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A qualitative study of orthodontic patients' experiences in quarantine during the COVID-19 pandemic outbreak

Khaled Wafaie,^a Hisham Mohammed,^b Abdelrahman M. A. Mohamed,^a Jinshu Zhou,^a Ben Daniel,^c and Qiao Yiqiang^a

Henan, China and Dunedin, New Zealand

Introduction: Coronavirus disease 2019 (COVID-19) is one of the most formidable challenges that influenced all domains of health care delivery. This research explored the experiences and challenges orthodontic patients faced in quarantine during the COVID-19 outbreak. The goal was to learn from patients about their oral health and general practices during this time to provide optimal delivery of orthodontic treatment care. **Methods:** A phenomenographic qualitative design involving semistructured face-to-face interviews. A purposive sampling strategy was deployed to collect qualitative data from 24 orthodontic patients who quarantined during the COVID-19 pandemic. All interviews were digitally recorded, and afterwards, they were transcribed verbatim. **Results:** Four main themes and associated subthemes were identified. The themes were (1) oral-health-related behavioral changes, (2) impact on treatment progression, (3) psychosocial impact and attitude changes, and (4) areas for future enhancements in health care delivery. Overall findings revealed both positive and negative behavioral changes in orthodontic patients regarding their adjustment during the quarantine and its implications to general health and well-being. **Conclusions:** Findings from this study suggest that COVID-19 impacted dental health care delivery to orthodontic patients during the quarantine. Patients reported psychosocial and behavioral changes as a consequence of treatment disruption and pandemic lockdown. The implications of these findings to the clinical dental environment and patient education are pivotal to further target areas in dental health care delivery that require strengthening. As such, clinicians could expect behavioral changes from orthodontic patients and identify better strategies to mitigate clinical challenges resulting from such changes. (Am J Orthod Dentofacial Orthop 2022;161:e498-e506)

On December 2019, Wuhan Municipal Health Commission reported 27 patients with viral pneumonia, of which 7 were critically ill. However, it was not until early January 2020 that the World Health Organization (WHO) expressed great interest in the pathogenesis of such respiratory virus designated “2019-nCoV” and later referred to in the media as a

coronavirus disease 2019 (COVID-19).¹ Because of its rapid spread, the progression of COVID-19 in terms of transmission and mortality urged China to start a lockdown process in many Chinese cities. Later, many countries initiated lockdown and quarantine procedures as WHO declared COVID-19 a global pandemic.² These quarantine procedures act as a measure to control the spread of the virus.³ However, such measures negatively impacted the citizens, leading to financial losses, frustration, boredom, posttraumatic stress symptoms, anger, and even violent behavior. The pandemic lockdown, without transparent information about the quarantine and the designated protocols, was highly stressful and nerve-wracking to many people.⁴ Previous research has shown a direct relationship between stress levels and oral health; patients with more anxiety have poorer oral health.⁵

Health care systems faced challenges pertinent to supplying sufficient medical equipment to sustain effective management of various medical conditions while ensuring a safe environment for patients and their

^aDepartment of Orthodontics, Faculty of Dentistry, First Affiliated Hospital of Zhengzhou University, Henan, China.

^bDepartment of Oral Sciences, Faculty of Dentistry, University of Otago, Dunedin, New Zealand.

^cHigher Education Development Centre, University of Otago, Dunedin, New Zealand.

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Address correspondence to: Qiao Yiqiang, Department of Orthodontics, Faculty of Dentistry, First Affiliated Hospital of Zhengzhou University, No. 1 Jianshe East Road Erqi District, Zhengzhou, Henan, China; e-mail, qiaoyiqiang@126.com.

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treating physicians. Incorporating the latest technologies and health care guidelines would decrease cross-infection and develop a safe patient environment.⁶⁻⁸ Studies have shown that dental clinics should adopt stricter infection control protocols during the pandemic.^{9,10} Over the last few years, the focus has been on developing and launching new health care applications to help track patients' treatment progression. Furthermore, it serves as a reminder system for those receiving long-term treatment, such as orthodontic patients.¹¹ The reliance on artificial intelligence, digital applications, and online sources to obtain information related to health care increased dramatically during the COVID-19 pandemic.¹²⁻¹⁴ In addition, studies have shown that these applications saved time, decreased the workload, and improved the quality of services.¹⁵⁻¹⁸

Orthodontic treatment aims to improve patients' oral health-related quality of life, as it tackles different domains related to boosting patients' self-esteem after treatment.¹⁹ Thus, a patient-centered approach would allow the clinician to understand patients' treatment needs setting achievable goals throughout treatment. Many studies explained the relation between oral health and its impact on patients' quality of life.²⁰⁻²² However, current challenges are more extensive than any other time, with the COVID-19 pandemic placing patients and their clinicians in an unprecedented situation. With the lack of prior published qualitative research focusing on those long-term dental patients receiving orthodontic treatment, our paper would present first-hand insight into understanding the impact of the COVID-19 pandemic on those patients and accordingly deliver practical means for clinical practice.

Orthodontic patients often present for long-term treatment and require regular check-ups every 4-6 weeks. Maintaining excellent oral hygiene ensures their oral health is not affected by decalcifications and periodontal disease.²³ These patients are given suitable instructions to aid in effective management during their course of treatment. This qualitative research aims to understand orthodontic patients' experiences and perceptions during the COVID-19 outbreak and quarantine. This will shed some light on the psychosocial effects on the patients and their families, and how it has affected their oral-health habits and their expectations from treatment.

MATERIAL AND METHODS

The ethical committee review board approved the study at the First Affiliated Hospital of Zhengzhou University (2020-KY-190). This qualitative phenomenographic research adopted face-to-face semistructured

interviews to get in-depth data on the experiences of orthodontic patients who had undergone COVID-19 pandemic lockdown. This study followed the standard criteria of reporting qualitative studies: Consolidated criteria for Reporting Qualitative Research checklist.²⁴

The main aim of the phenomenographic approach was to identify how participants dealt with oral health and how that relates to their general health. Purposive sampling was used to recruit participants, and this ensured that adolescent and adult participants encompass a wide age range and different stages of orthodontic treatment. Participants identified as adolescents and adults (aged 16-35 years) who underwent fixed maxillary and mandibular appliance treatment in the First Affiliated Public Hospital of Zhengzhou university and experienced a full quarantine lockdown because of the COVID-19 pandemic in China were eligible for inclusion. Participants were not eligible for inclusion if they had syndromes or needed a combined orthodontic-orthognathic approach.

Before interviews, verbal information was given to the participants, accompanied by written consent. Participants' confidentiality was assured using a password-secured folder and a number identifier instead of names. Data collection and recruitment were done in parallel, guiding the decision process until new themes were identified and data saturation occurred.

The study employed a nonprobability purposive sampling technique, in which participants were invited to undertake interviews because they met the criterion of orthodontic patients who underwent quarantine during the COVID-19 pandemic. Semistructured interviews were done in the First Affiliated Hospital of Zhengzhou University, in a private nonclinical room for an average of 38 minutes. A list of questions and a developed topic guide were prepared and guided the first 5 pilot interviews. Data saturation was met after recruiting 24 patients (mean age 25.2 ± 0.9 years; 17 females and 7 males). The demographics and baseline characteristics, the severity of malocclusion as assessed with the dental aesthetic index (DAI),²⁵ treatment stages, and used appliances are presented (Table 1).

The interviews were done between May 2020 and August 2020 in Mandarin Chinese. They were digitally recorded and transcribed verbatim, and then translated into English using a professional translator. During interviews, the interviewer could pose new questions, and any new themes raised by patients guided the subsequent interviews. Interviews were conducted by 1 investigator (J.Z.) who possesses a Master of Science in orthodontics. The interviewer was trained in qualitative research interviews at the school of public health before the commencement of interviews.

Table I. Demographic and descriptive characteristics of participants

<i>Demographics</i>	
Age, mean (standard deviation), range in years	25.2 (0.9), 16-35
Gender	
Female	17
Male	7
Ethnicity	
Han Chinese	24
Marital status	
Married	8
Single	16
Highest education level	
Junior high school	3
Bachelor	15
Masters	6
The severity of malocclusion (DAI scores)	
Mild (<26)	0
Moderate (26-30)	2
Severe (31-35)	8
Handicapping (>35)	14
Treatment stage	
Alignment	3
Space closure	13
Finishing	8
Extraction vs nonextraction	
Extraction-based treatment	17
Nonextraction treatment	7
Appliances	
Fixed appliances plus miniscrews	15
Fixed appliances plus bite planes	2
Fixed appliances alone	7

The interviews were read more than once by 2 independent reviewers (K.W. and H.M.) and then again by a third reviewer (B.D.). Interviews were analyzed, coded, and compared using the NVivo software (version 11; QSR International Pty Ltd, Victoria, Australia). Central themes were identified along with the critical question of the semistructured interviews. The 3 reviewers discussed the nature of the initial themes. The themes relate to patients' oral health experiences, the effect of the COVID-19 outbreak on the quality of treatment, psychosocial changes, and general reflections on health and well-being during the lockdown.

RESULTS

In addition to the 4 main themes, subthemes were further identified from the qualitative data (Table II). These themes enabled further elaboration from a patient-centered angle and helped with questioning during the interviews. All participants spent a standardized period of >2 months of enforced COVID-19 lockdown and quarantine. They were instructed to

contact the hotline number and share their private application accounts if there was a need for an emergency video call.

Oral health-related behavioral changes

Oral health is a fundamental component of general health; it is directly related to cardiovascular diseases, pneumonia, pregnancy, and birth complications.²⁶ Patients' perceptions, measures, and motivations for maintaining optimum oral health differ from one person to another. This theme was subdivided into 3 subcategories.

Changes in the frequency and duration of brushing during the quarantine. Some participants expressed that staying at home alone for long periods negatively impacted their oral health and brushing habits. As staying at home for longer hours, and not having any social interaction with others, had an undesirable impact on their behavior.

"To be honest, I didn't; take care of my oral hygiene that much during the lockdown because I was always at home. I didn't have any social obligations since I hardly ever went out, and for that reason, I didn't brush my teeth much, which I admit is something I should have worked on." (Participant 15)

In contrast, participants who stayed at home for extended times with their families felt more impelled by their families to maintain good oral health. They brushed their teeth 2-3 times a day for 2-3 minutes. Others even stated that they brushed their teeth for a more extended period (5-10 minutes).

"During this time, I helped my son develop good oral hygiene habits; I believe now he brushes his teeth better. My husband also has good brushing habits." (Participant 7)

"I have more free time at home, so I brush my teeth after lunch, and I do it more carefully, and I brush for longer periods." (Participant 10)

Factors affecting oral hygiene habits. All participants agreed that the type of food they ate affected their oral hygiene. Some types of food require longer brushing time because it sticks to the braces. At the same time, others explained that the frequency of eating is the main factor that makes them brush more. Participants also stated that staying at home for long hours made them careless about their hygiene because they were spending longer hours playing games or hanging around family.

"At home, I often eat fruits and snacks, which leads to an increase in the number of times I brush my teeth. In addition, some types of food affect the duration of brushing, especially food that's difficult to clean." (Participant 1)

Table II. Main themes and subthemes

Main themes		Subthemes			
Oral-health related behavioral changes	Changes in frequency and duration of brushing during the quarantine	Factors affecting oral hygiene habits	Diet changes in quarantine		
Impact on treatment progression	Quality and duration of treatment	Following orthodontic instructions	Anxiety from having an emergency and its solution		
Psychosocial impact and attitude changes	Significant negative emotions from treatment pause	Feeling helpless	Social interaction	Fear of infection	Positive emotions and memorial moments
Areas for future enhancements in health care delivery	Short-term recommendations	Long-term recommendations			

Diet changes in quarantine. All participants have had diet changes regarding the kind of food they ate and the number of times they ate throughout the day. The majority of participants ate more snacks and fruits during the lockdown. They stated that having their routine of going to work or university made them more inclined to eat a balanced diet. They stated that they usually ate healthy meals in their workplace or university cafeterias. However, they frequently indulged in their favorite food during the lockdown because they had extra time at home to cook their preferred recipes. They also expressed worries about bad breath, mainly if they ate more than 1 meal or snacks without brushing.

“The main change is in the increased frequency of eating, I often eat more snacks at home, but it doesn’t affect my three main meals every day.” (Participant 23)

Impact on treatment progression

Orthodontic treatment may cause several risks like decalcification, root resorption, gingival recession, and alveolar bone loss. However, these risks can be controlled with proper compliance from the patients. This theme was subdivided into 3 subcategories.

Quality and duration of treatment. Some participants felt that their teeth were not moving in the right position; others felt that the treatment progression became very slow. However, all participants agreed that the quarantine would not affect treatment results, and it could impact the overall duration of treatment by 2-3 months.

“I think it may prolong my treatment time, but the outcome should not be affected. I think it depends on how skilled the doctor is. I trust my doctor in this regard; after all, he is a professional in the field.” (Participant 11)

Following orthodontic instructions. Half of the participants stopped using the elastic bands as instructed. Most of them forgot to wear it during the quarantine period because they were busy with social activities

with family, whereas others ran out of elastics, so they needed to wait until the COVID-19 lockdown was lifted. Most participants tried to take extra care of their braces by eating small portions over time because they knew it would not be possible to rebond their brackets or have an emergency appointment.

“I have been eating these days very carefully because I don’t know when I’ll be able to see my doctor, and my mother will be distraught if the bracket falls off.” (Participant 18)

Anxiety from having an emergency and its solution. All participants felt worried about emergencies, so they took good care of their braces and followed all instructions. Some emergencies occurred despite being cautious, such as excess wire, debonded brackets, and gingival bleeding. Participants expressed their gratitude for having a video call with their orthodontist, which solved their problems temporarily.

“During the quarantine, the wire pricked my mouth, and I called the doctor through video call; the doctor told me the solution, so the matter was resolved smoothly.” (Participant 13)

Psychosocial impact and attitude changes

Several studies suggest that staying at home for long periods and decreasing activity can lead to bone and muscle weakness. Moreover, the decreased exposure to sunlight affects mental health because of the decline in vitamin D levels, resulting in a compromised immune system making people prone to infectious diseases.^{27,28} In contrast, it can be a direct cause of rumination and lethargy. The extent of these physical and mental effects differs from one patient to another according to their environment, social circle, and individual circumstances. This theme was subdivided into 5 subcategories.

Significant negative emotions from treatment pause. Participants stated that the quarantine period was stressful for different reasons. Some participants came

from places far away from the hospital, and being in quarantine will force them to go through a longer duration of treatment which will affect their plans. In addition, they were worried about their treatment progress; they felt their teeth were moving in the wrong direction.

“To be honest, I want to remove the appliance early. My home is 450km away from Zhengzhou, and it takes me 1.5 hours to get to Zhengzhou by high-speed train. If I could finish treatment earlier, I would not have to run around; to be honest, I was a little impatient. I was also worried that the bracket would fall off.” (Participant 14)

“I was worried that the tooth will not move or change according to the plan designed by the doctor. If I return to the doctor regularly, the doctor can find some problems in time.” (Participant 1)

Feeling helpless. Some participants felt out of control because of the surrounding circumstances. Some participants have had to go through life-changing examinations, which made them unsure when they should start to prepare for the examinations and when their examinations will be held. In addition, during this period, some unauthorized Websites sought to have more followers, so they spread rumors on the Internet about the COVID-19 situation, causing more stress on people who didn't have access to official sources.

Some of the participants' families felt worried about their financial situation, as they kept buying family needs without having stable income. In addition, they had some worries about not being able to visit the hospital or go out in case of an emergency.

“They had some anxiety. Because they thought I might be too nervous about the exams, I never knew when my postgraduate entrance exams would be held. So, I wanted the quarantine period to end quickly.” (Participant 3)

“My family become a little frustrated because we needed to continue paying our rent, in addition to the daily expenses, and we were not sure about my dad's salary.” (Participant 20)

Social interaction. Participants stated that the psychosocial effects were caused either by the extended times spent with their families or the lack of social life for those who live alone. Some patients explained that the lack of social life affected their hygiene habits as it made them more prone to depression and feeling less active with an increased need to eat more. The patients who stayed with their families felt that the extended stay with family, in turn, increased their house chores, making them less inclined to pay attention to their braces.

“No, because my son couldn't go to school, I needed to spend a lot of energy and time with him, which diverted my attention and left me no time to spend thinking about my teeth. I enjoyed spending time

with my son, even though it often overwhelmed me.” (Participant 14)

“I think I should have adopted a calmer attitude. I should adapt to the changes around me, rather than fear them. It made me realize that I could have gotten through this more easily.” (Participant 9)

Fear of infection. Participants stated that their families were very worried about COVID-19, especially when they went to the markets to buy groceries every day. However, seeing that the number of patients declined over time gave them a little hope.

“To be honest, I was worried about the virus, but seeing the number of cases decrease every day, gave me hope that I could go out to the hospital soon.” (Participant 6)

Positive emotions and memorable moments. Although most participants had negative feelings, positive emotions will still be memorable moments. They enjoyed family gatherings and social media application games. They also showed gratitude to medical staff and governmental efforts, ensuring that the quarantine would end soon.

“This is the longest vacation I have ever taken with my daughter; I think it is challenging to work every day and not have a chance to stay with my family.” (Participant 22)

Areas for future enhancements in healthcare delivery

Reflecting on patients' points of view is mandatory for future enhancement and better management. The patient-centered treatment approach implied respect for the patients' preferences, integrated them into their treatment, and supported them physically and emotionally, resulting in better understanding and ease of access to care.²⁹ This theme was subdivided into 2 subdivisions.

Short-term recommendations. These are recommendations that patients can develop by themselves or with the help of their orthodontist. Patients stated that if they could go back in time, they would increase the duration of their brushing, take extra measures about their hygiene, and improve their eating habits by eating fewer snacks and following a healthier diet. In addition, they would bring more elastic bands in the future. Some patients recommended trying meditation an hour a day, as it helped them. Participants recommended contacting the orthodontist directly in case of any doubt.

“First, brush your teeth well. Secondly, follow the doctor's advice. I think one of the reasons why I haven't finished the treatment in 2 years is that I didn't follow the doctor's advice in the starting phase, which led to slow progress.” (Participant 8)

Long-term recommendations. These are recommendations that need the involvement of other parties or need a long time to be developed. Participants requested an online Website to be launched to help them book the next appointment and provide easy access for any emergencies. They also recommended having a scheduled online meeting with their orthodontist to keep them updated on their current situation and answer any questions besides an online instructional video for any emergency.

“I would like to make an appointment not only over the phone but also over the Internet, which I think would be more convenient.” (Participant 4)

DISCUSSION

In recent years, there has been more demand for orthodontic treatment. Throughout the long journey of orthodontic treatment, many changes could be seen through treatment, which would require certain levels of compliance from the patients and adaptation from both sides, the patients and their orthodontists. COVID-19 is one of the most formidable challenges that many countries currently face. Many governments have taken active steps to control the disease's spread by imposing lockdown and quarantine restrictions as effective measures against COVID-19. However, this may have adverse mental and physical effects on the population.^{4,30} This is the first qualitative to assess the potential impact of COVID-19 quarantine on orthodontic patients from a patient's point of view. Orthodontic treatment, mainly with fixed appliances, needs regular check-ups for adjustment. High treatment costs and discomfort would often accompany full compliance from patients after each visit, thus, placing an extra burden on patients and their families.^{31,32}

In this study, 4 themes were developed. The effects of quarantine on oral health and patients' behavior were one of the most exciting themes. Patients expressed at different time points how social life changes affected their diet and oral hygiene habits. This study concluded that social life directly relates to the initiative to adhere to oral health and diet instructions. In contrast, it could be argued that quarantine also gave some patients the freedom to brush their teeth more frequently because staying home made it easier for them.

Interestingly, patients noted that their diet changed during quarantine in terms of food and the number of times they ate throughout the day. They also agreed that the type of food determines how long they brush their teeth. Patients felt anxious and stressed because of all the changes they had undergone throughout the quarantine period. Furthermore, they directly linked the changes in their behavior to the added stress put on

them, which comes as no surprise.^{4,30} However, it would be interesting if further research could outline the long-term effects of quarantine.

Moreover, patients were concerned about dealing with an emergency, as most of them expressed their fear of any issues arising with their braces, which may prolong the treatment or compromise the result. Having the ability to schedule an orthodontic appointment to address some emergencies related to attaching a debonded bracket or cutting excess wires was almost impossible during quarantine. Patients tried to deal with these emergencies by themselves, and others changed their oral health practices to be more vigilant to avoid being placed in such situations.³³

Patients generally felt that their family and friends' presence during the quarantine played the primary role as internal motivation and external support, consistent with previous research.³⁴ However, not all patients were living with their families. That is why patients expressed their gratitude for having video calls with their treating orthodontist and for receiving illustrative videos in response to emergencies. Video calls play a central role in reassuring patients about their treatment progress, and video calls also act as a reminder for them to continue following instructions. In that way, they feel actively involved with their treatment, allowing them to be optimistic about the overall conditions. Application platforms play a vital role during the epidemic by virtually guiding and instructing patients.³⁵ Another interesting theme was the patients' perceptions of their treatment outcomes and how they think it may affect them. Adding an extra 2 or 3 months over the whole treatment duration is acceptable to some patients, knowing that their final results will be achieved.

In contrast, prolonging treatment could be stressful for some patients; they stated that proper supervision from their orthodontist would help them feel more involved in their treatment. Most participants expressed that following the quarantine instructions was not easy, especially wearing the elastic bands, which could be interesting for future research. Participants in this research favored the presence of Websites for obtaining information and reserving appointments. However, they felt that it must be related to authorized governmental organizations, giving more credibility to the sources of knowledge.

A thorough reflection on the essential themes discussed so far signifies the need for transitory changes and targets some areas for future improvement in the management of patients in such situations. First, such circumstances demand the orthodontists to swiftly shift to effective electronic and postal means of communication.³⁶ This is salient as patients discussed their

suboptimal oral health and difficulties dealing with emergencies. Incorporating illustrative videos, reminders, video calls, and electronic monitoring could successfully manage such situations. Experts' education of auxiliary staff on communication mechanisms during these tense circumstances will provide the necessary psychological support to the patients and their families.³⁷

Proper communication plays a role in the proper management of treatment progress and helps deal with behavioral changes expected from patients.^{4,5} Hence, tailored strategies to mitigate these changes could be identified. In addition, some orthodontic patients expressed feeling stressed, helpless, anxious, and depressed. Orthodontists should be aware that having braces during lockdown and quarantine places extra burdens on the patients and their families.³⁸ Thus, orthodontists' role in reassuring their patients could also extend to the awareness of other agencies providing support in such circumstances to manage proper referrals. Some governmental agencies support patients with psychological burdens by providing psychological crisis intervention plans to deal with public health emergencies during the epidemics.³⁹ However, recent evidence points out the lack of proper diagnosis and follow-up for these patients.⁴⁰ Governments could aim to support patients by increasing the number of licensed psychiatrists and the financial support for affected families. Orthodontists may contribute to these schemes by providing financial orthodontic treatment reduction for those affected families during the epidemic.

Orthodontic patients anticipated issues relating to their treatment progression and some delays in their treatment. However, they retained their confidence in achieving adequate results. With these anticipations, orthodontists could look forwards to considering maneuvers aiming to accelerate their orthodontic treatment provision and strategies with less compliance-dependent mechanics. Consequently, modifications to adapt to these unbridled changes aiming for shorter treatment may be considered and discussed with the patients as part of their informed consents to make the treatment shorter and try to finish as soon as possible. Finally, a considerable emphasis should be placed on maintaining proper oral hygiene during these periods and decrease the potentially detrimental effects of decalcifications, root resorption, and gingival recessions on the orthodontic patient.²³

This qualitative study highlighted the experiences and perceptions of orthodontic patients during quarantine. However, there are essential considerations to be noted. This study is based on data from the perspective of patients who experienced certain restrictions related

to COVID-19 in China, and it could be argued that it does not mimic COVID-19 circumstances globally, as every country had its response to COVID-19. In addition, in-depth interviews were conducted with adolescent and adult patients receiving orthodontic treatment. Therefore, it is essential to highlight that translating such results to clinical practice could not be generalized to patients outside the selected age range. Perspectives of selected participants might differ from the younger cohort of patients who tend to demand more care and instruction from their parents or caregivers.

The interviews were done in Mandarin Chinese to encourage participants to be as expressive as possible. However, this has added extra difficulty to the transcription of the interviews and increased the possibility of errors resulting from translation. Because the interviewers were orthodontists, some patients might feel uncomfortable and possibly provide expected responses. This factor was minimized by introducing the interviewers as researchers, and the interviews were conducted once in a private nonclinical room. Finally, it would be beneficial if objective quantitative data about compliance with treatment instructions and expected outcomes from orthodontic treatment were further explored in future research.

CONCLUSIONS

This study explored in-depth orthodontic patients' psychosocial changes and reflections on their treatment experiences during the COVID-19 outbreak and quarantine. Patients showed both positive and negative experiences in the quarantine period.

1. Social relationships during quarantine directly relate to the initiative to maintain proper oral health.
2. The patients noted changes in diet, frequency of brushing, and duration during COVID-19 lockdown.
3. Orthodontic patients did not believe that COVID-19 quarantine would affect their treatment outcomes. However, they stated that a negative impact on the overall duration of treatment might occur.
4. Compliance with elastic wear and orthodontic instructions were suboptimal during the quarantine period.
5. COVID-19 lockdown was stressful and added an extra psychological burden to the patients and their families, given the additional anxiety related to their treatment completion.
6. Participants recommend a transition to electronic follow-up during these times to maintain adequate interaction with their treating clinician and for better health care delivery and outcomes.

7. Clinicians could expect behavioral changes from orthodontic patients and should identify better strategies to mitigate clinical challenges.

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