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Interruption of Orthodontic Treatment During the COVID-19 Pandemic: A Systematic Review

Interrupción del Tratamiento de Ortodoncia Durante la Pandemia de COVID-19: Una Revisión Sistemática

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ABSTRACT: The objective of this study was to critically analyze and discuss the main consequences that occurred due to the interruption of treatment during the COVID-19 pandemic.This review was developed in accordance with the PRISMA Preferred Reporting Items for Systematic Reviews. The research question was determined using the PECO strategy. Electronic searches were performed in PubMed, Cochrane Library, Science Direct, SciELO and gray literature for relevant published articles. Observational studies with patients undergoing interrupted orthodontic treatment during the COVID-19 pandemic, containing information on time of treatment interruption, age, sample size, experimental groups, evaluation criteria and study results, were included. The search strategy resulted in the retrieval of 568 publications. After applying the eligibility criteria, 11 articles were selected for qualitative analysis. The results show a decrease in the frequency of patients at the dental office for follow-up appointments during the pandemic and the appearance of symptoms due to the interruption of orthodontic therapy. It is concluded that due to the COVID-19 pandemic, several consequences occurred due to the interruption of orthodontic treatment such as periodontal problems, pain, damage to the appliance, failure to bond the brackets, detachment of the elastic ligature and the appearance of mouth ulcers.

KEY WORDS: COVID-19; orthodontic treatment; orthodontic appliance; treatment interruption; systematic review.

INTRODUCTION

In late 2019, an outbreak of severe pneumonia was diagnosed in a group of Chinese patients in the city of Wuhan, which was subsequently recognized as the coronavirus disease 2019 (COVID-19) (Lu *et al*., 2020). This so far unknown virus quickly spread to other cities in China and, consequently, throughout the world, triggering a global pandemic, as announced by the World Health Organization on March 11, 2020 (Cotrin *et al*., 2020; Organization WH, 2020).

SARS-CoV-2 belongs to the coronavirus family and is the virus responsible for the COVID-19 pandemic. It is highly contagious and causes severe acute respiratory syndrome in affected patients (Cascella *et al*., 2023). The appearance of the disease brought not only the risk of death but also the creation of blockades and strict measures worldwide, such as the closure of schools and public places (Hamnerm *et al*., 2020; Liu *et al*., 2020). In addition, it was also recommended that exams and elective dental appointments be cancelled and/or postponed since such practices demand physical proximity and increase the risk of contamination and dissemination of COVID-19 between dentists and patients (Meselson, 2020).

Consequently, orthodontic treatment, which is responsible for solving malocclusion problems, was also impaired due to the emergence of COVID-19 (Umeh *et al*., 2021). The estimated duration is 2 to 3 years, where patients visit the clinic regularly for device activation and treatment

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follow-up (Pirvu *et al*., 2014), and its postponement during the pandemic resulted in an extension of treatment time with other associated implications, such as periodontal problems, pain, and appliance breakage (Abed Al Jawad & Alhashimi, 2021; Yavan *et al*., 2022).

Despite the few studies in the literature on the subject, it is known that the COVID-19 pandemic caused significant impacts on orthodontic treatment for both patients and orthodontists (Cotrin *et al*., 2020; Umeh *et al*., 2021; Abed Al Jawad & Alhashimi, 2021; Yavan *et al*., 2022). In this context, the aim of the present study was, based on a systematic review, to critically analyze and discuss the main consequences of the interruption of orthodontic treatment during the COVID-19 pandemic.

MATERIAL AND METHOD

This systematic review was developed in accordance with the PRISMA protocol for systematic review papers (www.prisma-statement.org) and was registered in PROSPERO (www.crd.york.ac.uk/PROSPERO) under the protocol number CRD42022349351.

1. PECO question. The research question was determined using the PECO strategy: population: patients undergoing orthodontic treatment aged 8 years or older using fixed or removable appliances; exposure: treatment discontinuation; comparison: non-interrupted treatment; and outcome: orthodontic complications. Therefore, the research question was established as: Have patients undergoing orthodontic treatment over 8 years of age, users of fixed or removable appliances, and exposed to treatment interruption due to COVID-19, presented different types of orthodontic complications when compared to patients whose treatment has not been interrupted?

2. Inclusion and exclusion criteria. Observational studies with patients undergoing interrupted orthodontic treatment during the COVID-19 pandemic, containing information on treatment interruption time, age, sample size, experimental groups, assessment criteria, and study results, were included in the present study. Articles, dissertations, and theses published in English without restriction of year of publication were considered eligible. Publications that did not contain the necessary information to be included in the study were excluded.

3. Search strategy. This systematic review started in July 2022 at the Federal University of Vales do Jequitinhonha e Mucuri, Diamantina, Minas Gerais, Brazil. PubMed, Cochrane Library, Science Direct, and SciELO electronic databases were searched using the keywords “COVID-19”, “orthodontic treatment”, “orthodontic appliance,” and “treatment interruption” in English (COVID-19 AND orthodontic treatment OR orthodontic appliance OR treatment interruption). All search terms were indexed in MeSH and there was no individualized strategy for the different databases. A manual search was performed in the reference lists of the articles included in the review and in the gray literature (Google Scholar and databases of theses/dissertations) to complement the search that was initially performed. The searches were carried out independently by two researchers, and the references were organized using the EndNote X7 software. The researchers independently selected articles based on an analysis of the title and abstract (pre-screening), followed by a full-text analysis of the pre-selected articles. The primary outcome sought was orthodontic complications, and the secondary outcome was the impact on treatment time.

4. Selection of articles and data extraction. Two independent researchers carried out the selection of articles based on the analysis of titles and abstracts (pre-selection), followed by a full-text analysis of the pre-selected articles. The outcome sought was orthodontic complications during the orthodontic treatment performed during the COVID-19 pandemic. Data extraction was also performed independently by two reviewers, and the data extraction form was created by analyzing the following variables: author/year/country where the study was conducted; study design; sample size; participant characteristics (age, region of residence, and duration of orthodontic treatment); and outcome characteristics (time of interruption of treatment, evaluation criteria, and study results). Differences of opinion in the selection of articles or in the extraction of data were resolved by consensus among the researchers.

5. Qualitative analysis. To analyze the quality and risk of bias of the articles, the two reviewers rigorously evaluated the included articles using the JBI Critical Appraisal Tools for Observational Studies. The JBI Critical Appraisal Tools for Observational Studies assess the methodological quality of a study and determine the extent to which a study has addressed the possibility of bias in its design, conduct, and analysis.

The eight questions on the JBI checklist were answered for each article included in the study with the following answers: Yes, No, Uncertain or Not applicable. The questions answered for each of the studies were:
1. Were the inclusion criteria in the sample clearly defined?

2. Were the study subjects and setting described in detail?
3. Was the exposure validly and reliably measured?
4. Were objective criteria and standards used for measuring conduct?
5. Were confounding factors identified?
6. Have strategies been stated for dealing with confounding factors?
7. Were the results validly and reliably measured?
8. Was appropriate statistical analysis used?

The studies that obtained the highest number of "Yes" answers were considered of high quality, while those that presented the highest number of "No", "Uncertain" or "Not applicable" answers were considered of low quality. Disagreements between authors about the risk of bias in specific studies were resolved by discussion followed by consensus.

RESULTS

1. Study Selection. The initial search resulted in 568 articles: 211 from Pubmed, 0 from Cochrane, 79 from Web of Science, 8 from SciELO, 270 from Science Direct and no articles were found in the Gray literature. After removing 65 duplicate articles, the remaining 503 were submitted to title analysis. Pre-selection based on titles led to the exclusion of 215 papers, and the remaining 288 were selected for abstract reading. After reading the abstracts, 277 papers were excluded and 11 were considered eligible. From the manual search of the reference lists of the selected articles, no work was identified as eligible. After reading the articles in full, 11 studies were included in the review and submitted to qualitative analysis (Fig. 1).

2. Data extraction. Table I presents the data characteristics of the 11 articles included in the review. The selected studies were observational. The publication dates of the included articles ranged from 2020 to 2022. Most studies presented data related to the continuity or not of orthodontic treatment during the COVID-19 pandemic and the main complaints of patients during this period.

3. Quality analysis of the articles. Table II presents detailed information on the methodological quality of the included studies. Five studies were classified as high quality (Cotrin *et al*., 2020; Yavan *et al*., 2022; Shenoi *et al*., 2020; Turkistani *et al*., 2020; Yavan *et al*., 2021), and six studies were classified as low quality (Umeh *et al*., 2021; Abed Al Jawad & Alhashimi, 2021; Artese, 2020; Martina *et al*., 2021; Motevasel *et al*., 2020; Saccomanno *et al*., 2022). The studies by Artese (2020) and Abed Al Jawad and Alhashimi (2021) obtained all checklist responses as "Not applicable".

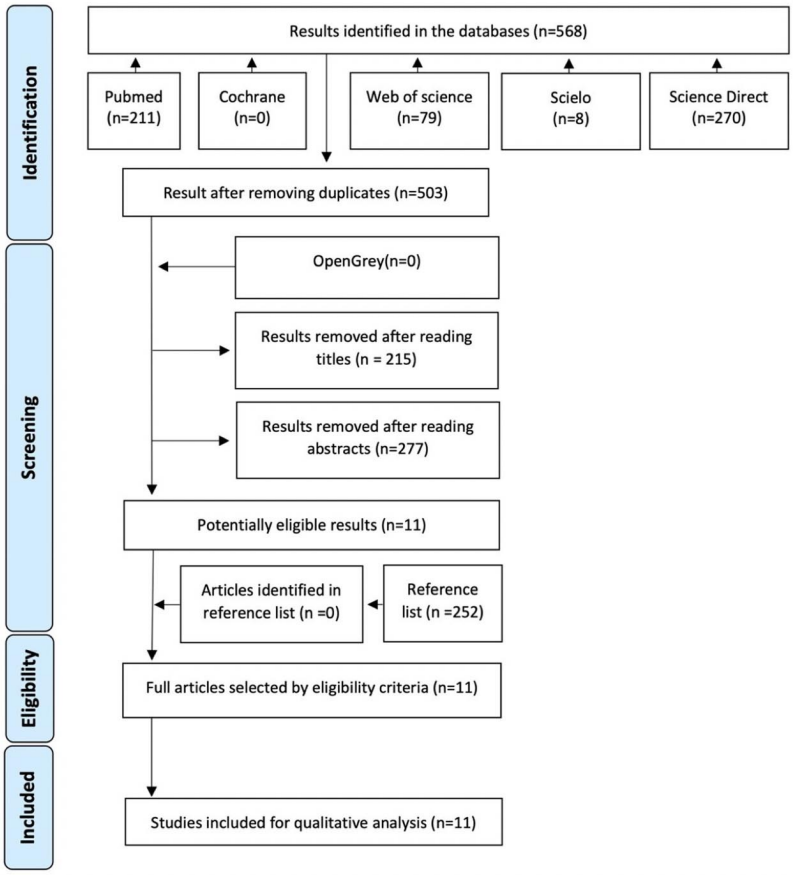

Fig. 1. Flowchart of the bibliographic search and selection process, adapted from the PRISMA.

Table I. Data of the selected studies.

AUTHORS	JOURNAL	TITLE	COUNTRY	STUDY DESIGN	SAMPLE SIZE	OBJECTIVE	PROTOCOL	CONCLUSION
Shenoi, Deshpande *et al.*, 2020	Journal of Indian Orthodontic Society	Impact of COVID-19 lockdown on patients undergoing orthodontic treatment: a Questionnaire Study	India	Cross-sectional study- closed and self-developed online questionnaire	n= 500	To assess the impact of interruption during the COVID-19 pandemic on the treatment and mental health of patients undergoing orthodontic treatment.	1. Patient selection (patients undergoing orthodontic treatment in any form started before the pandemic); 2. Distribution of online questionnaires at random (it was mandatory that patients answer the 15 questions); 3. Descriptive and inferential analysis of participants' responses.	It was concluded that it is important for orthodontists to understand the psychology of patients undergoing orthodontic treatment. The patient must be taken care of mentally and physically in any situation.
Artese, 2020	Dental Press Journal of Orthodontics	COVID-19: The aftermath for orthodontics	Brazil	Not applicable	Not applicable	Consequences in orthodontics during the COVID-19 pandemic.	Not applicable	Not applicable
Turkistani, 2020	Journal of the World Federation of Orthodontists	Impact of delayed orthodontic care during COVID-19 pandemic: emergency, disability and pain	Saudi Arabia	Cross-sectional descriptive study	n= 259	To assess the impact of clinical office closure and delay in providing orthodontic care in emergencies, pain intensity and disability experienced by orthodontic patients during the COVID-19 pandemic.	1. Submission of the consent form; 2. Sending a questionnaire with demographic questions and questions related to the patient's orthodontic treatment; 3. Submission of the Manchester Orofacial Pain Disability scale; 4. Statistical analysis of participants' responses.	Delay in orthodontic care can give rise to orthodontic emergencies experienced by patients, but the pain and disability resulting from these events are minimal. More research is needed to complement the findings of this study.
Cotrin, Peloso *et al.*, 2020	Orthodontics & Craniofacial Research	Impact of coronavirus pandemic in appointments and anxiety/concerns of patients regarding orthodontic treatment	Brazil	Cross-sectional study	n= 354	To assess the impact of the COVID-19 pandemic and quarantine on orthodontic consultations and patients' anxiety and concern with ongoing treatment.	1. Definition of patient inclusion criteria; 2. Sending a questionnaire to patients from private dental clinics in 2 metropolitan cities via WhatsApp; 3. Statistical analysis of the obtained data.	The quarantine and the coronavirus pandemic have been shown to have an impact on orthodontic appointments and patient anxiety.
Yavan, 2021	Journal of the World Federation of Orthodontists	Effects of the COVID-19 pandemic on new patient visits for orthodontic treatment: a comparison of 2020 and the previous 3 years	Turkey	Retrospective study	n= 10.030	To compare the demographic characteristics of visits by new patients for orthodontic treatment in the year of the pandemic (2020) versus previous years.	1.Selection of patients who were undergoing orthodontic treatment between January 1, 2016 and December 31, 2020; 2. Collection of patient demographic data; 3. Statistical analysis of collected data.	There was a sharp drop in the number of new patient visits for orthodontic treatment in the pandemic year (2020) compared to previous years.
Abed Al Jawad and Alhashimi, 2021	Dental Press Journal of Orthodontics	Orthodontic treatment pauses during COVID-19 outbreak: are we overlooking potential harms to our patients and their treatment outcomes?	Qatar	Literature review	Not applicable	Assess the damage and its negative impacts on patients undergoing orthodontic treatment during the COVID-19 pandemic	1. Damage related to unsupervised orthodontic patients (damage to dental mechanics; damage to completed treatment; psychological damage; damage to teeth and periodontium); 2. Necessary actions by the orthodontist to gradually recall patients and avoid treatment failure.	Orthodontists should be aware of the harm caused by treatment interruption and should consider referring patients with a high need for treatment to avoid problems with the final results.
Umeh, Utomi *et al.*, 2021	American Journal of Orthodontics and Dentofacial Orthopedics	Impact of coronavirus disease 2019 pandemic on orthodontic patients and their attitude to orthodontic treatment	Nigeria	Cross-sectional descriptive study	n= 400	To assess the impact of the COVID-19 pandemic on the orthodontic patient.	1. Filot study carried out with 10 patients; 2. Distribution of questionnaires to participants through an online data collection platform with intentional sampling technique; 3. The questionnaire had 4 sections: demographic data, impact of treatment in the pandemic, knowledge about COVID-19 and risk perception and attitude towards the pandemic; 4. Statistical analysis of collected data.	The COVID-19 pandemic has had a negative impact on orthodontic treatment and patients' financial and emotional well-being. Patients were willing to continue with treatment during the pandemic, complying with precautionary measures to prevent the spread of the disease.
Martina, Amato *et al.*, 2021	Progress in Orthodontics	The perception of COVID-19 among Italian dental patients: an orthodontic point of view	Italy	Cross-sectional study - Online questionaire	n= 1566	To investigate patients' perceptions of dental practice during COVID-19 and whether the pandemic will affect the care of orthodontic patients in dental practice.	1. Approaching patients online via Facebook, WhatsApp and mailing lists; 2. Submission of online questionnaires consisting of 21 questions (5 on personal data, 3 on anxiety about going to the dentist, 4 on the presence of TMD and 5 on orthodontic treatment); 3. Statistical analysis of patient's responses.	Most patients believe that dental offices are the places with the highest risk of transmission of COVID-19. Gender, age and level of distress were associated with fear of going to the dentist during the pandemic.
Motevasel, Helms *et al.*, 2022	American Journal of Orthodontics and Dentofacial Orthopedics	The impact of the COVID-19 pandemic on U S orthodontic practices in 2020	United States	Cross-sectional study	n= 507	To investigate the immediate impact and long-term implications of severe acute respiratory syndrome on US orthodontic practices in 2020.	1. Development of a questionnaire divided into 5 sections; 2. Presentation of the questions prepared to 14 US orthodontists for evaluation; 3. Distribution of questionnaires; 4. Statistical analysis of collected data.	The COVID-19 pandemic has had a broad and significant impact on the patient care and financial aspects of orthodontic practices in the US in 2020.
Yavan, Cingoz *et al.*, 2022	American Journal of Orthodontics and Dentofacial Orthopedics	Incidence of orthodontic appliance failures during the COVID-19 lockdown period	Turkey	Observational study	n= 350	To document the incidence of fixed orthodontic appliance failures and the periodontal health status of patients undergoing treatment during COVID-19.	1. Definition of patient inclusion criteria; 2. Observation of orthodontic failures; 3. Evaluation of periodontal parameters; 4. Statistical analysis of the obtained data.	Orthodontic appliances may have higher failure rates during a block than in normal periods, also affecting patients' periodontal health.
Saccomanno, Saran *et al.*, 2022	Dentristy Journal	The influence of the COVID-19 pandemic on orthodontic treatments: a survey analysis	Italy	Research Analysis	Not applicable	To evaluate the influence of the pandemic on the choice to start orthodontic treatment, oral health care, and the importance given to the appearance of dental occlusions.	1. Analysis of responses to a questionnaire applied to 159 patients; 2. Study power analysis; 3. Statistical analysis of participants' responses.	The study suggests that the economic crisis resulting from the pandemic does not, in principle, affect the work of the orthodontist, or the patient's decision to undergo orthodontic treatment.

Table II. Methodological and conclution of the selected studies.

Author	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
Shenoi, Deshpande *et al.*, 2020	Yes	Yes	Yes	Yes	Not applicable	Not applicable	Yes	Yes
Artese, 2020	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Turkistani, 2020	Uncertain	Yes	Yes	Uncertain	Yes	Yes	Yes	Yes
Cotrin, Peloso *et al.*, 2020	Yes	Yes	Yes	Yes	Sim	Not applicable	Yes	Yes
Yavan, 2021	Yes	Yes	Yes	Yes	Not applicable	Not applicable	Yes	Yes
Abed Al Jawad and Alhashimi, 2021	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Umeh, Utomi *et al.*, 2021	Uncertain	Yes	Yes	Uncertain	Sim	Not applicable	Yes	Yes
Martina, Amato *et al.*, 2021	Uncertain	Yes	Yes	Uncertain	Sim	Not applicable	Yes	Yes
Motevasel, Helms *et al.*, 2022	Uncertain	Yes	Yes	Uncertain	Yes	Not applicable	Yes	Yes
Yavan, Cingoz *et al.*, 2022	Yes	Yes	Yes	Yes	Not applicable	Not applicable	Yes	Yes
Saccomanno, Saran *et al.*, 2022	Uncertain	Uncertain	Yes	Uncertain	Not applicable	Not applicable	Yes	Yes

DISCUSSION

The results of the systematic review showed that there were complications in orthodontic treatment during the COVID-19 pandemic, with very heterogeneous assessments. It was not possible to perform a meta-analysis in this study because the results of the articles found were dispersed among themselves.

The COVID-19 pandemic had a negative impact not only on the interruption of orthodontic treatment but also on the quality of life and well-being of the patients (Umeh *et al*., 2021). Cross-sectional studies showed through questionnaires that most patients were afraid of going to the dentist during the global crisis due to the greater chances of being contaminated by SARS-CoV-2 in the dental office, which also reduced the number of new patients starting orthodontic treatment during this period (Cotrin *et al*., 2020; Shenoi *et al*., 2020; Martina *et al*., 2021; Saccomanno *et al*., 2022).

With the decrease in the frequency of patients in the dental office for follow-up appointments during the pandemic, the appearance of symptoms due to the interruption of orthodontic therapy was also observed, some of which were periodontal problems, pain, and damage of the appliance (Abed Al Jawad & Alhashimi, 2021). Among the incidence of failures that occurred in the orthodontic appliance during this period, failure in bracket bonding, detachment of the elastic ligature, and the appearance of oral ulcers were the most reported by the patients who participated in the research, respectively (Yavan *et al*., 2022). In addition, other complications reported were the bad smell, the sharp ligature, and the worsening of the malocclusion (Cotrin *et al*., 2020; Turkistani *et al*., 2020). All these reports are probably because patients have reduced or stopped going to the dentist due to the COVID-19 pandemic, leading not only to treatment delay but to several complications with the loss of maintenance time.

The authors also showed how the psychological and emotional situation of this population changed during the crisis period. The fear of visiting the dental office reflected concern about the global pandemic, which showed patients' awareness of their systemic health at the time. Despite reporting a certain anxiety regarding the continuity of orthodontic treatment, it was not a priority during the pandemic period, when they were psychologically shaken by the situation they were experiencing (Cotrin *et al*., 2020; Shenoi *et al*., 2020), and at a moment when the entire world population was feeling fragile by the growth of contamination by the virus and its consequences.

As for the concern with the smile during this period, most interviewees reported that the pandemic did not influence the importance given to smile despite their absence in dental office (Saccomanno *et al*., 2022), which can be explained by the fact that the use of masks during this period has made people less careful with their own teeth due to the use of face masks. Regarding the type of appliance, most used fixed appliances when compared to the other types and said that the pandemic did not influence/influenced the type of orthodontic appliance to be (Martina *et al*., 2021; Saccomanno *et al*., 2022).

In addition, orthodontists also reported difficulties during this period. With the various limitations and the decrease in the frequency of patients in the dental office, many orthodontists resorted to other strategies to remain in contact with their patients. Among them, we mention tele orthodontics, phone calls, and the use of e-mail for patient management during the pandemic (Motevasel *et al*., 2020). Unfortunately, it is known that despite maintaining distant contact with their patients, their absence from the daily clinic directly affected the financial situation of orthodontists in this period, who found it extremely difficult to continue and complete their work.

Regarding the progress of the treatment of these patients due to the interruption in the period of the COVD-19 pandemic, they reported a delay in completing the treatment since the time has become longer and the device will remain in the mouth for much longer for a total resolution of malocclusionproblems (Shenoi *et al*., 2020). Some patients also reported undesirable effects due to treatment interruption, such as discomfort from the orthodontic wire, pain, and the fact that brackets and elastics were lost during this period (Umeh *et al*., 2021; Shenoi *et al*., 2020; Turkistani *et al*., 2020). These results show that with the interruption of orthodontic treatment during the pandemic, its success and completion were directly affected.

According to this systematic review, there were several implications caused by the COVID-19 pandemic in orthodontic treatment. Therefore, after this period has ended, it is up to orthodontists to try to reverse the complications and delays caused and seek to attract patients who have not started their treatment due to the onset of the global pandemic.

CONCLUSION

After analyzing the studies included in this systematic review, it is concluded that due to the COVID-19 pandemic, there were several consequences due to the interruption of orthodontic treatment such as periodontal problems, pain, damage of the appliance, failure in bracket bonding, detachment of the elastic ligature, and the appearance of oral ulcers.

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Competing Interests. The authors declare no competing interests.

Author's contributions. This work was a collaboration of all authors. TFS and AMTRN designed the study. AMTRN and CCOS collected the data. TFS, AMTRN, MTBAG and LDAS analyzed the data.

NERI, R.T. A. M.; ALMEIDA E SILVA, L. D.; GUIMARÃES, A. M. T. B.; SANTOS, O. C. C. & FONSECA-SILVA, T. Interrupción del tratamiento de ortodoncia durante la pandemia de COVID-19: Una revisión sistemática. *Int. J. Odontostomat., 19(4)*:385-391, 2025.

RESUMEN: El objetivo de este estudio fue analizar y discutir críticamente las principales consecuencias asociadas a la interrupción del tratamiento de ortodoncia durante la pandemia de COVID-19. Esta revisión se realizó de acuerdo con las directrices PRISMA para revisiones sistemáticas. La pregunta de investigación se formuló utilizando la estrategia PECO. Se efectuaron búsquedas electrónicas en PubMed, Cochrane Library, ScienceDirect, SciELO y literatura gris para identificar estudios relevantes. Se incluyeron estudios observacionales con pacientes cuyo tratamiento de ortodoncia fue interrumpido durante la pandemia de COVID-19 y que reportaran información sobre tiempo de interrupción, edad, tamaño de muestra, grupos experimentales, criterios de evaluación y resultados. La búsqueda recuperó 568 publicaciones. Tras aplicar los criterios de elegibilidad, se seleccionaron 11 artículos para el análisis cualitativo. Los resultados mostraron una disminución en la asistencia de los pacientes a las citas de seguimiento durante la pandemia y la aparición de síntomas y complicaciones asociadas a la interrupción del tratamiento ortodóncico. Se concluye que la pandemia de COVID-19 generó diversas consecuencias derivadas de la interrupción del tratamiento de ortodoncia, entre ellas problemas periodontales, dolor, daño en los aparatos, desprendimiento de brackets, desajuste de las ligaduras elásticas y aparición de úlceras orales.

PALABRAS CLAVE: COVID-19, tratamiento de ortodoncia, aparatos de ortodoncia, interrupción del tratamiento.

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