Original Article

The Impact of Endodontic Workload and Allocated Treatment Time of Dentists in Turkey on Perceived Stress and Complication Frequency and Suggested Solutions

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Abstract

Background: Procedural complications and workload have been reported as sources of stress in dentistry. **Aim:** To investigate the impact of endodontic workload and allocated treatment time of dentists on perceived stress and frequency of complications **Material and Methods:** The online survey included questions to evaluate the average number of root canal treatments per week, stress levels during root canal treatment, frequency of single-visit root canal treatments, time spent on single-visit treatments, frequency of endodontic complications per week, preference for management of complication, and proposed solutions. **Results:** A negative correlation was found between endodontic workload and perceived stress, which was statistically significant at slight and moderate stress levels ($P < 0.05$). Amongst the clinicians who feel "very stressful" during the treatment, the clinicians who allocate only 20 minutes or less per treatment had the highest frequency, and their numbers were significantly higher than clinicians who spent 20–40 minutes per treatment ($P < 0.05$). Amongst the clinicians who experience instrument separation 4–6 times/week, the number of clinicians who spent 40–60 minutes or more than 60 minutes per root canal treatment was significantly lower in comparison to the number of clinicians who spent 20–40 minutes ($P < 0.05$). **Conclusion:** Increasing the quality of dental equipment and reducing the time pressure on dentists might result in lesser stress levels of clinicians and fewer endodontic complications.

Keywords: *Endodontics, root canal treatment, stress, workload*

Introduction

Dentistry is one of the most stressful professions due to its requirement for communication competencies, clinical skills, and theoretical knowledge.[1] Professional burnout is a likely result of occupational stress.[2] Professional burnout is characterized by mental or emotional exhaustion, depersonalization, and dissatisfaction with personal accomplishments.[3] Unsurprisingly, the quality of one's work and professional relationships are negatively affected by burnout. Many health workers argue that the high workload is a prominent source of low-quality health services.[4] Demanding patient interactions and workload have been reported as sources of stress in dentistry as well.[5]

Iatrogenic intraoperative complications, such as instrument separation or root perforation, can arise at any stage during root canal treatment. A recent survey showed that ledge formation and instrument separation are the most common complications during canal shaping.[6] If left untreated, incomplete removal of infected tissues might lead to post-treatment disease.[7,8] Apart from the failure of treatment, in another aspect, endodontic complications are stressors for the dentists.[9] Therefore, not only for

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providing high-quality dental care, but also to avoid medico-legal issues and to alleviate occupation stress, endodontic complications should be addressed in terms of determination of the root of the problem and problem-solving.

To our knowledge, there is no study that has evaluated the possible relationship between endodontic treatment load and endodontic complication frequency, bringing the stress levels of the dentist into the equation. The null hypothesis of this study was that there is a positive correlation between Turkish dentists' endodontic treatment load and perceived stress levels. This study also seeks to receive feedback from dentists about possible solutions for endodontics.

Materials and Methods

The study protocol was approved by the Ethics Committee of Non-Interventional Clinical Research (Approval number: 2021/597). A multiple-choice online survey consisting of 15 questions regarding educational level, clinical experience, workplace, number of root canal treatments performed, stress levels during root canal treatment, frequency of single-visit treatments, time spent on single-visit treatments, frequency of endodontic complications, management of endodontic complications, and suggestions for avoidance of endodontic complications was generated and delivered to 750 Turkish dentists via e-mail.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 23 software (SPSS Inc., Chicago, IL, USA). The Chi-squared test was used to compare categorical variables according to groups, and multiple comparisons of ratios were analyzed with Bonferroni correction Z test. The level of significance was set as $P < 0.05$.

Results

The total number of dentists who participated in the survey was 547; therefore, the participation rate was calculated as 72.9%. The distribution of the participants' general information according to education level, clinical experience after graduation, and workplace is presented in Figure 1. Feedback from participants regarding the workload, perceived stress levels, frequency of single-visit root canal treatments, allocated treatment time, frequency of endodontic complications, preference for management of complication, and proposed solutions are presented in Table 1. The majority of participants (61.6%) reported that they undertake the management and complication of the treatment. Only 8.4% of the participants stated that they were satisfied with the working conditions. More than half of the respondents (51.9%) suggested improvement of equipment for the betterment of the quality of work and their stress levels. Comparison of stress levels according to the average number of root canal treatments per week and allocated treatment time is presented in Table 2. A negative correlation was found between endodontic workload and perceived stress, which was statistically significant at slight and moderate stress levels ($P < 0.05$). Amongst the clinicians who felt "very stressful" during the treatment, the clinicians who allocated only 20 minutes or less per treatment had the highest frequency and their numbers were significantly higher than clinicians who spent 20–40 minutes per treatment ($P < 0.05$). Comparison of endodontic complication frequency according to the average number of root canal treatments per week is presented in Table 3. There was no correlation between the root canals performed per week and the frequency of endodontic complications that occurred, apart from instrument separation in the root canal ($P > 0.05$). Comparison of endodontic complication frequency according to allocated treatment time is presented

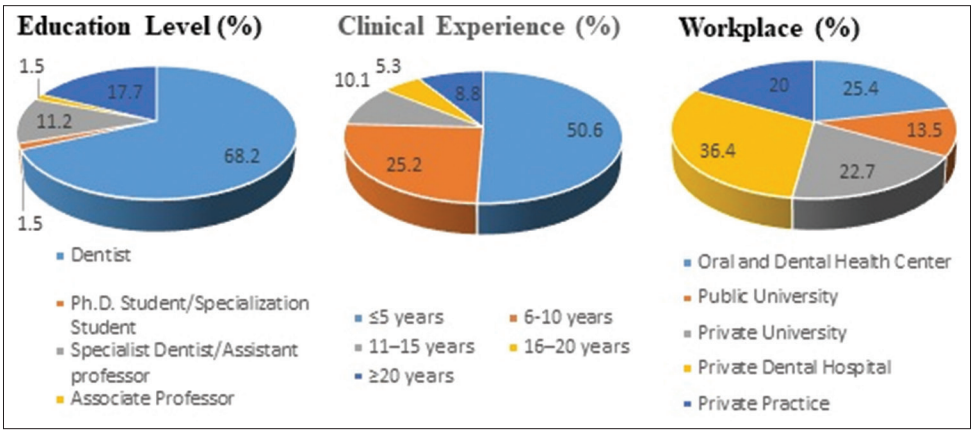

Figure 1: The distribution of participants' general information according to educational level, clinical experience after graduation, and workplace

Table 1: Feedback from participants regarding the workload, perceived stress levels, frequency of single-visit root canal treatments, allocated treatment time, frequency of endodontic complications, preference for management of complication, and proposed solutions

Question	Frequency	Percentage
Average number of root canal treatments per week		
0-5	130	23.8
6-10	164	30.0
11-15	122	22.3
16-20	48	8.8
>20	83	15.2
Stress levels during root canal treatment		
Not stressful	80	14.6
Slightly stressful	176	32.2
Moderately stressful	235	43.0
Very stressful	56	10.2
Frequency of single-visit root canal treatments		
80%-100%	160	29.3
50%-80%	114	20.9
20%-50%	102	18.7
<20%	170	31.1
Time spent on single-visit treatments		
<20 min	15	2.7
20-40 min	110	20.1
40-60 min	265	48.4
>60 min	157	28.7
Frequency of endodontics complications (in a week)		
Instrument separation		
0-3	529	96.7
4-6	16	2.9
7-9	2	0.4
Ledge formation		
0-3	529	96.7
4-6	17	3.1
7-9	1	0.2
Unable to reach apical construction		
0-3	439	80.3
4-6	91	16.6
7-9	12	2.2
≥10	5	0.9
Apical transportation		
0-3	509	93.1
4-6	36	6.6
7-9	2	0.4
Furcal or root perforation		
0-3	540	98.7
4-6	6	1.1
7-9	1	0.2
Apical extrusion of irrigation solution		
0-3	529	96.7
4-6	18	3.3
Management of Complication		
Management of the complication and completion of the treatment by the same dentist	337	61.6
Referral of patient to an endodontist	30	5.5
Extraction of tooth	0	0
Follow-up and extraction in case of failure of treatment	180	32.9

Contd...

Table 1: Contd...

Question	Frequency	Percentage
Proposed solutions		
Reduction in clinical workload	63	11.5
Improvement/renewal of instruments used in the clinic	284	51.9
Working with a specialist dentist in the same hospital/increasing the number of specialists	68	12.4
Satisfied with the current situation	46	8.4
Increasing professional training opportunities	72	13.2
Other	14	2.6

Table 2: Comparison of stress levels according to the average number of root canal treatments per week and allocated treatment time

	Stress levels during root canal treatment (Frequency/Percentage)				*P*
	Not stressful	Slightly stressful	Moderately stressful	Very stressful	
Number of root canal treatments per week					
0-5	8 (6.2)[a]	43 (33.1)	58 (44.6)[a,b]	21 (16.2)	<0.001
6-10	19 (11.6)[a]	45 (27.4)	83 (50.6)[b]	17 (10.4)	
11-15	18 (14.8)[a]	40 (32.8)	52 (42.6)[a,b]	12 (9.8)	
16-20	7 (14.6)[a,b]	19 (39.6)	20 (41.7)[a,b]	2 (4.2)	
>20	28 (33.7)[b]	29 (34.9)	22 (26.5)[a]	4 (4.8)	
Time spent for single visit treatments					
<20 min	3 (20)	5 (33.3)	3 (20)	4 (26.7)[a]	0.012
20-40 min	20 (18.2)	47 (42.7)	39 (35.5)	4 (3.6)[b]	
40-60 min	34 (12.8)	81 (30.6)	123 (46.4)	27 (10.2)[a,b]	
>60 min	23 (14.6)	43 (27.4)	70 (44.6)	21 (13.4)[a]	

Data with different letters indicate significant differences within each column ($P<0.05$)

in Table 4. Amongst the clinicians who experienced instrument separation 4–6 times/week, the number of clinicians who spent 40–60 minutes or more than 60 minutes per root canal treatment was significantly lower in comparison to the number of clinicians who spent 20–40 minutes ($P < 0.05$).

Discussion

The present study on the endodontic workload of Turkish dentists showed that Turkish dentists performed root canal treatment regularly; this was more frequent than the dentists in the US, the UK, and the Ivory Coast.[6,10,11] This result is also compatible with a study conducted in Turkey that demonstrated that 40.7% of Turkish dentists treated more than 10 endodontic cases per week.[12] We found that 46.3% of the participants treated more than 10 endodontic cases per week. The difference between the studies might be attributed to the increased expectations of patients to retain their teeth.

Only 28.7% of the participants stated that they were able to offer 60 minutes or longer time for a single-visit root canal treatment. Eighty-eight percent of Australian endodontists reported that they estimated their single-visit root canal treatment time to be longer than 60 minutes.[13] This difference is partly expected since endodontists might accept referred patients with more complicated cases that might take a longer time to deal with, and our study participants included dentists from various backgrounds, which was not limited to endodontists.

The majority of dentists in the USA and endodontists in Australia reported their preference for single-visit root canal treatment.[11,13] A study showed that in Turkey, dentists' preference for single-visit root canal treatment varied between 1.8% and 80.5% of the cases depending on the clinicians' experience and the particular case.[14] In our study, 50.2% of the respondents stated that they preferred single-visit treatment for the majority of the cases. However, this was found to be lower for dentists in India (26%).[15] Consequently, the results of studies on the preference for single-visit treatment varied between countries and the year in which the study was conducted.

Endodontic treatment was found to be more stressful than restorative and periodontal treatment by undergraduate students.[16] A recent study revealed that more than half of the fifth-year Polish dental students confirmed that they experienced high or moderate levels of stress during endodontic treatment.[17] Similarly, high levels of stress was reported by general dental practitioners in Sweden during root canal treatment.[18] Twenty-nine percent of

Table 3: Comparison of endodontic complication frequency according to the average number of root canal treatments per week

	Average number of root canal treatments per week					*P*
	0-5	6-10	11-15	16-20	>20	
Instrument separation						
0-3	127 (97.7)[a,b]	160 (97.6)[a,b]	120 (98.4)[b]	48 (100)[a,b]	74 (89.2)[a]	0.013
4-6	3 (2.3)[a,b]	3 (1.8)[b]	2 (1.6)[a,b]	0 (0)[a,b]	8 (9.6)[a]	
7-9	0 (0)	1 (0,6)	0 (0)	0 (0)	1 (1,2)	
Ledge formation						
0-3	126 (96.9)	161 (98.2)	117 (95.9)	48 (100)	77 (92.8)	0.203
4-6	3 (2.3)	3 (1.8)	5 (4.1)	0 (0)	6 (7.2)	
7-9	1 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	
Unable to reach apical construction						
0-3	109 (83.8)	134 (81.7)	87 (71.3)	38 (79.2)	71 (85.5)	0.220
4-6	20 (15.4)	24 (14.6)	28 (23)	9 (18.8)	10 (12)	
7-9	1 (0.8)	3 (1.8)	6 (4.9)	1 (2.1)	1 (1.2)	
≥10	0 (0)	3 (1.8)	1 (0.8)	0 (0)	1 (1.2)	
Apical transportation						
0-3	125 (96.2)	156 (95.1)	108 (88.5)	41 (85.4)	79 (95.2)	0.051
4-6	4 (3.1)	8 (4.9)	14 (11.5)	6 (12.5)	4 (4.8)	
7-9	1 (0.8)	0 (0)	0 (0)	1 (2.1)	0 (0)	
Furcal or root perforation						
0-3	126 (96.9)	163 (99.4)	121 (99.2)	48 (100)	82 (98.8)	0.649
4-6	3 (2.3)	1 (0.6)	1 (0.8)	0 (0)	1 (1.2)	
7-9	1 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	
Apical extrusion of irrigation solution						
0-3	127 (97.7)	160 (97.6)	113 (92.6)	47 (97.9)	82 (98.8)	0.074
4-6	3 (2.3)	4 (2.4)	9 (7.4)	1 (2.1)	1 (1.2)	

Data with different letters indicate significant differences within each row ($P<0.05$)

Turkish dentists experienced burnout which was more common than dentists from the US and Europe.[19] The results of the study showed that 53.2% of Turkish dentists found root canal treatment to be moderately or very stressful. Recently graduated dentists in the UK expressed a lower degree of confidence in root canal treatment in comparison to dentists who had more than five years of experience.[20] Considering the fact that more than half of the participants (50.6%) had five years or less of experience, higher stress levels with regard to performing root canal treatment were expected.

Thirty-seven percent of private dentists from Denmark reported "Too heavy workload" as a stressor.[21] Our results revealed a negative correlation between endodontic workload and perceived stress, which is statistically significant at slight and moderate stress levels. The null hypothesis was therefore rejected. These results contradict with a previous study that found a relationship between emotional exhaustion and an increased number of patients.[19] This difference could result from the participation of specialist dentists or dentists with a higher educational level (31.7%) who are likely to perform root canal treatment more often than general practitioners which led to familiarity with endodontic procedures. In relation to this finding, it is also accepted that repetition of a certain procedure is key for improving clinical skills.[22]

Sixty-four point four percent of dentists in the UK reported "Working under constant time pressure" as a stressor.[23] Amongst the clinicians who felt "very stressful" during the treatment, the clinicians who were able to spend only 20 minutes or less time per treatment had the highest frequency and their numbers were significantly higher than clinicians who spent 20–40 minutes per treatment. This result was compatible with the aforementioned study in terms of the effect of time pressure on stress levels of clinicians.

Decisional self-esteem is negatively correlated with high levels of anxiety of dentists.[24] However, higher levels of stress was not found to be an influencing factor on the accuracy of preparation of root canals.[25] Since the stressful nature of dental care is expected, the maintained performance of dentists under stress is important and stress management should not be underestimated by undergraduate curriculums. On the other hand, stress management is also important for the quality of life and health of dentists, since high work

Table 4: Comparison of endodontic complication frequency according to allocated treatment time

	Time spent for single visit treatments				*P*
	<20 min	20-40 min	40-60 min	>60 min	
Instrument separation					
0-3	12 (80)[a]	101 (91.8)[a]	261 (98.5)[b]	155 (98.7)[b]	<0.001
4-6	2 (13.3)[a]	9 (8.2)[a]	4 (1.5)[b]	1 (0.6)[b]	
7-9	1 (6.7)[a]	0 (0)[b]	0 (0)[b]	1 (0.6)[ab]	
Ledge formation					
0-3	14 (93.3)	103 (93.6)	260 (98.1)	152 (96.8)	0.239
4-6	1 (6.7)	6 (5.5)	5 (1.9)	5 (3.2)	
7-9	0 (0)	1 (0.9)	0 (0)	0 (0)	
Unable to reach apical construction					
0-3	8 (53.3)[a]	80 (72.7)[a]	224 (84.5)[b]	127 (80.9)[a,b]	0.002
4-6	4 (26.7)	24 (21.8)	36 (13.6)	27 (17.2)	
7-9	2 (13.3)[a]	4 (3.6)[a,b]	3 (1.1)[b]	3 (1.9)[a,b]	
≥10	1 (6.7)[a]	2 (1.8)[a,b]	2 (0.8)[a,b]	0 (0)[b]	
Apical transportation					
0-3	13 (86.7)	97 (88.2)	248 (93.6)	151 (96.2)	0.228
4-6	2 (13.3)	12 (10.9)	16 (6)	6 (3.8)	
7-9	0 (0)	1 (0.9)	1 (0,4)	0 (0)	
Furcal or root perforation					
0-3	15 (100)	106 (96.4)	264 (99.6)	155 (98.7)	0.096
4-6	0 (0)	4 (3.6)	1 (0.4)	1 (0.6)	
7-9	0 (0)	0 (0)	0 (0)	1 (0.6)	
Apical extrusion of irrigation solution					
0-3	14 (93.3)[ab]	103 (93.6)[b]	262 (98.9)[a]	150 (95.5)[a,b]	0.039
4-6	1 (6.7)	7 (6.4)	3 (1.1)	7 (4.5)	

Data with different letters indicate significant differences within each row ($P<0.05$)

stress is associated with less exercise, less sleep, and more alcohol use by dentists.[23] Moreover, developing better interpersonal communication skills through continuing dental education might be beneficial due to the fact that positive dentist–patient communications and peer contacts are helpful for dentists to be able to cope with high job demands.[26] Involvement in teaching activity, which might lead to a self-image of "being useful", also seems to lower stress levels of doctors and dentists.[27]

Due to the multi-staged and technical precision demanding nature, various complications can occur during root canal treatment at any stage.[28] Endodontic complications hamper a complete elimination of intracanal microorganisms; thus, these complications might lead to a negative outcome in the treatment and require surgical or nonsurgical intervention or tooth extraction which result in consideration of a further prosthodontic treatment plan.[29,30] It was also reported that a considerable rate of endodontic cases (32%) have a procedural error.[31]

Similar to a previous study, there was no correlation between the root canals performed per week and endodontic complications occur, apart from instrument separation in root canal.[6] An overwhelming majority of respondents reported that they experienced the aforementioned endodontic complications three times or less in a week. In relation to these results, more easily reachable scientific courses and lectures, participation of dentists with a postgraduate background in endodontology, and use of superior instruments might be the reasons.

Intracanal instrument separation is an intraoperative endodontic complication that occurs in 0.5% to 5% of cases.[32–34] Amongst the clinicians who experienced instrument separation 4–6 times/week, the number of clinicians who performed root canal treatment more often than 20 times/week was significantly higher in comparison to clinicians who performed root canal treatment fewer than 6 times/week. A similar pattern could be observed when chair-time spent per single-visit root canal treatments are taken into consideration. Amongst the clinicians who experienced instrument separation 4–6 times/week, the number of clinicians who spent 40–60 minutes or more than 60 minutes per root canal treatment was significantly lower in comparison to the number of the clinicians who spent 20–40 minutes. Similarly, it was found that three or less instrument separations per week was experienced significantly more

often by clinicians who spent 40–60 minutes or more than 60 minutes per treatment than whose who spent 20–40 minutes or less than 20 minutes. These results are reasonable since root canal preparation demands high precision, skilled labor, and therefore a sufficient amount of time.

Locating the apical constriction was found to be one of the most challenging aspects of root canal treatment, especially for dental students who just entered the clinic stage of education.[35] It is shown that every 1-mm loss of working length increases the failure rate by 14% in teeth with apical periodontitis.[36] While there was no correlation between the number of treatments per weeks and the number of the unreached apical construction per week, amongst the clinicians who are not able to reach the apical construction three times or fewer per week, clinicians who spared 40–60 minutes per treatment had significantly higher quantity in comparison to clinicians who spent 20–40 minutes or less than 20 minutes. Dealing with a root canal with a greater curvature and smaller diameter could be challenging and time-consuming; the result that spending more time results in less frequency in unreached apical construction is also expected. Additionally, although it might seem as a limitation of this study that only intraoperative complications were covered, the majority of endodontic complications occurred during the procedure.[37]

To improve the general quality of endodontic treatments of dentists, taking dentists' feedback into consideration might be useful. Dentists tend to prefer hands-on courses and continuing educational courses over other forms of lifelong learning.[38] On the other hand, dental students have expressed their need to treat higher number of patients during undergraduate education and they reported "problem-solving" as the topic that should be specifically underlined.[39] The practical component of undergraduate education aims to teach relatively basic procedures and aspects of root canal treatment, and dental students perform in an environment where clinical tutors' help is readily available. Therefore, hands-on courses in relation to problem-solving in endodontics and further development of undergraduate endodontics curriculum with an emphasis on complication management might be beneficial.

The majority of participants (61.6%) reported that they undertake the management and complication of the treatment, while a considerable minority (32.9%) reported that they follow up the case and consider extraction in case of failure. The low referral rate (5.5%) and the high self-management (including extraction) rate might be related to the few number of endodontists in Turkey and due to the fact that dentists, in general, tend to be populated in certain regions in Turkey, and therefore referral to an endodontist might not be a viable option in every case.[40] None of the participants considered direct extraction of the tooth since the majority of intraoperative endodontic complications were manageable and tooth survival was expected by patients as well.

Only 8.4% of the participants stated that they were satisfied with the working conditions. More than half of the respondents (51.9%) suggested that improvement or renewal of instruments used in the clinic was necessary for the betterment of the quality of work and their stress levels. The authors of this study are in agreement that financial issues play a crucial role in this aspect of improvement of quality of work and working conditions, and dentists, especially those who work as employees, are reasonable to demand better quality of equipment. The most commonly suggested solutions were increasing professional training opportunities (13.2%), working with a specialist dentist (12.4%), and reduction in clinical workload (11.5%). Therefore, it might be speculated that general practitioner dentists are able to cope with the majority of endodontic complications when high-quality instruments and proper training opportunities are provided.

Conclusion

Although developing an adaptive response to stress subsequently might be the case, the Ministry of Health, dental schools, and dental associations should still have a common goal to improve the coping mechanisms of dentists, the quality of dental equipment, and their knowledge of endodontics. We also conclude that further studies need to take time pressure into consideration when stress levels of clinicians and the quality of endodontic treatment are evaluated.

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Conflicts of interest

There are no conflicts of interest.

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