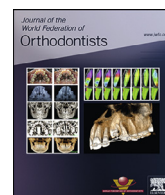




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Effects of the COVID-19 pandemic on new patient visits for orthodontic treatment: A comparison of 2020 and the previous 3 years



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ABSTRACT

Background: Coronavirus disease (COVID-19) has led to unprecedented challenges in the arts, sports, education, finance, and healthcare. The aim of this study was to compare demographic characteristics of new-patient visits for orthodontic treatment in the pandemic year (2020) versus previous years.

Methods: The retrospective study included patients who sought care at a tertiary orthodontic referral center between January 1, 2016 and December 31, 2020. Clinical and demographic characteristics, including age, age group (child, young adult, adult), gender, and numbers of monthly and annual new-patient visits were compared between the pre-pandemic (2017–2020) and post-pandemic (2020) periods. The daily average numbers of appointments were compared for 2019 versus 2020.

Results: The average number of monthly new-patient visits was 240.69 ± 81.48 in the pre-pandemic period, as opposed to 113.75 ± 88.89 in the year 2020 ($P < 0.001$). The average number of monthly new-patient visits decreased by 48.3% in 2020 compared to 2019, while the average number of daily new-patient visits in 2020 decreased significantly in all months ($P < 0.05$), except for January ($P = 0.613$) compared to the monthly numbers from the previous year. No significant difference was found between the pre-pandemic period and 2020 with regard to gender ($P = 0.410$). In all years, the numbers of new-patient visits were higher for women, compared with men, and for children, compared with adults.

Conclusions: The results indicated a sharp decrease in the number of new-patient visits for orthodontic treatment in the pandemic year (2020) compared to previous years.

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1. Introduction

The new type of coronavirus, severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), emerged in China's Hubei Province at the end of 2019 and rapidly spread to many countries in the world, owing to its ability to infect, and as a result, a pandemic was declared by the World Health Organization (WHO) in March 2020 [1,2]. To prevent the rapid spread of coronavirus 2019 (COVID-19), lockdown measures of varying duration and strictness have

been imposed at both regional and national levels [3]. In addition to postponement of sporting events and art- and education-related activities, non-urgent dental examinations and practices have also been postponed or canceled by the authorities, owing to the fact that such practices require physical proximity between the providers and patients increasing the risk of contamination and further spread [4,5]. However, after the loosening of lockdown measures, dental examinations and practices resumed with precautionary measures in place [6].

Orthodontists recommend regular clinical examination of children beginning from the early mixed dentition stage [7]. These examinations are extremely important, as they allow detection of both bad habits that may lead to orthodontic anomalies, decay, or early losses of primary teeth that may cause loss of space in the dental arch, and medical problems that predispose patients to these anomalies. Moreover, regular orthodontic follow-up of children, who are in their active growing stages are of paramount im-

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portance for the diagnosis and treatment of skeletal anomalies, which can be corrected in the early stage with orthopedic approaches [8]. In addition to these issues, more and more adults and young adults seek treatment at orthodontic clinics for dental aesthetics, phonation, and various functional and temporomandibular joint disorders [9]. Accordingly, COVID-19 presents an unprecedented challenge for orthodontics, as it does in other branches of dentistry [6,10].

It has been documented that individuals may not seek help at hospitals for problems other than coronavirus, owing to the fear of infection with COVID-19 [11]. To date, numerous studies have investigated the effect of the fear of becoming infected or contagious—along with effects of stay-at-home orders and lockdown measures that emerged with the pandemic in 2020—from hospital admissions due to urgent or non-urgent clinical conditions other than COVID-19 [12–14]. Additionally, the reasons for and numbers of dental emergencies resulting in dentistry department visits during the COVID-19 pandemic have been investigated [6,10,15]. However, to our knowledge, there has been no study specifically investigating new-patient visits due to non-urgent dental or orthodontic treatment. The aim of this study was to compare the demographic characteristics of individuals who sought orthodontic treatment in the pandemic year (2020) versus in previous years.

2. Materials and methods

The present study was approved by the Republic of Turkey Ministry of Health, the Turkish Medicines and Medical Devices Agency (approval no. 2021-01-09T16_29_35), and ethical approval was obtained from Adyaman University Clinical Research Ethics Committee (no. 2021/01-41).

The retrospective study included patients who sought orthodontic treatment at Adyaman University Dentistry Faculty Orthodontics Department between January 1, 2016 and December 31, 2020. Data on demographic characteristics, including national ID number, name, surname, age, gender, and date of visit, were transferred into the Microsoft SQL program (Microsoft, Redmond, WA) and reviewed for each individual. Only initial presentations for treatment were considered. The data for the year 2016 were used to confirm whether patients were seeking initial or repeat treatment between 2017 and 2020.

2.1. Statistical analysis

Statistical power analyses were performed using G-POWER (version 3.0.10; Heinrich Heine University Dusseldorf, Dusseldorf, Germany). The optimal total sample size for the study was calculated to be 4332, based on an expected effect size of 0.1, with an alpha score of 0.05 and a power of 95%. The study comprised 10,030 patients who sought orthodontic treatment at a tertiary orthodontic referral center (Orthodontics Department at Adyaman University School of Dentistry).

Data were analyzed using SPSS for Windows, version 25.0 (IBM Corp., Armonk, NY). Normal distribution of continuous variables was assessed using the Shapiro–Wilk test. The monthly average numbers of initial presentations for treatment for the years 2017–2019 were compared using a one-way ANOVA. The average monthly numbers of new-patient visits in the pre-pandemic period versus in the year 2020 were compared, using Student's *t* test. The daily average numbers of visits in 2019 versus 2020 were compared, using the Mann–Whitney *U* test and Student's *t* test. Mean ages for the years 2017–2019 were compared using a one-way ANOVA, followed by a post hoc Bonferroni test. Mean ages

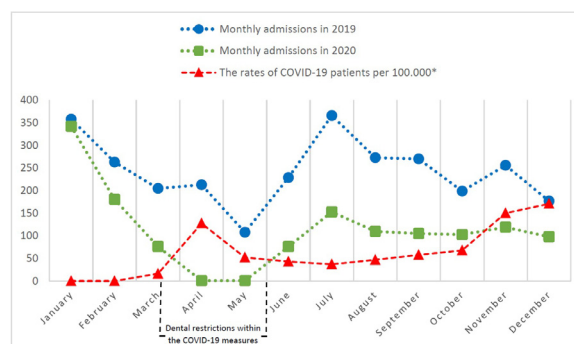


Fig. 1. Graphical presentation of the total number of orthodontic new patient visits in 2019 and 2020, by month. *In the country where the present study was conducted [16]. COVID-19, coronavirus disease 2019.

for the years 2019 and 2020 were compared using Student's *t* test. Categorical variables were compared using the chi-square test. A *P* value of <0.05 was considered significant.

3. Results

Table 1 shows the demographic characteristics of patients who first presented for treatment during the pre-pandemic period. No significant difference was found among the years in the pre-pandemic period (2017–2019) with regard to the number of initial presentations for treatment ($P = 0.892$) (Table 1). The average monthly number of new-patient acceptances was 240.69 ± 81.48 in the pre-pandemic period, as opposed to 113.75 ± 88.89 in 2020 ($P < 0.001$; Table 2). Table 3 presents the numbers of daily and monthly new-patient acceptances in the years 2019 and 2020 (Fig. 1) [16]. The average number of monthly appointments decreased by 48.3% in 2020, compared to 2019, and the average number of daily appointments in 2020 decreased significantly in all months ($P < 0.05$), except for January ($P = 0.613$), compared with the same month of the previous year (Table 3). No significant difference was found among the years in the pre-pandemic period, or between the pre-pandemic period and 2020, with regard to gender distribution ($p = 0.086$ and $p = 0.410$; Table 2). However, the proportion of women was significantly higher than that of men in all years ($P < 0.05$). A significant difference was found among the years in the pre-pandemic period with regard to both mean age and the age-group distribution (children, young adults, and adults; $P = 0.017$ and $P < 0.001$; Table 1). Similarly, a significant difference was found between the pre-pandemic period and 2020 with regard to mean age and the age-group distribution ($P = 0.006$ and $P < 0.001$; Table 2).

4. Discussion

The city where the university clinic is located in which the present study was conducted has a population density (people per square kilometer) and age distribution similar to the world average [17], and there is no other health center in the region that can perform comprehensive clinical and radiographic orthodontic examinations. Accordingly, this clinic was a suitable research environment in which to investigate the effect of COVID-19 on orthodontic treatment. The present study also aimed to determine and compare the demographic characteristics of the patients before versus during the pandemic period.

In the study locale, all the orthodontic appointments, except for emergency dental interventions, were cancelled or postponed to an unspecified date, and the dental clinics were closed to new

Table 1
Comparison of demographic characteristics among pre-pandemic years

Characteristic	2017	2018	2019	P	2017 vs. 2018	2017 vs. 2019	2018 vs. 2019
Monthly new patient visits	231.58 ± 94.57	247.41 ± 82.45	243.08 ± 72.36	0.892 ^Φ	NS	NS	NS
Gender							
Female	1717 (61.78)	1774 (59.75)	1721 (59.00)	0.086 [†]	NS	NS	NS
Male	1062 (38.22)	1195 (40.25)	1196 (41.00)				
Age group (y)	15.82 ± 5.74	16.00 ± 6.90	15.51 ± 7.28	0.017 ^Φ	0.947 [‡]	0.229 [‡]	0.015 [‡]
Child	1153 (41.5)	1369 (46.1)	1536 (52.7)	0.000 [†]	0.000 [†]	0.000 [†]	0.000 [†]
Young adult	1464 (52.7)	1354 (45.6)	1126 (38.6)				
Adult	162 (5.8)	246 (8.3)	255 (8.7)				

Values are n (%) or mean ± standard deviation, unless otherwise indicated.

NS, not significant.

^Φ ANOVA test

[†] Chi-square test.

[‡] Bonferroni test.

Table 2
Comparison of demographic characteristics between pre- and post-pandemic periods

Characteristic	Pre-pandemic (2017–2019)	Post-pandemic (2020)	P
Monthly new patient visits	240.69 ± 81.48	113.75 ± 88.89	0.000 ^{*,Ψ}
Gender			
Female	5212 (60.2)	805 (59.0)	0.410 [†]
Male	3453 (39.8)	560 (41.0)	
Age groups (y)	15.78 ± 6.69	16.19 ± 8.08	0.006 ^{Ψ,α}
Child	4058 (46.8)	670 (49.1)	0.000 ^{*,†}
Young adult	3944 (45.5)	553 (40.5)	
Adult	663 (7.7)	142 (10.4)	

Values are mean ± standard deviation, or n (%), unless otherwise indicated.

* $P < 0.001$.

^Ψ Independent samples *t*-test.

[†] Chi-square test.

^α $P < 0.01$.

Table 3
Comparison of daily and monthly appointment volume in 2019 and 2020

Month	2019 Total (n)	2020 Total (n)	Change (%)	2019 Daily (mean ± SD)	2020 Daily (mean ± SD)	P
January	358	342	-4.47	16.27 ± 8.61	14.86 ± 9.78	0.613 ^Ψ
February	263	181	-31.18	13.15 ± 4.65	9.05 ± 4.68	0.009 ^{Ψ,α}
March	205	76	-62.93	9.76 ± 4.59	3.45 ± 4.56	0.000 ^{Ψ,*}
April	213	1	-99.53	9.68 ± 4.95	0.04 ± 0.21	0.000 ^{*,§}
May	108	1	-99.07	4.69 ± 3.16	0.04 ± 0.21	0.000 ^{*,§}
June	229	76	-66.81	11.45 ± 7.11	3.45 ± 2.89	0.000 ^{Ψ,*}
July	366	153	-58.20	15.91 ± 9.35	6.65 ± 3.91	0.000 ^{Ψ,*}
August	273	110	-59.71	13.00 ± 5.96	5.23 ± 2.89	0.000 ^{Ψ,*}
September	270	105	-61.11	12.85 ± 6.36	4.77 ± 2.09	0.000 ^{Ψ,*}
October	199	103	-48.24	8.65 ± 4.51	4.47 ± 1.99	0.000 ^{Ψ,*}
November	256	119	-53.52	12.19 ± 4.82	5.66 ± 2.92	0.000 ^{Ψ,*}
December	177	98	-44.63	8.04 ± 2.95	4.26 ± 2.15	0.000 ^{Ψ,*}

SD, standard deviation.

^Ψ Independent samples *t*-test.

^α $P < 0.01$.

* $P < 0.001$.

[§] Mann-Whitney U test.

patients, owing to regulations imposed by the Republic of Turkey, Health Ministry on March 17, 2020, to prevent the spread of COVID-19. Accordingly, only patients that required “emergency intervention” were treated at the clinics, such as those who had intraoral irritation from orthodontic appliances, or active appliances that eventually could cause harmful effects in the mouth. Additionally, orthodontic appointments for new patients were made only for neonates with cleft lip and palate, as they needed feeding plates and nasal molding. Subsequently, beginning on March 11, 2020, nationwide lockdown measures were imposed for April and May of 2020. As of June 1, the lockdown measures were gradually lifted. The required preventive measures to be taken were announced, as was the resumption of clinical examinations and ap-

pointments. During the rest of the year, there were no restrictions regarding dental and orthodontic examinations and appointments.

In the pre-pandemic period, the number of orthodontic new-patient appointments was stable. In 2020, however, the average number of new patient visits per month showed a sharp decrease, in contrast to the average in the pre-pandemic period. Moreover, the average number of daily visits in 2020 decreased significantly in all months ($P < 0.05$) except for January ($P > 0.05$), compared to the same months of the previous year. Taylor reported that individuals with high anxiety levels may be reluctant to seek medical help, owing to their concerns that hospitals are a source of contamination [11]. Similarly, in our study, there was a sharp decrease (-31.18%) in number of visits in February 2020, compared

to the number in February of the previous year, even though the first COVID-19 case in Turkey was officially reported on March 11, 2020. This decrease can be attributed to the widespread uncertainty caused by the sudden onset of SARS-CoV-2, the sudden increase in people's anxiety levels, and the stay-at-home orders [18–20]. Similarly, more recent studies have indicated that orthodontic patients with high anxiety levels were reluctant to attend their appointments in the first months of the pandemic [21–23].

In our study, a significant decrease (99.58%) was found in the number of initial presentations for treatment in March, April, and May 2020, compared to the same months of the previous year, which can be explained by the restrictions on new orthodontic appointments. Similarly, Birkmeyer et al. [14] reported that the number of non-COVID-19 admissions from February to April 2020 decreased by over 20% compared to the same months of the previous year. Cozzi et al. reported that the number of visits to the tertiary-level pediatric emergency department decreased by 77.5% in 2020, compared to 2019, due to the effect of lockdown [12]. Long and Corsar found that the daily number of visits for treatment for dental abscesses decreased by 64% during the 2 weeks following the closure of dental practices [6].

As of June 1, 2020, the lockdown measures in Turkey were gradually lifted, clinical examinations and appointments in dental offices and many other types of healthcare facilities resumed, and no restrictions were imposed throughout the following summer. Nevertheless, our findings indicated that the numbers of visits during the summer months (June–August) decreased by 66%, 59%, and 58%, respectively, compared to the same months of the previous year, which may be attributable to the reluctance of patients to seek medical help due to their fear of contracting COVID-19. Similarly, a previous study indicated that the number of admissions to the emergency department during the Middle East Respiratory Syndrome (MERS) outbreak decreased, even during non-lockdown periods [24]. Another longitudinal study compared the effects of the COVID-19 pandemic on stress and anxiety levels in young individuals and found no significant difference in the levels in April versus July in 2020 [25].

The literature indicates that the number of COVID-19-positive cases increased in the fall months, compared with the summer months, in 2020 in the northern hemisphere, where the present study was conducted [26]. Nevertheless, in our study, the decreases in the number of monthly new-patient visits in October (–48.24%) and November (–53.52%) in 2020, compared with the same months of the previous year, were proportionally higher than the decrease in September 2020 (–61.11%). This decrease can be explained by the notion that uneasiness among individuals was still prevalent during the fall months, but they were adapting to the pandemic conditions. Similarly, a study conducted in Finland compared the fall months of 2020 with the same period of the previous year and reported a significant increase, of 28.83%, in the anxiety levels of workers in the fall months of 2020 compared to the same period of the previous year [27].

In our study, the number of monthly new-patient visits in December 2020 decreased by 44.63% compared to the number in the same month of the previous year, which indicates that the downward trend of the fall months continued in the winter months. Additionally, the downward trend in late 2020, when the second wave of COVID-19 occurred [28] and new restrictions were imposed in various sectors in Turkey, can be ascribed to the increase in individuals' fear of contracting COVID-19 in dental settings during these months.

Our findings indicate that women had a higher proportion of appointments, compared with men, during both the pre-pandemic

period (60.2% vs. 39.8%) and in 2020 (59% vs. 41%). This finding may be related to differences in perceptions regarding aesthetics and healthcare among women, compared with those of men. There is a consensus in the literature that women more often seek and receive orthodontic treatment than do men [29–31]. In addition, Holmes [32] suggested that, despite a lack of objective evidence, women perceive themselves as having less-attractive teeth and more treatment needs than men. In our study, however, no significant difference was found between the pre- and post-pandemic periods with regard to gender. On the other hand, given that the stress and anxiety levels caused by COVID-19 have been reported to be significantly higher in women, compared to those in men [19,20], it is surprising that there was no significant gender difference in our study between the pre- and post-pandemic periods.

Youth has been defined by the United Nations (UN) as the age cohort of 15–25 years [33]. Accordingly, in our study, individuals who presented for orthodontic treatment were classified as children (age 0–14 years), young adults (age 15–25 years), or adults (age >26 years), and a significant difference was found among the years in the pre-pandemic period with regard to mean age and the distribution of age groups. Moreover, despite the steady increase in the numbers of appointments among children and adults over the years, there was a steady decline in the number of appointments among young adults, which could be associated with the fact that the general health insurance system in Turkey covers many healthcare costs, to encourage children to receive early treatment. On the other hand, among the individuals that were admitted in 2020, the proportion of children (49.1%) was higher than that of young adults (40.5%), whereas the proportion of adults (10.4%) increased compared to that in previous years. We believe that this increase could be due to the uptrend in the previous years, and that the COVID-19 pandemic had no effect on this proportional increase. In keeping with this view, the literature also indicates that more adults were newly accepted for orthodontic treatment over the same years [10,34].

Our study was limited in several ways. First, as in other cross-sectional studies, the study covered a certain period of time (2017–2020) and included visits of individuals in a single city to a single tertiary orthodontic referral center. Various countries and regions, and even cities within the same country, were differentially affected by the varying numbers and intensities of COVID-19 waves [3]. Additionally, the forms of the measures and restrictions, and the loosening of restrictions, can vary across countries and regions. Therefore, the data presented in our study regarding the demographics of patients and the volume of orthodontic appointments during the COVID-19 period may not be generalized to other countries, regions, cities, or even faculties or private clinics. Second, the individuals included in our study could not be grouped socioeconomically, and thus, the effect of socioeconomic status on the numbers of new patients could not be evaluated. Due to these limitations, further studies are needed to validate our findings by evaluating a greater number of new patients, based on individuals' socioeconomic characteristics, and by including different periods of the pandemic and different regions or countries.

5. Conclusions

The results indicated a sharp decrease in the number of new-patient visits for orthodontic treatment in the pandemic year (2020) compared to the number in previous years. The treatment of orthodontic anomalies that require early diagnosis and management may be delayed due to the decrease in the number of new-patient acceptances during the pandemic period. The findings of

our study may provide a benchmark for the possible increase in appointments after the COVID-19 pandemic or the possible decrease in appointments during new pandemics.

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