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Research Article

Evaluation of the Effect of COVID-19 on Patients Undergoing Orthodontic Treatment

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Abstract

Aim: COVID-19 necessitated a reassessment of existing work patterns in all professions. The aim of this study was to evaluate the physical and psychosocial effects of the pandemic on different orthodontic treatment groups.

Material and Methods: This descriptive, cross-sectional survey study evaluated data from 235 volunteers aged 18 years and older who were receiving orthodontic treatment (mean age: 23.8+5.8 years; 83 male, 152 female). The 15-item questionnaire comprised three sections: sociodemographic characteristics, the psychosocial effects during the COVID-19 pandemic, and the physical/oral symptoms in orthodontic patients who had COVID-19. Statistical significance was set at $P<0.05$.

Results: Over half (53.2%) of participants stated they attended routine orthodontic follow-up visits and felt no concern about the risk of COVID-19 transmission, while 85.9% said they were happy to receive orthodontic treatment during the pandemic. In addition, 68.1% of the participants considered the pandemic to be advantageous for orthodontic treatment, most commonly because wearing masks concealed orthodontic wires (44.3%).The most pronounced intraoral finding among patients with COVID-19 was loss of taste (5.9±4.6).

Conclusion: The COVID-19 pandemic was found to have no serious negative psychosocial effects. Mask use was reported to be the greatest advantage, while dysgeusia was one of the most common oral findings.

Keywords: COVID-19, orthodontics, pandemics, braces, clear aligner appliances

INTRODUCTION

Pandemics of varying scale and severity have occurred throughout human history. In addition to causing mass casualties, they have also wrought many economic and psychosocial consequences. Current advances in technology have made it possible for health services and personnel to reach more areas in shorter time. As a result, infection can be detected more rapidly and controlled more easily than in the past. However, international travel has also become faster, more comfortable, and more affordable, which facilitates the spread of epidemics. Therefore, it did not take long for the COVID-19 epidemic that emerged in Wuhan, China in late 2019 to spread to other continents. The World Health Organization (WHO) officially named the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection "COVID-19" on February 11, 2020 and declared it a pandemic on March 11, 2020 (1). Globally, more than 600 million cases of COVID-19 have been identified and more than 6.4 million deaths documented, with 4.2 million new cases reported between August 29 and September 4, 2022, representing a 12% decrease in the number of

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weekly cases compared to the previous week (2).

The COVID-19 pandemic, which is now in its third year, has posed a major threat to public health worldwide (3). Even when infection is controlled through effective treatment and/or vaccination, dramatic and long-term changes in lifestyle, work, and sociocultural relations are expected to affect the entire world population (4). Like other health services, dentistry has also been reshaped during this process. The COVID-19 pandemic has had a direct impact on all social environments and professions, and orthodontics is also among these occupational groups. While the physical and psychosocial effects of the pandemic are still being felt in orthodontics practice, it is estimated that some important adaptations will be reversible and some will be permanent (3).

In addition to the consequences of the pandemic for physicians, orthodontic patients' expectations from dentists, treatment priorities, and views on treatment have also changed. During the pandemic, all routine dental services were suspended in countries experiencing COVID-19 outbreaks as priority shifted to the need for organized emergency care provided by teams equipped with appropriate personal protective equipment (5). Dentistry practices pose a greater risk for the transmission of COVID-19 than many other health services because of the intense aerosol production, high viral load in the saliva of infected people, and the close face-to-face contact with patients during treatment (6). The invariable detection of SARS-CoV-2 in the oral mucosa (7) and saliva (8) of infected persons required dental health professionals and other medical personnel performing aerosol-generating procedures to be placed in the "very high risk of exposure" category (9).

Today, dental emergencies can be managed through remote triage via phone calls, e-mail, or other online methods (10). The scientific literature on tele-dentistry is extensive and mainly covers preventive dentistry practices for people living in isolated areas. While tele-dentistry in orthodontics previously encompassed diagnosis and treatment planning, it has now developed to include areas such as the follow-up of clear aligner use and the use of elastics in fixed orthodontic treatments with functional or removable appliances (10).

Compared to other branches of dentistry, the fewer emergencies in patients receiving orthodontic treatment have resulted in a different experience of the COVID-19 pandemic. The relatively long duration of orthodontic treatments and the need for regular monthly follow-up resulted in many patients having brackets or appliances at the start of the pandemic. When patients have difficulty going to their orthodontists, various problems such as soft tissue irritations, bracket failure, and noncompliance with appliance wear can occur. However, regular monthly visits may cause patients to feel uneasy about the risk of transmission involved in going to the hospital. Factors such as these led to an increase in tele-dentistry practices in orthodontics. Some patients may even consider it advantageous to undergo orthodontic treatment during the COVID-19 pandemic for reasons such as decreased socialization, more time spent at home, and the masks hiding their braces. Although the physical and psychosocial expectations of orthodontic patients have changed during COVID-19, it is important to determine the impact of the pandemic on patients at the level of public health needs. The aim of this study was to evaluate the psychosocial and physical effects of the pandemic on patients in different orthodontic treatment groups.

MATERIAL AND METHOD

This descriptive and cross-sectional study was approved by the Istanbul Medipol University Noninvasive Clinical Research Ethics Committee (E-10840098-772.02-5645). Informed consent forms explaining the study methods were signed by all individuals who participated in the study.

Study Design

The study was conducted in a single center (Istanbul Medipol University Faculty of Dentistry, Department of Orthodontics) with 235 randomly selected volunteers aged 18 and over who were undergoing orthodontic treatment. The data were obtained between February and September of 2022 using a self-administered 15-item questionnaire. In power analysis, the minimum sample size for study power of 95% with a significance level of 5% and effect size of 0.30 was calculated as 220 individuals. The survey data of 235 individuals were included in the study to increase the reliability of the results. Inclusion criteria were age of 18 years or older, voluntary participation, and no prior history of orthodontic treatment. Exclusion criteria were the presence of any craniofacial syndrome and diagnosed psychiatric problems. Questionnaire responses collected from 235 individuals (83 male and 152 female) who met the study inclusion criteria comprised the material of the study. Patients were offered no incentive or compensation for their participation.

The questionnaire included three sections. The first part asked about the participants' sociodemographic characteristics, the second part evaluated the psychosocial effects of orthodontic treatment during the COVID-19 pandemic, and the third part was a physical assessment of orthodontic patients who had COVID-19 infection. In the third section, individuals were asked to rate their intraoral findings on a Visual Analog Scale ranging from 0 to 10.

Treatments were divided into three groups, those involving fixed orthodontic treatments (brackets), clear aligners, and removable appliances.

Statistical Analysis

Descriptive statistics were used to summarize continuous variables. Frequency and percentage values were calculated as descriptive statistics for categorical variables. Relationships with categorical variables were analyzed using chi-square test or Yates continuity correction, as appropriate.

Statistical significance was set at P<0.05. Analyses were performed using MedCalc® Statistical Software version 19.7.2 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021).

RESULTS

A total of 235 individuals (mean age: 23.8+5.8 years) participated in this cross-sectional study. Of the individuals surveyed, 64.7% were female (n=152) and 35.3% (n=83) were male. The distribution of clinical and sociodemographic data is shown in Table 1. Over half (53.6%) of the participants were students, while 10% stated that they were not working or studying. Approximately half of the patients started their orthodontic treatment process during the pandemic (n=120, 51.1%) and about half started before the pandemic (n=115, 48.9%). Most participants (91.5%) were undergoing fixed orthodontic treatment, 17 participants reported using clear aligners, and 7 participants were treated with removable appliances. Nearly half (46.4%) of the participants reported continuing their normal school/work routine, whereas 22.1% stated they had switched to remote education/work.

Analysis of the participants' responses to questions about the psychosocial effects of orthodontic treatment during the COVID-19 pandemic is shown in Table 2. While 53.2% of the participants stated that they attended routine orthodontic follow-up visits and were not concerned about the risk of COVID-19 transmission, 28.1% said they experienced anxiety. The majority of participants (85.9) stated that they were happy to undergo orthodontic treatment during the pandemic, and 74.9% stated that

Table 1. Distribution of clinical and sociodemographic data

	N	%
Gender		
Male	83	35.3
Female	152	64.7
Total	235	100
School/Work life		
'I am studying'	126	53.6
'I am working'	85	36.2
None	24	10.2
Beginning of orthodontic treatment		
After March 2020 when COVID-19 was seen in Turkey	120	51.1
Before March 2020 when COVID-19 was seen in Turkey	115	48.9
Type of orthodontic treatment		
Fixed orthodontic treatment	215	91.5
Clear aligners	13	5.5
Removable appliances	7	3
School/Work life routine		
Normal	109	46.4
Hybrid (normal + remote)	48	20.4
Remote	52	22.1
None	26	11.1

N: number of participants

Table 2. The psychosocial effects of orthodontic treatment during the COVID-19 pandemic		
	N	%
I feel concerned about the risk of COVID-19 transmission while I attend routine orthodontic follow-up visits		
Strongly agree	19	8.1
Agree	47	20
Neutral	44	18.7
Disagree	79	33.6
Strongly disagree	46	19.6
I am not happy to undergo orthodontic treatment during the COVID-19 pandemic		
Strongly agree	7	3
Agree	12	5.1
Neutral	14	6
Disagree	92	39.1
Strongly disagree	110	46.8
It is difficult to clean the appliance or brackets during the COVID-19 pandemic		
Strongly agree	9	3.8
Agree	24	10.2
Neutral	26	11.1
Disagree	100	42.6
Strongly disagree	76	32.3
I comply with the dietary restrictions more easily during the COVID-19 pandemic		
Strongly agree	40	17
Agree	75	31.9
Neutral	50	21.3
Disagree	48	20.4
Strongly disagree	22	9.4
I think the COVID-19 pandemic is an advantage for orthodontic treatment due to reasons such as less socialization, mask hiding the wires, and spending more time at home		
Strongly agree	90	38.3
Agree	70	29.8
Neutral	20	8.5
Disagree	32	13.6
Strongly disagree	23	9.8
Which of the advantages from the previous question outweighs you?		
Less socialization	37	15.7
Mask hiding the wires	104	44.3
Spending more time at home	64	27.2
Other (…)	30	12.8
I recommend starting orthodontic treatment more to others during the COVID-19 pandemic		
Strongly agree	66	28.1
Agree	79	33.6
Neutral	58	24.7
Disagree	20	8.5
Strongly disagree	12	5.1

N: number of participants

cleaning their appliance or brackets was not more difficult. A small percentage (8.1%) of participants were unhappy with orthodontic treatment during the pandemic, while 14% stated that the pandemic made it difficult to clean their appliance or brackets. Approximately half (48.9%) of the participants stated that they complied with the dietary restrictions more easily during the pandemic, while over two-thirds (68.1%) reported that the pandemic was advantageous for orthodontic treatment. The most commonly cited advantages were that masks hiding the wires (44.3%), they spent more time at home (27.2%), and they socialized less (15.7%). In addition, 61.7% of the participants stated that they recommended starting orthodontic treatment more to others during the COVID-19 pandemic.

The analysis of COVID-19 prevalence according to orthodontic treatment type is shown in Table 3. A history of COVID-19 infection was reported by 27.2% of the participants, while the other 72.8% had not been infected. There was no difference between the groups in terms of COVID-19 frequency and treatment types (P=0.406). The physical assessment and evaluation of intraoral findings in orthodontic patients who had COVID-19 are shown in Figure 1. Among the intraoral findings of patients who experienced COVID-19 infection, the highest score was for loss of taste (5.9±4.6), followed by metallic taste, intraoral wounds/aphthae, tooth sensitivity, tooth clenching/grinding, jaw joint pain, and tongue numbness.

Type of treatment (fixed orthodontic treatment, clear aligners, removable appliances) was not associated with statistically significant differences in responses to any of the questionnaire items (P>0.05) (Table 4).

Table 3. COVID-19 prevalence according to orthodontic treatment type

	Treatment type			Total	P*
	Fixed orthodontic treatment N(%)	Clear Aligner N(%)	Removable appliance N(%)		
COVID (+)	58(27)	3(23.1)	2(33.3)	64(27.2)	0.406
COVID (-)	157(73)	10(76.9)	4(66.7)	171(72.8)	

* Chi-square test, Statistical significance was set at P<0.05. N: number of participants

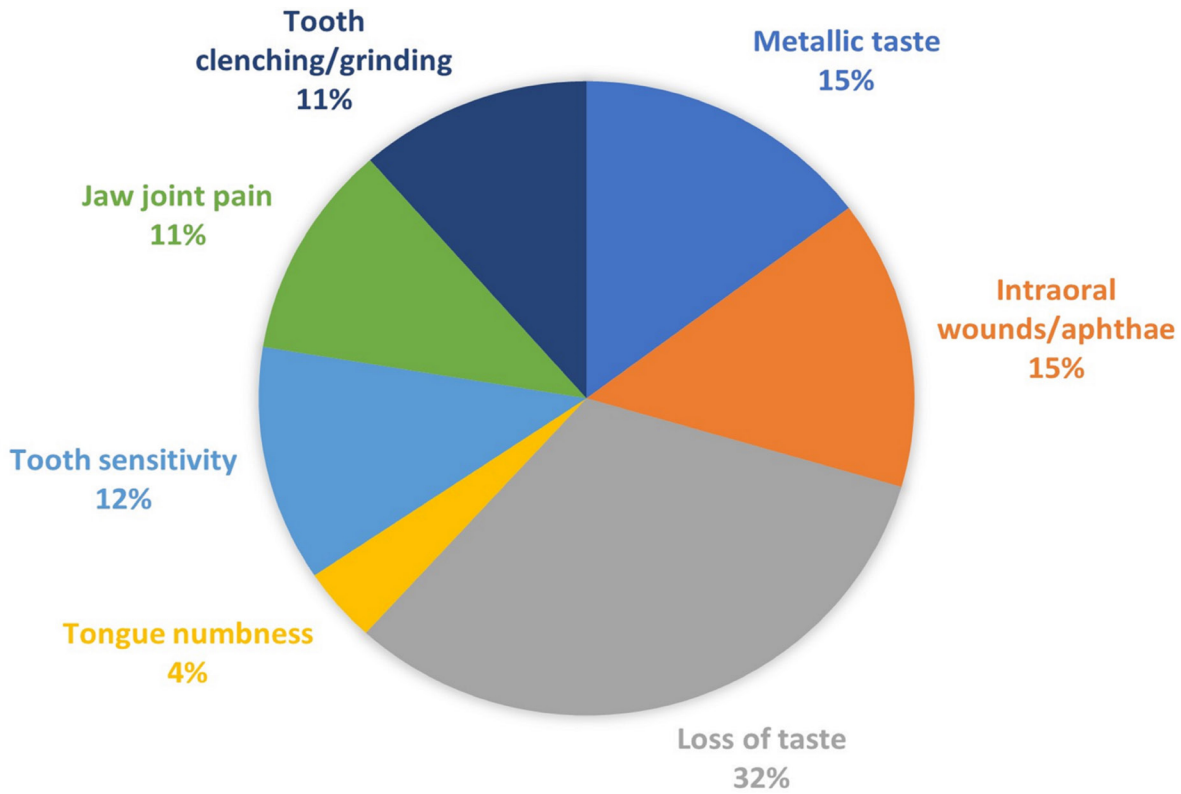

Figure 1. Intraoral findings in individuals who had COVID-19 during orthodontic treatment

Table 4. Evaluation of the questions according to treatment types

	Treatment type			p*
	Fixed orthodontic treatment N(%)	Clear Aligner N(%)	Removable appliance N(%)	
I feel concerned about the risk of COVID-19 transmission while I attend routine orthodontic follow-up visits				
Strongly agree	14(6.5)	3(23.1)	2(33.3)	
Agree	45(20.9)	1(7.7)	1(16.7)	
Neutral	42(19.5)	1(7.7)	1(16.7)	0.141
Disagree	73(34)	4(30.8)	2(33.3)	
Strongly disagree	41(19.1)	4(30.8)	-	
I am not happy to undergo orthodontic treatment during the COVID-19 pandemic				
Strongly agree	7(3.3)	0	0	
Agree	12(5.6)	0	0	
Neutral	12(5.6)	1(7.7)	1(16.7)	0.849
Disagree	81(37.7)	8(61.5)	2(33.3)	
Strongly disagree	103(47.9)	4(30.8)	3(50)	
It is difficult to clean the appliance or brackets during the COVID-19 pandemic				
Strongly agree	9(4.2)	-	-	
Agree	22(10.2)	2(15.4)	-	
Neutral	23(10.7)	1(7.7)	2(33.3)	0.877
Disagree	91(42.3)	5(38.5)	3(50)	
Strongly disagree	70(32.6)	5(38.5)	1(16.7)	
I comply with the dietary restrictions more easily during the COVID-19 pandemic				
Strongly agree	38(17.7)	1(7.7)	1(16.7)	
Agree	66(30.7)	5(38.5)	4(66.7)	
Neutral	49(22.8)	1(7.7)	-	0.388
Disagree	41(19.1)	5(38.5)	1(16.7)	
Strongly disagree	21(9.8)	1(7.7)	-	
I think the COVID-19 pandemic is an advantage for orthodontic treatment due to reasons such as less socialization, mask hiding the wires, and spending more time at home				
Strongly agree	86(40)	2(15.4)	2(33.3)	
Agree	60(27.9)	7(53.8)	3(50)	
Neutral	18(8.4)	1(7.7)	-	0.128
Disagree	29(13.5)	2(15.4)	1(16.7)	
Strongly disagree	22(10.2)	1(7.7)	-	
Which of the advantages from the previous question outweighs you?				
Less socialization	36(16.7)	-	1(16.7)	
Mask hiding the wires	94(43.7)	7(53.8)	3(50)	0.270
Spending more time at home	60(27.9)	3(23.1)	1(16.7)	
Other (…)	25(11.6)	3(23.1)	1(16.7)	
I recommend starting orthodontic treatment more to others during the COVID-19 pandemic				
Strongly agree	60(2.5)	4(2.5)	2(2.5)	
Agree	71(2.5)	5(2.5)	3(2.5)	
Neutral	54(2.5)	2(2.5)	1(2.5)	0.879
Disagree	18(2.5)	2(2.5)	-	
Strongly disagree	12(2.5)	-	-	

* Chi-square test, Statistical significance was set at P<0.05. N: number of participants

DISCUSSION

The COVID-19 pandemic had a global impact, with more than 600 million cases and over 6.4 million deaths worldwide by September 2022 (2). In dentistry, as in all other health sectors, the pandemic has had economic, psychosocial, and physical consequences for both patients and physicians. Although dentistry involves an extremely high risk of exposure, there were no universal guidelines on how to manage SARS-CoV-2 (11,12). The pandemic also necessitated measures with additional costs, such as redesigning dental clinics, adopting dental treatment approaches with minimal aerosols, increasing tele-dentistry practices, and increasing ventilation, hygiene, and personal protective measures (13). Although adverse effects such as the closure of dental clinics and treatment interruptions occurred early in the pandemic, the process became more controllable later (14). Unlike in other branches of dentistry, orthodontic treatments are longer term, lasting an average of one and a half to two years. Therefore, it is one of the areas of dentistry in which the chronic effects of the pandemic are most apparent. While the physical and psychosocial expectations of orthodontic patients vary during this period, it is important to determine the impact of the pandemic on patients. The aim of this descriptive and cross-sectional survey study was to evaluate the psychosocial and physical effects of the pandemic on patients receiving orthodontic treatment. The data from this study will be useful in terms of patient-oriented evaluation of dentistry and orthodontic treatment practices during pandemics.

A total of 235 patients participated in the study, of whom 51.1% reported starting orthodontic treatment after March 2020, when COVID-19 first appeared in Turkey, and 48.9% reported starting before the pandemic. Although the larger number of participants compared to similar studies enabled a more robust analysis of the data, in future research it would be beneficial to include larger samples and create homogeneous study groups (14,15). Our results suggest that the impact of the pandemic on social life was limited for a sizeable proportion of the study participants, considering that 46.4% stated that their work or school life were continuing normally. Of course, this may be due to the fact that the survey was conducted in 2022 and not in 2020 and 2021, when the effects of the pandemic were at their height in Turkey.

The effects of the COVID-19 pandemic on the financial, psychosocial, and social lives of orthodontists and orthodontic patients have been attributed to increased anxiety and global economic problems (16). In the second part of our cross-sectional survey, we asked seven questions evaluating the psychosocial impact of orthodontic treatment on patients during COVID-19. When the responses were evaluated, 53.2% of the participants stated that they did not feel nervous about the risk of COVID-19 transmission when coming to routine orthodontics follow-up visits, while 28.1% stated that they experienced trepidation. The relatively low level of apprehension may be related to the fact that cases of COVID-19 are now more manageable, the pathogenesis has been better analyzed, population-based vaccination rates are high, individual and social preventive measures are well understood, and dental clinics have also increased preventive measures in these areas. We believe different results may have been obtained had the survey been conducted earlier in the pandemic (in 2020-2021), when levels of social anxiety and uncertainties were at their peak. In contrast, 85.9% of the participants stated that they were happy to undergo orthodontic treatment during this period, 68.1% considered the pandemic to be advantageous for orthodontic treatment for reasons such as reduced socialization, being able to hide wires behind masks, and being at home more, and 61.7% said they recommended starting orthodontic treatment to others more during this period. Only 8.1% of the patients expressed unhappiness with undergoing orthodontic treatment during the pandemic, while 14% of the participants stated that cleaning their appliance or brackets was more difficult during this period. Among the reasons for the pandemic being advantageous, 'masks hiding the wires' was the most commonly cited, at 44.3%. The change in aesthetic appearance is one of the main complaints from patients undergoing fixed orthodontic treatment with metal brackets. With the continuous use of masks in social environments during the pandemic, orthodontic wires were effectively hidden, helping to eliminate this concern for orthodontic patients. Considering the overall psychosocial effects of the pandemic on individuals receiving orthodontic treatment, it seems that undergoing orthodontic treatment during the COVID-19 pandemic was viewed favorably. In a similar study, it was reported that the pandemic generally had a negative psychosocial impact on patients because most follow-up appointments were postponed during the COVID-19 pandemic, resulting in increased concerns about prolongation of the treatment period (6). However, as mentioned above, the stage of the pandemic in which the assessment is made will influence these findings because of changes in pandemic-related restrictions in medical services over time.

Two-thirds of the participants (n=176, 74.9%) stated that they had improved oral hygiene habits during the pandemic, and nearly half (n=115, 48.9%) reported that they adhered more easily to the list of prohibited foods. In a similar study, 60.7% of the participants reported no change in brushing habits, while 14.1% reported improved hygiene habits (6). This difference is likely related to the different age groups analyzed, as that study included patients aged 12-18 years, while the patients in our study were over 18 years old. Furthermore, the announcements and reminders to increase personal hygiene during the pandemic presented in all mass media may have contributed to the improvement in these habits (17).

A history of COVID-19 infection was reported by 27.2% (n=64) of the participants in our study, while 72.8% (n=171) said they had never been infected. There was no difference in the prevalence of COVID-19 between patients

receiving different types of orthodontic treatment. Kaur et al. (16) stated that clear aligners alone posed the least risk for SARS-CoV-2 transmission compared to fixed labial/lingual orthodontic treatment appliances, but they were not a very widespread treatment alternative (16). Orthodontic treatment with clear aligners is believed to reduce the risk of transmission compared to fixed appliances because it requires the patient to spend less time spent in the clinical environment, involves lower aerosol exposure (especially during the debonding procedure), has longer follow-up intervals, and does not cause bracket/wire-related complications (16). Although there was no difference between different treatment groups in terms of the frequency of COVID-19, further studies designed to include more participants and homogeneous study groups are needed. The most common intraoral symptom in patients with COVID-19 was loss of taste, followed in descending order by metallic taste, intraoral wounds/aphthae, tooth sensitivity, tooth clenching/grinding, jaw joint pain, and tongue numbness. Altered taste sensation, known as dysgeusia, was the first recognized oral symptom of COVID-19 (18). In a recent review, oral lesions described in COVID-19 patients included findings such as ulcers, erosion, vesicles, fissured tongue, papules, halitosis, hemorrhagic scabs, petechiae, erythema, and spontaneous bleeding, and oral lesions were reported to be more common and severe in older patients and those with clinically severe COVID-19 (18). Poor oral hygiene, certain opportunistic infections, immune suppression, and stress have been reported to be the main predisposing factors to oral symptoms in COVID-19 patients (18,19).

Based on the responses to questions about orthodontic treatment types, most participants (91.5%) were undergoing fixed orthodontic treatment. The proportions of participants being treated with clear aligners and removable appliances were 5.5% and 3%, respectively. Our rationale for grouping the patients according to treatment type was the possibility that patients receiving different treatments may experience different psychosocial effects during the pandemic. Compared to fixed orthodontic appliances, clear aligners have advantages such as shorter examination time, shorter bonding and debonding phases, longer follow-up intervals, greater feasibility of tele-orthodontics, reliable treatment planning with digital scans, better plaque control and consequent reduction in white spot lesions, and less root resorption (16,20-25). For these reasons, treatment with clear aligners may be more preferable during the pandemic than fixed appliances. However, the drawbacks of clear aligners also warrant mention, such as their limited utility in complex malocclusions, the need for additional aligners at the end stage, the need to use attachments or intermaxillary elastics, the high cost, and adherence problems (26). However, our results indicated no difference in the psychosocial effects of the COVID-19 pandemic according to orthodontic treatment type (P>0.05).

A limitation of this study was the heterogeneous number of patients in the treatment groups. It should be kept in mind that these results may vary in the evaluation of larger and homogeneous treatment groups. Further clinical and survey studies are needed to determine the ideal choice of orthodontic treatment during current and potential future pandemics.

CONCLUSION

Compared to the start of the COVID-19 pandemic, when its impact was most pronounced, patients receiving orthodontic treatment later in the pandemic seemed to experience no serious negative psychosocial effects. While a small proportion of patients receiving ongoing orthodontic treatment still feel uneasy about the risk of transmission during routine follow-up visits, the majority of participants stated they were happy to undergo orthodontic treatment during the pandemic and recommended their friends and family also receive orthodontic treatment during this period. Although we observed no differences between orthodontic treatment types in terms of the effects of the pandemic, further studies with more participants and homogeneous treatment group sizes are needed to obtain more reliable results.

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REFERENCES

1. Responding to community spread of COVID-19. https://www.who.int/publications/i/item/responding-to-community-spread-of-covid-19 access date 07.09.2022
2. Weekly epidemiological update on COVID-19 - 7 September 2022. https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---7-september-2022 access date 07.09.2022
3. Garcia-Camba P, Marcianes M, Varela Morales M. Changes in orthodontics during the COVID-19 pandemic that have come to stay. Am J Orthod Dentofacial Orthop. 2020;158:e1-e3.
4. Lindauer SJ. COVID-19 affecting our world. Angle Orthod 2020;90:467.
5. Coulthard P. Dentistry and coronavirus (COVID-19) - moral decision-making. Br Dent J. 2020;228:503-5.
6. Ay Unuvar Y, Deniz P, Kose E. The assessment of impact of the COVID-19 pandemic on patients receiving orthodontic treatment. Turk J Orthod. 2021;34:242-8.
7. Xu H, Zhong L, Deng J, et al. High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. Int J Oral Sci. 2020;12:8.
8. To KK, Tsang OT, Yip CC, et al. Consistent detection of 2019 novel coronavirus in saliva. Clin Infect Dis. 2020;71:841-3.
9. Singh H, Maurya RK, Sharma P, et al. Aerosol generating

procedural risks and concomitant mitigation strategies in orthodontics amid COVID-19 pandemic - An updated evidence-based review. Int Orthod. 2021;19:329-45.

10. Saccomanno S, Quinzi V, Sarhan S, et al. Perspectives of tele-orthodontics in the COVID-19 emergency and as a future tool in daily practice. Eur J Paediatr Dent. 2020;21:157-62.
11. Banakar M, Bagheri Lankarani K, Jafarpour D, et al. COVID-19 transmission risk and protective protocols in dentistry: a systematic review. BMC Oral Health. 2020;20:275.
12. Innes N, Johnson IG, Al-Yaseen W, et al. A systematic review of droplet and aerosol generation in dentistry. J Dent. 2021;105:103556.
13. Sharan J, Chanu NI, Jena AK, et al. COVID-19-Orthodontic care during and after the pandemic: a narrative review. J Indian Orthod Soc. 2020;54:352-65.
14. Isiekwe IG, Adeyemi ET, Aikins EA, Umeh OD. The COVID-19 pandemic and orthodontic practice in Nigeria. J Orthod Sci. 2021;10:5.
15. Morosan H. Orthodontic treatment in times of COVID-19. J Med Life. 2021;14:205-9.
16. Kaur H, Kochhar AS, Gupta H, et al. Appropriate orthodontic appliances during the COVID-19 pandemic: A scoping review. J Oral Biol Craniofac Res. 2020;10:782-7.
17. González-Olmo MJ, Delgado-Ramos B, Ruiz-Guillén A, et al. Oral hygiene habits and possible transmission of COVID-19 among cohabitants. BMC Oral Health. 2020;20:1-7.
18. Iranmanesh B, Khalili M, Amiri R, et al. Oral manifestations of COVID-19 disease: A review article. Dermatol Ther. 2021;34:e14578.
19. Amorim Dos Santos J, Normando AGC, Carvalho da Silva RL, et al. Oral mucosal lesions in a COVID-19 patient: New signs or secondary manifestations? Int J Infect Dis. 2020;97:326-8.
20. Srirengalakshmi M, Venugopal A, Pangilinan PJP, et al. Orthodontics in the COVID-19 Era: the way forward part 2 orthodontic treatment considerations. J Clin Orthod. 2020;54:341-9.
21. Buschang PH, Shaw SG, Ross M, et al. Comparative time efficiency of aligner therapy and conventional edgewise braces. Angle Orthod. 2014;84:391-6.
22. Thai JK, Araujo E, McCray J, et al. Esthetic perception of clear aligner therapy attachments using eye-tracking technology. Am J Orthod Dentofacial Orthop. 2020;158:400-9.
23. Kravitz ND, Burris B, Butler D, Dabney CW. Teledentistry, do-it-yourself orthodontics, and remote treatment monitoring. J Clin Orthod. 2016;50:718-26.
24. Albhaisi Z, Al-Khateeb SN, Abu Alhaija ES. Enamel demineralization during clear aligner orthodontic treatment compared with fixed appliance therapy, evaluated with quantitative light-induced fluorescence: a randomized clinical trial. Am J Orthod Dentofacial Orthop. 2020;157:594-601.
25. Gay G, Ravera S, Castroflorio T, et al. Root resorption during orthodontic treatment with Invisalign(R): a radiometric study. Prog Orthod. 2017;18:12.
26. Galan-Lopez L, Barcia-Gonzalez J, Plasencia E. A systematic review of the accuracy and efficiency of dental movements with Invisalign(R). Korean J Orthod. 2019;49:140-9.