was designed to explore the variations in stress levels, TMD symptoms, and salivary cortisol concentrations among dentistry students throughout their prosthodontic internship.

Material and Methods: Thirty-one students (13 in their 4th year and 18 in their 5th year) participating in their prosthodontic internship at Tokat Gaziosmanpaşa University Faculty of Dentistry were included in this study. The Perceived Stress Scale-10 (PSS-10) was employed for stress assessment and the Fonseca Anamnestic Index (FAI) for TMD assessment. Cortisol levels, a biological stress parameter, were measured at the beginning and end of the internship. Data were analyzed using Mann-Whitney U, Wilcoxon, and Spearman's rho tests.

Results: A significant increase was found in stress levels of 5th-year students at the end of the internship (p=0.033). Although there was a trend towards an increase in 4th-graders, it was not found to be significant (p=0.099). Cortisol levels increased in both groups but were not statistically significant. There was no significant change in FAI scores. However, there was a positive correlation between stress and TMD scores in 5th-graders before and after the internship.

Conclusion: Prosthodontic internships may be associated with increased stress levels in students, and a positive association between stress and TMD symptoms was observed. It is recommended to support these results with larger sample sizes and implement stress management programs during clinical training.

Key words: Stress level, cortisol level, dentistry students, temporomandibular disorders.

INTRODUCTION

Dentistry education is a challenging process that incorporates intensive theoretical knowledge and practical applications (1). Students, particularly during their clinical internships, directly contact with patients and start taking on responsibilities (2). The clinical training process brings many stress factors, including meeting patient expectations, operating under time pressure, difficulty in finding clinical cases, lack of equipment, demonstrating proficiency in technical skills, and maintaining academic success (3,4). The prosthodontics internship is particularly important for students because they have intense responsibilities such as meeting patient expectations (5), fulfilling aesthetic and functional requirements (6), and taking impressions and fittings under time pressure (7) in prosthetic fabrication.

Stress has multifaceted effects on an individual's psychological and physiological health. Prolonged stress can lead to psychiatric conditions such as depression, anxiety, and sleep disorders

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Corresponding Author: Meryem Şahin,
E-mail: mrym_ndr@hotmail.com

(8). It can also suppress the immune system, increasing susceptibility to infection (9). It also poses a risk factor for cardiovascular disease (10). Moreover, stress triggers cortisol release via the hypothalamic-pituitary-adrenal (HPA) axis, allowing this hormone to be used as a biological stress marker (9,11). Therefore, it is important to assess students' stress levels during clinical internships using both subjective questionnaires and biological parameters. The Perceived Stress Scale (PSS), developed by Cohen et al. (1983), is one of the most widely used self-report tools for measuring stress. The short form of this scale (PSS-10), Turkish validity and reliability study of which was carried out by Eskin et al.(12), provides measurement invariance across age, gender, and clinical situations (13).

Stress can have psychological consequences and also affect the musculoskeletal system. Temporomandibular disorders (TMD), in particular, are among the stress-related psychosomatic problems (14). The literature indicates that stress can increase parafunctional habits, placing excessive stress on the temporomandibular joint and leading to the emergence of TMD symptoms (15,16). In this regard, the Fonseca Anamnestic Index (FAI) comes to the fore as a reliable and practical tool for screening for TMD symptoms (16,17).

This pilot study aims to evaluate stress, TMD symptoms and cortisol levels in dentistry students during their prosthetic dental treatment internship.

MATERIAL AND METHODS

This study was carried out in Faculty of Dentistry at Tokat Gaziosmanpasa University. Ethical approval was received from the Tokat Gaziosmanpaşa University Research Ethics Committee (24-KAEK-068) in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants for participation in the study. This study initially included 38 students who participated voluntarily. Four students were excluded because they provided saliva samples for cortisol measurement at the beginning of the internship but not at the end, and three students were excluded due to missing cortisol measurement data. Consequently, a total of 31 students (13 in their 4th year and 18 in their 5th year students) were included in the analysis. During the prosthetic dental treatment internship, participants' age, gender, height, weight, body mass index (BMI), smoking status, presence of chronic disease, and medication use were recorded. Other potential confounding factors that may affect cortisol levels were not fully controlled in this study.

The students were asked to complete a questionnaire incorporating the PSS-10 to determine their stress levels and the FAI to measure symptoms of temporomandibular disorder at the beginning and end of the internship.

Using ELISA (Wuhan Fine Biotech Co., Ltd., No: EH0641, Wuhan, China), cortisol levels were determined from saliva samples collected on an empty stomach between 8:30 and 9:00 a.m. at the beginning (T0) and end (T1) of the internship.

Statistical Analysis

IBM SPSS 22 was utilized for data analysis. Normal distribution assumptions were tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Since parametric assumptions were not met, the Wilcoxon test was used for intragroup comparisons, the Mann-Whitney U test for intergroup comparisons, and Spearman's rho correlation analysis for intervariable relationships. Statistical significance was set at $p<0.05$.

RESULTS

Demographic data obtained in this study are shown in Table 1. The statistical analysis for all the results below is shown in Table 2. Examining the perceived stress scale results, it can be seen that the mean pre-internship stress score for 4th-year students was 21.0±4.72, and it was 24.13±6.21 for post-internship. While both values were in the moderate stress category (14-26), the final score approached the high stress threshold (27-40) (Figure 1). This increase was not statistically significant (p=0.099). For 5th-year students, the pre-internship score was 22.3±6.26 and the post-internship score was 24.9±5.21. Although these values were in the moderate stress category, the post-internship scores approached the high stress threshold. This increase was statistically significant (p=0.033).

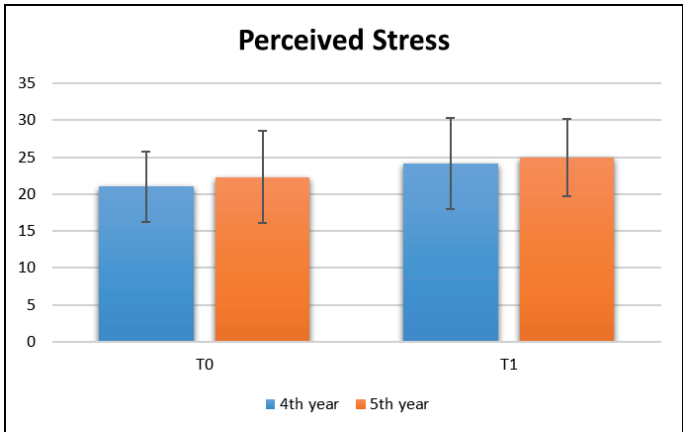


Figure 1. Perceived stress levels by 4th and 5th years.
T0: Pre-internship , T1: Post- internship

Given the FAI results, the mean pre-internship score for 4th-graders was 33.44±29.08 and post-internship score was 33.13±19.82. Both values were in the mild TMD (20-40) category, and the difference between them was not significant (p=0.180). For 5th-graders, the mean pre-internship score was 36.75±13.11 and that of post-internship was 38.25±20.15. The results remained in the mild TMD category but approached the moderate TMD (45–65) border, and the difference was not significant (p=0.888) (Figure 2).

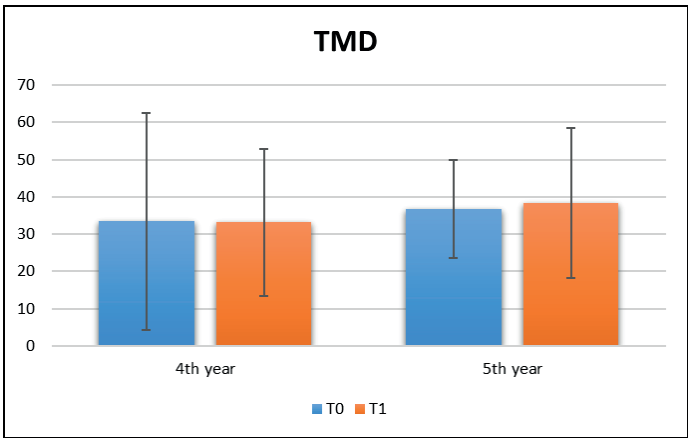


Figure 2. TMD level by 4th and 5th years

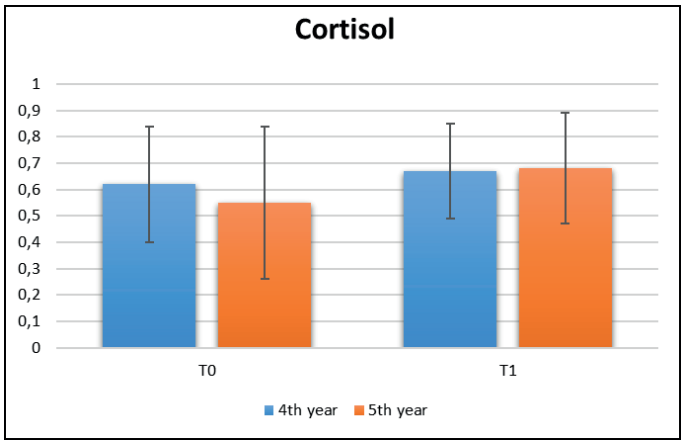


Figure 3. Cortisol levels by 4th and 5th years

The mean cortisol level for 4th-year students was 0.62±0.22 µg/dL before the internship and 0.67±0.29 µg/dL after it. This increase was not statistically significant (p=0.311). For 5th-year students, pre-internship level was 0.55±0.18 µg/dL and post-internship level was 0.68±0.21 µg/dL. No statistically significant difference was found between pre- and post-internship cortisol levels in 5th-year students (p=0.064) (Figure 3).

Considering the correlation analysis results, no significant relationship was found between stress, TMD, and cortisol for the 4th grade students. However, there was a positive correlation between stress and TMD for the 5th grade students, both before (r=0.619, p=0.004) and after (r=0.449, p=0.047) the internship (Table 3).

Table 1. General information about students

		Min-Max	Mean±SD
Age		21-24	22.81±0.80
Height		148-191	168.79±8.68
Weight		42-120	66.42±17.31
BMI		15.9-36.6	23.12±4.68

Table 2. Evaluation of cortisol, stress and TMD levels by 4th and 5th years

		4th year	5th year	
		Mean±SD (median)	**Mean±SD (median)**	**¹p**
Cortisol	T0	0.62±0.22 (0.63)	0.55±0.18 (0.53)	0.173
	T1	0.67±0.29 (0.67)	0.68±0.21 (0.68)	0.496
	²p	0.311	0.064	
	Change	0.04±0.26 (0.07)	0.14±0.27 (0.19)	0.471
Stress scale score	T0	21.0±4.72 (21)	22.3±6.26 (22.5)	0.493
	T1	24.13±6.21 (23.5)	24.9±5.21 (25)	0.576
	²p	0.099	**0.033***	
	Change	3.13±6.52 (2.5)	2.6±5.15 (3)	0.936
TMD	T0	33.44±29.08 (27.5)	36.75±13.11 (37.5)	0.159
	T1	33.13±19.82 (25)	38.25±20.15 (35)	0.336
	²p	0.180	0.888	
	Change	-0.31±28.6 (5)	1.5±14.61 (0)	0.309

¹Mann Whitney U Test *²Wilcoxon sign test* **p<0.05*

T0: Pre-internship , T1: Post- internship

Table 3: Correlation of cortisol, stress, and TMD levels for 4th and 5th years

		4th year	5th year		
		r	p	r	p
T0	**Cortisol-Stress**	-0.137	0.588	0.026	0.912
	Cortisol-TMD	-0.267	0.318	-0.279	0.234
	Stress-TMD	0.054	0.842	**0.619**	**0.004***
T1	**Cortisol-Stress**	0.306	0.310	0.380	0.120
	Cortisol-TMD	0.268	0.376	0.190	0.449
	Stress-TMD	0.187	0.487	**0.449**	**0.047***
Change	**Cortisol-Stress**	0.093	0.762	0.406	0.094
	Cortisol-TMD	-0.053	0.864	-0.092	0.717
	Stress-TMD	-0.055	0.840	0.025	0.916

Spearman's rho correlation test **p<0.05*

T0: Pre-internship , T1: Post- internship

DISCUSSION

In this study, stress levels TMD symptoms and cortisol levels as a biological stress indicator were evaluated in dentistry students during their prosthodontic internship.

Stress is a significant problem for dental students, both in theoretical courses and in clinical practice. As students transition to the clinical phase, stress significantly increases due to working with real patients and assuming treatment responsibilities (18). Lack of clinical equipment and difficulties finding suitable cases are also significant stress factors (3). Previous studies indicated that the periods of highest stress levels are typically the 4th and 5th years (2, 19). Prosthodontic internship students and residents experience one of the highest stress levels in dentistry (20, 21). Specifically, time pressures, coordination with the laboratory, managing patient expectations, and communication requirements are major sources of stress (22, 23). Completing clinical requirements, lengthy treatment periods, complex procedures, and ensuring patient satisfaction are significant stress factors for prosthodontic interns (20). Prosthodontic residents reported higher scores than other disciplines for personal life, academic achievement, lack of self-confidence, and faculty-related stress. Furthermore, this stress was shown to negatively affect job satisfaction (21). In this study, students' stress levels were assessed using the PSS-10. This scale offers high validity and reliability in predicting the pathological effects of stress in clinical and community samples (24). The total score ranges between 0 and 40, with 0-13 indicating low, 14-26 indicating moderate, and 27-40 indicating high stress. As the survey results indicate, the average stress score for fourth-year students was 21.0 before the internship and 24.13 after the internship. This score indicates a moderate stress category at the beginning of the internship (14-26), and approached the upper limit of moderate, approaching the high stress category (27-40) at the end of the internship. For 5th-year students, the initial score was 22.3 and 24.9 at the end of the internship. While both scores were within the moderate stress category, the scores after the internship were closer to the high stress threshold. As a result, stress levels increased in both classes, and this increase was found to be statistically significant in the 5th year (p=0.033). It was reported that stress increases significantly in prosthodontics and dentistry students during the transition from preclinical to clinical practice (18). In particular, starting to work with real patients, increased responsibilities, and the demands of the clinical environment lead to a significant increase in students' stress levels. A previous study revealed that 81.1% of students reported increased stress during this transition, and physical stress symptoms (palpitations, dizziness, headaches, muscle tension) were frequently reported during this period (18). As students progress through the clinical years, even though they initially experience high levels of stress, most report that they adapt to the environment and their stress levels decrease after a semester (approximately one term/semester). The same study also reported that some students experience continued stress or encountered new sources of stress as clinical workload and expectations increase (18). The increased stress levels toward the end of the internship in both classes in the present study may be associated with the stress factors mentioned earlier. The higher level of anxiety observed in 5th-year students may be due to the delay in graduation or other stress factors. More specific surveys that address more stress could be conducted to address this.

Stress can trigger the development of TMD through muscle tension and parafunctional habits (e.g., teeth clenching, bruxism) (25). Studies on clinical dentistry students have shown that high stress is significantly associated with TMD symptoms (25). As students transition to the clinical phase, increased patient responsibilities and workload increase stress and elevate the risk of TMD (18, 26). The FAI is a simple, low-cost questionnaire widely used in the screening of TMD (27), with a total score ranging between 0 and 100. A score of 0-15 indicates no TMD, 20-40 indicates mild, 45–65 indicates moderate, and 70–100 indicates severe TMD. The FAI/TMD

has been widely used to assess the prevalence and severity of temporomandibular joint disorders (TMJ/TMD) in dental students (28) and has been shown to increase rates of TMD in students undergoing clinical training (29). In this study, the mean FAI scores for 4th-graders were 33.44 at the beginning and 33.13 at the end of internship, both in the mild TMD (20-40) category. For 5th graders, the mean scores were 36.75 at the beginning and 38.25 at the end of internship, both in the mild TMD category, but tended to increase toward the moderate TMD threshold (45-65). No statistically significant difference was found between the change in TMD levels from baseline to completion in 4th- and 5th-graders, and in the comparisons between grades ($p>0.05$). Examining the relationship between stress and TMD, there was no significant relationship between the beginning and end of the clinical period among 4th-year students. However, a positive and statistically significant relationship was found between stress levels and TMD among 5th-year students, both at the beginning ($p=0.004$) and at the end ($p=0.047$) of internship. However, no significant relationship was observed between stress and TMD in terms of the change from baseline to completion in either class. This result suggests that perceived stress may increase in parallel with TMD, particularly in students at an advanced clinical level.

Stress activates the HPA axis, leading to the release of cortisol from the adrenal glands. This hormone plays a role in energy mobilization, immune response regulation, and cognitive processes (30,31). During acute stress, increased cortisol promotes the “fight-or-flight” response and facilitates short-term survival (31). Chronic stress, however, can lead to persistently high cortisol levels, creating negative outcomes such as metabolic disorders, cardiovascular disease, immune system weakness, and psychiatric disorders (30,31). Cortisol can be measured in saliva, blood, urine, and hair samples (32, 33). Previous studies revealed that stressful life events and negative emotions increase cortisol levels both momentarily and chronically (34). In this study, even though an increase was observed in cortisol levels at the end of the 4th and 5th grades compared to the beginning, this increase was found to not be statistically significant in both grades, and there was no significant difference between grades ($p>0.05$). This may be related to the limited sample size and the high variability in cortisol levels between individuals. No previous study directly examined cortisol levels during prosthetic dental treatment in intern dentistry students. However, an increase in stress and cortisol levels was reported in general in dentistry students during clinical practice (35). In a study carried out by Alsarhan et al., no significant difference was found in cortisol levels between the clinical and preclinical periods, however, the source of stress and individual perception played an important role (35). In another study, salivary cortisol levels were found to be significantly higher in clinical students compared to preclinical students, suggesting that the clinical period creates more physiological stress (36). Individual perception of stress stands out as the most important factor in changes in cortisol levels (36). In the present study, no significant relationship was found between stress and cortisol levels among 4th-grade students, whereas there was a positive relationship between stress and cortisol among 5th-grade students, especially in the level of change. However, this finding was not statistical significant ($p>0.05$).

Findings suggest that the prosthodontic internship may be associated with increased stress levels among students, and that stress may be associated with TMD symptoms; however, no statistically significant changes in cortisol levels were observed. Strengthening preclinical training and gradual clinical transitions can reduce stress stemming from students’ lack of knowledge and skills (18, 37). Previous studies in the literature reported that mentoring, a buddy system (peer support), and sharing experiences with alumni are effective in helping trainees cope with stress (38), whereas methods such as breathing exercises, relaxation techniques, and music therapy are effective in reducing both psychological and physical stress (39,40). Considering that stress can exacerbate TMD symptoms, it would be appropriate to monitor students’ temporomandibular joint and parafunctional habits during the prosthodontic internship and, if necessary, recommend preventive approaches such as the use of a night guard and masticatory muscle relaxation exercises.

This pilot study has limited generalizability due to its small sample size and single-center nature. Furthermore, only the prosthodontic internship was evaluated, and other internship types were not included in the comparison. Future studies are needed to compare different clinical internships, conduct prospective evaluations with larger samples, and examine the effects of psychosocial support programs on interns’ stress management.

Author contributions

MS: design of the study, data collection for the article, analysis of the results, writing; FG: design of the study, conduct of the experiments, writing.

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Ethical approval

Ethical approval was received from the Tokat Gaziosmanpaşa University Research Ethics Committee (24-KAEK-068) in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants for participation in the study.

Competing interests

The authors declare no competing interests.

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