



Concerns and Problems of Orthodontic Patients during the COVID-19 Pandemic

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ABSTRACT

Objectives: We aimed to find the main concerns of patients undergoing active orthodontic treatments and their orthodontic treatment-related (OTR) problems during the coronavirus disease-2019 (COVID-19) pandemic.

Materials and Methods: A researcher-made questionnaire addressing several aspects of the effects of COVID-19 pandemic on treatment was distributed among 181 orthodontic patients receiving active treatment. Anxiety, concern, problems, and willingness to attend orthodontic appointments and to undergo other dental procedures was questioned. The correlation of gender, age, COVID-19-related anxiety and OTR anxiety was statistically analyzed. Patient satisfaction level with different aspects of dental-clinic performance was also evaluated.

Results: The participants included 117 females and 64 males, of which 94% adhered to the pandemic restrictions. The mean COVID-19-related- and OTR-anxiety were 51.7% and 52.7%, respectively. Higher COVID-19-related anxiety was significantly correlated with higher OTR anxiety ($P < 0.001$). There was an inverse correlation between general COVID-19-related anxiety and OTR anxiety and willingness to attend orthodontic appointments ($P < 0.05$). A positive insignificant ($P = 0.07$) correlation existed between age and willingness to attend appointments. The main concern was prolongation of treatment and the most common problem was irritation of oral soft tissues by appliances. The majority (65.3%) were willing to attend their orthodontic appointments. Orthognathic surgery (62%) had the highest while, dental restorations and radiography had the lowest refusal rates (9.9%).

Conclusion: COVID-19 pandemic significantly affected orthodontic treatment. The level of COVID-19-related anxiety was moderately high and patients were concerned about the impact of lockdown on their orthodontic treatment outcome. Young adults demonstrated higher levels of stress than other age-groups.

Keywords: COVID-19; Orthodontics; Surveys and Questionnaires; Anxiety

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INTRODUCTION

The coronavirus disease-2019 (COVID-19)

outbreak raised a worldwide concern, and due to its rapid person-to-person transmission, it

promptly turned into a pandemic [1,2]. Several countries implemented mandatory lockdowns which included closure of all universities and suspension of all non-essential activities of institutions [3]. Home quarantine is an unpleasant experience and its consequences could negatively impact the mental health of individuals [4]. Data from previous investigations showed that pandemics carry serious psychological burden [5]. Thus, the psychological impacts of COVID-19 pandemic should receive more attention from the media and healthcare policy makers.

Since the most common mode of COVID-19 transmission is through virus-containing aerosols and droplets, aerosol-generating dental procedures can significantly increase the risk of COVID-19 spread. Also, the risk of cross-contamination in dental offices is high [6,7]. Accordingly, it was recommended to interrupt elective dental procedures and offer only emergency-care during the pandemic [8,9].

Orthodontic treatment is not considered as an urgent dental procedure, and was therefore suspended during the COVID-19-related lockdown. While patients who sought other elective dental procedures could postpone their appointments, active orthodontic patients who required regular visits were not able to receive the needed care. Although most of the procedures during fixed orthodontic treatment are not aerosol-generating, many dentists and patients refused to continue treatment due to the mandatory lockdown or their personal COVID-19-related concerns. It has been reported that the COVID-19 pandemic had a significant impact on orthodontic practice [10,11]. Negative feelings and orthodontic problems reportedly increased [12,13], and most orthodontists believe that the pandemic would affect their future practice [14]. The impact of the pandemic and quarantine on orthodontic patients' anxiety and their concerns about their treatment was evaluated in other countries. In Brazil, it was reported that COVID-19-induced-anxiety was correlated with patients' willingness to attend orthodontic appointments and the quarantine developed concerns in patients about their

ongoing orthodontic treatment, especially the potential delay in their treatment. [15] Nigerian orthodontists and orthodontic residents perceived that COVID-19 pandemic had economic, psychosocial, and social impacts on the patients and they reported that they would place a greater emphasis on infection control due to patients' concern [14].

The aim of the present study was to find the main concerns of orthodontic patients undergoing active treatment during the COVID-19 pandemic lockdown and evaluate how orthodontic patients perceived the impact of COVID-19 on the outcome of their treatment. It also assessed the problems that orthodontic patients faced during the suspension of dental services, and their willingness to attend orthodontic appointments or seek other dental procedures during the pandemic.

MATERIALS AND METHODS

This cross-sectional study was conducted in fall of 2020 and was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.DENTISTRY.REC.1399.163). Active orthodontic patients with fixed appliances whose treatment had started before the pandemic at the postgraduate Orthodontic Department of Tehran University of Medical Sciences were enrolled and convenience sampling was applied. Patients with a history of systemic and psychological problems or those who were not interested to participate were excluded.

A researcher-designed questionnaire was developed in a panel discussion of a five-member team composed of orthodontists at the Orthodontic Department. Some of the items from the study by Cotrin et al [15] were addressed in addition to a number of more important issues. The final questionnaire consisted of the following five domains:

(I) Background information, such as age, gender, history of COVID-19 infection, being a healthcare worker, duration of orthodontic treatment, and level of adherence of the participants to COVID-19-related restrictions. (II) The anxiety of patients in two aspects: general anxiety associated with the COVID-19 pandemic and anxiety due to the effect of

COVID-19-related lockdown on patients' orthodontic treatment [Orthodontic treatment-related (OTR) anxiety]. The level of anxiety was assessed by a numerical ratio scale (NRS) from zero to 10. Zero represented no anxiety and 10 represented the maximum level of anxiety.

(III) The OTR problems that occurred for the patients during the lockdown period

(IV) Patients' confusion about how to continue their orthodontic treatment during the lockdown period along with patient satisfaction with the performance of their healthcare providers in informing and guiding them during the suspension of dental care services.

(V) Willingness of patients to seek other dental services required, if they were referred by their orthodontists.

To assess the face validity of the questionnaire, it was completed by several orthodontic patients in a face-to-face interview and then the items were discussed with the interviewees to find the vague phrases and modify them.

After signing informed consent forms, the participants filled out the questionnaire in their first orthodontic appointment after the lockdown period. For those patients who refused to attend their appointment, the questions were asked over the phone. The participants were reassured about the confidentiality of their information.

Statistical analysis

The relationship of age, sex and history of COVID-19 with the pandemic-related anxiety level and its effect on orthodontic treatment were analyzed by the logistic regression test. Due to the significant interaction of gender and other independent variables, data analyses were performed separately for females and males. The regression analysis was used to evaluate the correlation of age, gender, and history of COVID-19 with COVID-19-related anxiety and orthodontic-related anxiety.

RESULTS

One hundred eighty-one orthodontic patients with a mean age of 19.32 ± 6.16 (12

to 39) years filled out the questionnaire. The respondents consisted of 64 (35.4%) males and 117 (64.6%) females. The mean duration of participants' orthodontic treatment was 25.78 ± 16.97 months. Most participants (77.9%) had no history of COVID-19 infection. Also, the majority of patients (80.7%) were not healthcare workers, neither themselves nor their family members.

When the patients were asked whether they adhered to the COVID-19-related restrictions and guidelines, and how it affected their occupation, it was found that most participants respected the regulations and only 6.1% left home as usual without any limitation (Figure 1).

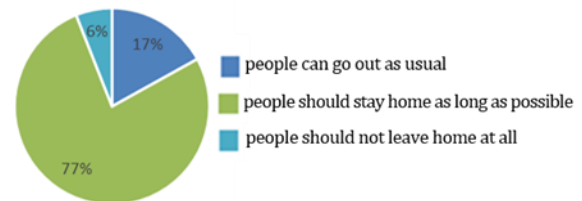


Fig. 1. Distribution of participants according to their attitude about adherence to COVID-19 related restrictions during the pandemic

The majority of the participants reported that they stayed home as much as possible and performed their occupational or educational activities from home (71.3%). Almost none of the patients stated that they would do their activities the same way as they did before the pandemic (Figure 2).

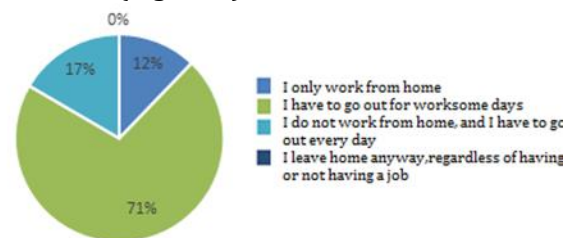


Fig. 2. Distribution of participants according to their answer about their occupational or educational status.

The mean pandemic-related anxiety level of participants according to the NRS was 5.17 ± 2.84 out of 10. The mean OTR anxiety level of patients was 5.27 ± 2.68 using the same scale.

When the patients were asked whether the COVID-19-related lockdown confused them about how to continue their routine orthodontic visits, the mean level of confusion was reported to be 3.80 ± 2.93 out of 10. The mean level of patient satisfaction with the performance of their healthcare providers in informing and guiding them during the suspension of dental care services was 7.56 ± 2.11 . The mean level of patient satisfaction with the performance of healthcare workers during the COVID-19 pandemic with regard to adherence to the protective guidelines was 7.72 ± 2.16 out of 10 (Table 1).

The concerns of patients with regard to the adverse effects of COVID-19-related lockdown on their orthodontic treatment and the challenges they faced are summarized in Table 2. The major concern of orthodontic patients was prolongation of their treatment course (113 patients out of 181). However, 25 participants

(13.8%) reported that they had no OTR concern. The majority of patients reported that they were willing to attend their orthodontic appointments during the pandemic (65.3%); while, 34.1% reported that they would attend only in case of emergency.

One patient (0.6%) reported that he was no longer willing to continue his treatment.

The dental procedures that the majority of patients were willing to do without fear were scaling and root planing followed by dental restorations, and the procedure with the highest refusal rate was orthognathic surgery (Figure 3). Of the participants who reported positive history of COVID-19 infection, 70% were willing to attend their orthodontic appointments.

There was a significant correlation between the general COVID-19-related anxiety and OTR anxiety (Pearson’s correlation coefficient=0.74 and $P < 0.001$).

Table .1. Numerical rating scale (0 to 10) score for different variables among a sample of orthodontic patients (n=181)

	Mean	Median	SD
General COVID-19 stress	5.17	2.84	5
Stress associated with orthodontic treatment	5.27	2.68	5
Feeling confused about how to continue treatment	3.80	2.93	3
Satisfaction with the performance of healthcare providers in guiding patients	7.56	2.11	8
Satisfaction with the performance of healthcare providers in adherence to protective protocols	7.72	2.16	9

SD: Standard deviation

Table 2. Orthodontic patients’ concerns and problems during the COVID-19 quarantine period

Patients’ concerns	N	%	Patients’ problems	N	%
Prolongation of treatment course	113	62.8	Traumatization of the lips and cheeks by the wire	77	42.5
Impairment of treatment outcome	51	28.2	Fracture of orthodontic bands or brackets	55	30.4
Soft tissue traumatization by the broken orthodontic appliance	35	19.3	Financial problems to pay the treatment fees	45	24.9
Appliance fracture might cause improper tooth movement	32	17.7	Toothache	42	23.2
I’m not worried	25	13.8	Improper dental movement	24	13.3
Others	10	5.5	Gingival swelling and bleeding	16	8.8

N: Number

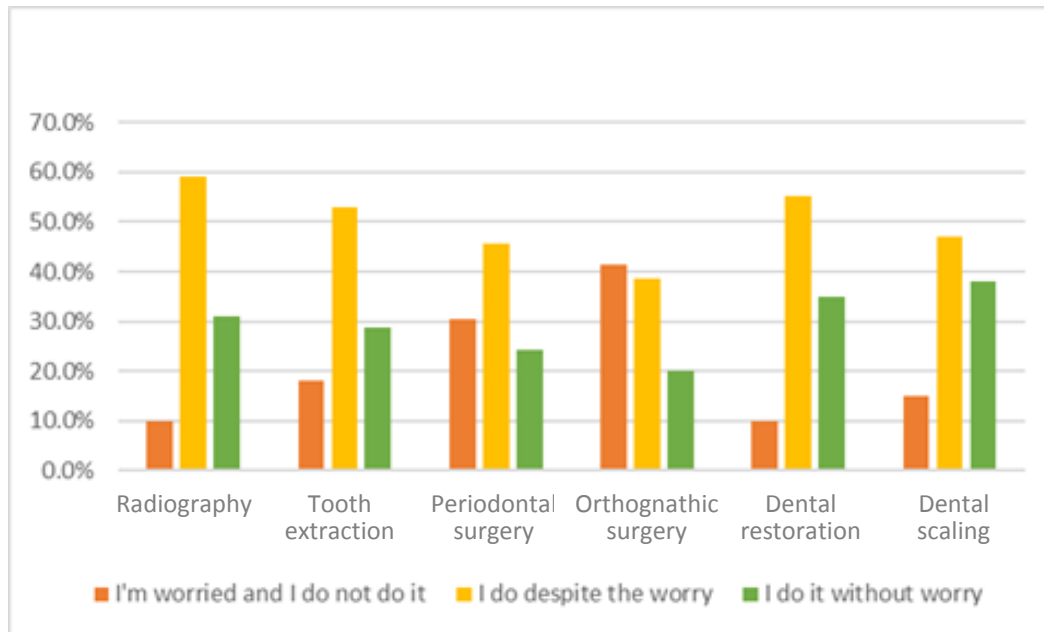


Fig. 3. Willingness of the participants to seek other dental services in case they would be referred by their orthodontist

The correlation between willingness to attend orthodontic appointments and other variables was assessed by the logistic regression analysis. There was an inverse correlation between general COVID-19-related anxiety and OTR anxiety and willingness to attend orthodontic appointments ($P < 0.05$). There was a positive correlation between age and willingness to attend orthodontic appointments although this correlation was not significant ($P = 0.07$). No correlation was observed between other variables, such as gender, positive history of COVID-19 infection, being a healthcare worker, orthodontic treatment duration, adherence to quarantine restrictions, and individual activity-related status (whether they worked from home or not) with willingness to attend orthodontic appointments ($P > 0.05$). Considering age and OTR anxiety independently, there was a significant correlation between these two variables and willingness to attend orthodontic appointments. Older participants had 0.80 higher probability to attend their orthodontic appointments (odds ratio=1.80; 95% CI=1.03-3.14, $P = 0.04$).

Also, patients with higher level of OTR anxiety had lower probability to attend their orthodontic appointments by 0.15 (odds ratio=0.85; 95% CI=0.75-0.96; $P = 0.01$).

Since the interaction of gender and other variables was significant, statistical analysis was independently performed for males and females.

Accordingly, the bivariate analysis was applied with a general linear model to show the relationship of different variables with general COVID-19-related anxiety separately in males and females. It was observed that females who adhered to COVID-19-related restrictions had significantly higher anxiety level ($P = 0.034$).

Male patients who reported higher pandemic-induced financial problems had significantly higher anxiety level as well ($P = 0.041$). Mean level of general COVID-19 related anxiety and mean level of orthodontic treatment-related anxiety by gender in different age groups are demonstrated in figure 4 and 5 respectively. Tables 3 and 4 show the bivariate and multiple analyses of the correlation of OTR stress with some qualitative variables.

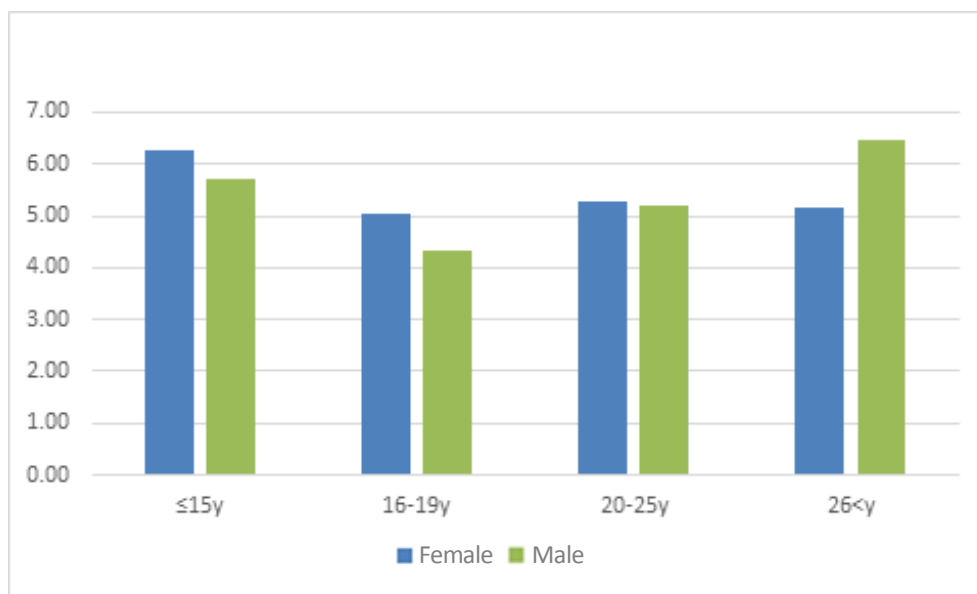


Fig. 4. Mean level of general COVID-19 related anxiety by gender in different age groups

In order to assess the correlation of OTR stress and other quantitative variables, a general linear model was applied which showed that the level of patients' confusion about how to continue their treatment had a

positive significant correlation with their OTR ($P=0.001$), and according to the regression correlation coefficient (0.0283), this correlation was greater in females than males.

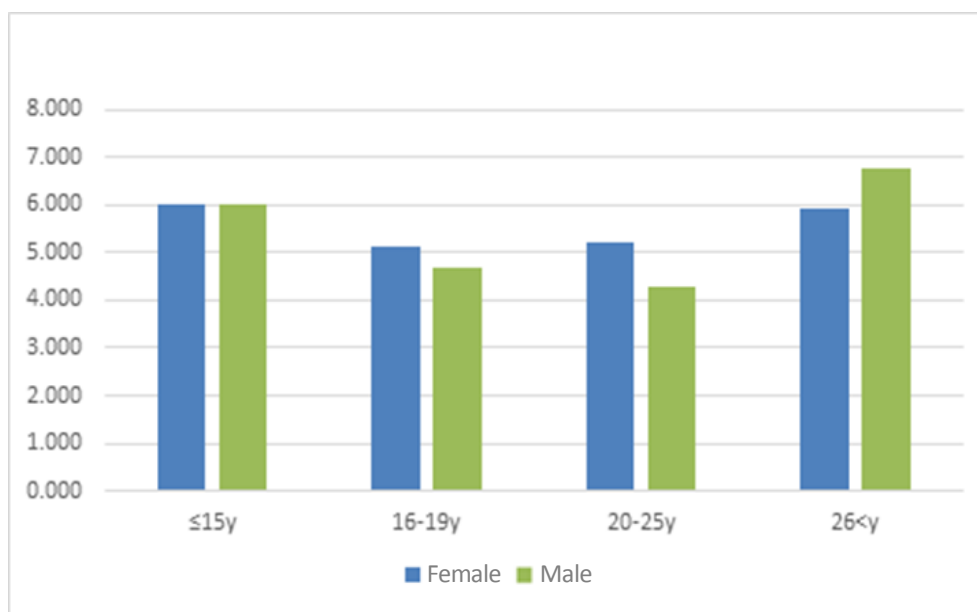


Fig. 5. Mean level of orthodontic treatment-related anxiety by gender in different age groups

Table 3. Correlation of orthodontic-related anxiety and different variables according to bivariate analysis among a sample of orthodontic patients (n=181)

			Mean	SE	P
Orthodontic treatment duration (months)	Female	≤ 24 months	5.17	0.304	0.434
		> 24 months	5.57	0.406	
	Male	≤ 24 months	4.59	0.436	0.037*
		> 24 months	6.08	0.544	
Disrupting the final result (patient concern)	Female	Yes	0.01	0.011	0.011*
		No	6.31	0.453	
	Male	Yes	5.47	0.645	0.579
		No	5.04	0.419	
I'm not worried (patient concern)	Female	Yes	3.46	0.655	0.003*
		No	5.58	0.251	
	Male	Yes	4.4	0.885	0.346
		No	5.31	0.381	
Willingness to seek orthodontic treatment	Female	I am willing	4.96	0.302	0.034*
		Only in case of emergency/ I am not willing	6.07	0.424	
	Male	I am willing	4.95	0.432	0.249
		Only in case of emergency/ I am not willing	5.78	0.570	
Fracture of orthodontic bands or brackets (patient problem)	Female	yes	5.32	0.498	0.990
		No	5.31	0.279	
	Male	Yes	6.11	0.520	0.021*
		No	4.48	0.444	
Gingival swelling and bleeding (patient problem)	Female	yes	6.87	0.920	0.082
		No	5.20	0.249	
	Male	Yes	7.5	0.946	0.011*
		No	4.83	0.357	

SE: standard error;

* Significant

Table 4. Correlation of orthodontic-related anxiety and different variables according to bivariate and multiple analyses among a sample of orthodontic patients (n=181)

			Mean	SE	P
Females	I'm not worried (no concern was reported)	Yes	5.56	0.25	0.019*
		No	3.83	0.67	
	Disrupting the final result (patient concern)	Yes	6.25	0.45	0.021*
		No	4.99	0.28	
Males	Orthodontic treatment duration (months)	≤24 months	5.45	0.52	0.021*
		>24 months	7.06	0.63	
	Gingival welling and (patient problem)	Yes	7.41	0.9	0.020*
		No	5.1	0.34	

SE: standard error;

* Significant

DISCUSSION

The COVID-19 pandemic had a tremendous impact on the dental healthcare profession. This is especially true about orthodontics in which frequent treatment sessions are essential. Although orthodontic procedures do not necessarily generate aerosol and emergency appointments are not frequently required, many problems may occur if patients do not have access to their orthodontist for a long time, such as appliance fracture, or unwanted tooth movement. Accordingly, the aim of the present study was to assess the orthodontic patients' anxiety and concerns, and to identify the problems they encountered during the COVID-19-related lockdown. It was observed that COVID-19 pandemic increased patients' anxiety and also made them concerned about their orthodontic treatment. Moreover, it affected their willingness to attend their orthodontic appointments and other dental procedures. The level of compliance with the COVID-19-related restrictions was high in the study population.

The mean level of COVID-19-related anxiety of patients was not very high (5.17 ± 2.84 out of 10) indicating moderate anxiety level. Albeit, the present study was concurrent with the third wave of the COVID-19 in Iran with an average daily infection rate of 4000-14,000 new cases and 140-480 daily mortality toll which was the highest relative to previous waves [16]. In countries with high incidence rate of COVID-19 such as Brazil, the level of anxiety was more similar to the current study [15,17].

A study in China reported an average anxiety level of about 34% which is lower than that in the Iranian population [18]. This finding is probably due to the higher incidence rate of COVID-19 in Iran or financial and political problems, such as inflation and sanctions which make the Iranian population more vulnerable to anxiety.

The level of patients' anxiety regarding the adverse effects of lockdown on their orthodontic treatment outcome was also moderate (5.27 ± 2.68 out of 10). As shown, the level of the two types of anxiety was somehow

similar. In Brazilian orthodontic patients [15], the OTR anxiety was less than the general level of COVID-19-related anxiety. The most common concern of patients was prolongation of their orthodontic treatment course, followed by impaired treatment outcomes. This result was in accordance with that of Xiong et al, who reported mental distress in over one-third of orthodontic patients and pointed to patients' concerns about the prolonged treatment duration [11].

The most commonly reported patient problem was traumatization of the lips and cheeks by orthodontic appliances, followed by band or bracket fracture/debonding which was predictable in the quarantine situation. The next common problem was financial problems for paying the treatment fee. During the 2020 quarantine caused by the COVID-19 pandemic, many industrial activities were suspended which significantly impacted the financial status of the people. Generally, acute and severe problems such as toothache, unwanted tooth movement, and gingival inflammation and bleeding were rarely reported. Although the elective dental procedures and educational activities were suspended in the Dental School of Tehran University of Medical Sciences, the emergency services including emergency orthodontic visits were performed at this dental clinic. Thus, patients and clinicians were not totally disconnected during the quarantine period. During the COVID-19 pandemic, national restrictions in the activities of level 2 and level 3 occupations were set by the government, as well as restrictions regarding intercity and between-city travels. This could cause some problems for patients to access their clinicians.

According to the results of the current study, the participants who respected the restrictions (never left home or just left home if necessary) showed higher level of fear about the effect of pandemic on their orthodontic treatment and they had less desire to attend their orthodontic appointments. This finding can be interpreted so that, these people have psychologically higher level of anxiety or at least express their anxiety more strongly.

Moreover, their stress regarding contracting the COVID-19 dominated their stress regarding impaired orthodontic treatment outcome.

The OTR anxiety in patients who were interested to attend their treatment appointments was lower than that in patients who were not interested. It means that having a higher level of stress about the adverse effects of pandemic on their treatment outcome does not necessarily mean that they are more interested to attend their treatment sessions.

Our results demonstrated that up to the age of 25 years, males were calmer than females and the COVID-19-related anxiety and OTR anxiety were both higher in females; however, in higher age groups, males had greater anxiety levels. This was in accordance with similar studies on other populations [15,18]. The highest level of anxiety was observed in females under 15 years of age while the lowest anxiety level was in 15-19-year-olds regardless of gender, which can be attributed to pubertal changes. The noticeable point is that after the age of 25 years, the level of COVID-19-related anxiety was considerably higher in males in all age groups. Recent studies demonstrated that young adults generally have higher level of anxiety in the pandemic compared with older people and they are more prone to psychological problems during a disease epidemic [18,19]. With regard to willingness to attend orthodontic visits, the majority of the participants reported that if they were contacted to schedule a follow-up visit, they would show up for their appointment and they were willing to continue their orthodontic treatment. Thus, clinicians should be further prepared for pandemic situations since missing the appointments would result in prolongation of treatment course [20]. Among patients who were willing to continue their treatment, 75 cases were females, which accounts for 64% of all female participants. This rate was 62 % for males, which shows a slightly greater willingness to continue orthodontic treatment in females than males. This finding was not in accordance with the

results of a similar study on the Brazilian population in which, males were more willing to attend their orthodontic appointments and had less stress about prolongation of their treatment course [15]. This may be due to the fact that women feel safer while staying at home and visiting their orthodontist only in emergency situations.

Considering the orthodontic treatment duration, more than half of the patients had between 7-24 months of orthodontic treatment, and 67 patients had more than 24 months of treatment. The latter group expressed higher OTR anxiety and were more willing to attend their orthodontic visits. It seems that since the latter group was in the final stages of their treatment, they were tired and impatient. Moreover, male patients with broken brackets and those experiencing mucosal or gingival inflammation and bleeding expressed higher OTR anxiety. This could be due to the costs of bracket rebonding or being bothered by the broken appliance.

The two variables of age and OTR anxiety had significant independent correlations with willingness to attend the appointments, which means that, regardless of age, the more the anxiety level, the less the willingness to attend orthodontic appointments. Regardless of the level of OTR anxiety, the older the patient, the more the willingness to attend the appointments. This finding was similar to the results of Cotrin et al, who reported that the level of anxiety had a significant inverse correlation with willingness to attend the appointments [15].

The level of satisfaction of patients participating in the present study with the performance of dental clinic in informing and guiding them during the quarantine period was 7.56 ± 2.11 out of 10, which was moderately high. The mode of informing patients was via a phone call, or social media apps such as WhatsApp. Probably for this reason, the level of confusion of patients to continue their treatment was low. Communicating with patients would definitely give them more confidence and builds their trust in their orthodontist and the staff, and would decrease their stress and anxiety about

their orthodontic treatment. It has been reported that the physician-patient communication is the most important factor in patient satisfaction [21].

On the other hand, with regard to the adherence of the staff to the COVID-19-related health protocols, a high level of satisfaction was reported by patients (more than 75%); part of which was due to strict monitoring of the observance of health instructions in university medical centers and thus, this finding cannot be generalized to all dental clinics.

When the patients were asked about referral for dental services other than orthodontics, scaling acquired the highest level of acceptance by the majority of participants while they were mostly reluctant to undergo orthognathic surgery. This can be attributed to the need for hospitalization for surgery which in turn increases the risk of COVID-19 as well as its high cost which could be hardly afforded by many patients due to financial problems associated with the lockdowns during the COVID-19 pandemic. Some other studies reported the effect of financial problems on choosing cheaper treatments such as preferring tooth extraction over root canal therapy [22].

This problem is more prominent in populations with low insurance coverage for dental care services. Accordingly, healthcare policy makers should prioritize improvement of insurance coverage specially for such unpredictable social events. The fact that the participants of the current study were chosen from the university medical center, increases the possibility of them to be mainly from low socio-economic status families which can affect their financial concern more significantly.

Considering the fact that in circumstances similar to COVID-19 pandemic, dental services might be suspended for a long time which increases the patients' anxiety, orthodontists should take into consideration some treatment strategies to minimize any delay in treatment process by reducing the dependence of the treatment procedure to face-to-face appointments for wire exchange or appliance activation. These strategies may

include application of archwires or force exerting appliances which become inactive in longer periods of time, such as super-elastic NiTi arch wires, well designed loops, and NiTi coli springs instead of elastomeric chains [23]. From this point of view, clear aligner method in which a set of aligners are delivered to patients has this advantage, and could be recommended. Moreover, improving the telemedicine infrastructure can be helpful and should be a paradigm for future orthodontic practice. Teledentistry which is a subunit of telemedicine (or telehealth) has been used for remote facilitating of dental care via the use of information technology rather than through direct face-to-face contact with patients. Although it has been mostly used for dental screening, diagnosis, treatment planning and consultation for areas with limited access to facilities, COVID-19 pandemic situations proves that there is an essential need to incorporate teledentistry into our routine dental practice [24]. Accordingly, orthodontic practitioners should also enhance their professional facilities and skills in this area to help and guide their patients in cases of lack of access. This would be advantageous in reducing orthodontic patients' concerns.

CONCLUSION

- The COVID-19 pandemic significantly affected orthodontic treatment. The level of COVID-19-related anxiety was moderately high. Also, patients were concerned about the impact of lockdown on their orthodontic treatment outcome.
- Delay in orthodontic treatment completion was the biggest concern of patients undergoing orthodontic treatment and the most frequent reported problem was appliance breakage.
- Referral dental services other than orthodontics which were more invasive and expensive or needed hospitalization, induced more stress in patients and participants were less willing to do them. The highest reluctance rate belonged to orthognathic surgery.
- Young adults demonstrated higher levels of stress than other age groups.

CONFLICT OF INTEREST STATEMENT

None declared.

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