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The impact of the COVID-19 pandemic on dental trauma attendance: a systematic review and meta-analysis

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Abstract

This systematic review and meta-analysis aimed to analyze the impact of the COVID-19 pandemic on dental trauma patient attendance. The study was registered in the PROSPERO system, using the CRD42021288398 protocol. Searching was performed in PubMed, Scopus, Web of Science, Embase, Lilacs, and OpenGrey databases, using the following keywords: "Tooth injuries," "Dental trauma," "Traumatic Dental injury," and "COVID-19". We included observational studies evaluating dental trauma in the context of the COVID-19 pandemic. Quality assessment was performed using the Joanna Briggs Institute Critical Appraisal Checklist for Cross-Sectional Studies. Meta-analysis was performed in RevMan 5.4 software with Odds Ratios as a pooled measure of effect, with a 95% confidence interval, and using random-effects modeling. After applying the eligibility criteria, 32 studies were included for qualitative analysis, in which 10 were used to assess the frequency of dental trauma diagnoses in dental emergencies. Despite the decrease of visits during COVID-19, the analysis revealed no difference between the pandemic and pre-pandemic periods. Regarding the type of dental trauma, two of the studies revealed no differences for the periods before and during the pandemic. This study revealed that the COVID-19 pandemic has not impacted the frequency or type of dental trauma compared to previous periods.

Keywords: COVID-19. Tooth injuries. Tooth avulsion. Tooth fractures. Systematic review. Meta-analysis.

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Introduction

The COVID-19 pandemic has affected the world's population, causing significant impacts to health care. Due to the aerosol transmission of the disease, health professionals, especially dentists, are more vulnerable and exposed to the risk of contamination. Given this scenario, there have been readjustments in health care, with greater investment in personal protective equipment (PPE) and biosafety measures to minimize the risk of cross-contamination between professionals and patients in the dental office environment.[1-3]

Moreover, to prevent the contamination, restrictive measures also had to be imposed, such as distancing and social isolation, occasionally suspending elective dental care for a period and assisting only urgent cases.[4] The main types of emergency in dental care are endodontic, surgical, traumatic, and infectious disease.[5,6]

Traumatic dental injuries are a public health problem worldwide that affect a considerable proportion of the population, especially children and young adults. Such injuries vary according to tooth structure involvement, from simple enamel fractures to avulsion. Depending on the severity, a trauma may require urgent professional care, possibly resulting in an irreparable dental damage. Many causes, such as falls, car accidents, sports, occupational accidents, or interpersonal violence can affect the dental arch and involve both teeth and their supporting tissues, causing functional, esthetic, and even psychological injury.[7-11]

Each treatment is performed in accordance with the need of the case. Thus, the variability of traumatic injuries determines the diversity of treatments, which can be categorized as endodontic (pulpotomy, pulpectomy), restorative, periodontal (splinting of teeth), surgical (extractions), or as pharmacological interventions.[6,12,13]

The COVID-19 pandemic has spread worldwide, bringing many challenges to Dentistry, especially in terms of the population's access to dental care after the restrictive measures. Due to the need for urgent dental treatment in some cases of dental trauma, it is essential to understand how the pandemic impacted the demand for care of patients who suffered dental trauma and were treated in urgent dental services. In this context, this study aimed to assess the impact of the current pandemic on dental trauma health care by carrying out a systematic review of the literature with a meta-analysis.

Methodology

This systematic review and meta-analysis was carried out in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines,[14] and the study was registered in the PROSPERO system, using the CRD42021288398 protocol.

The following research question guided the study development: "What is the impact on demand for care of patients who suffered dental trauma and were attended in urgent dental services?" From the *PECOS* strategy: Population – P: Dental trauma patients; Exposition – E: COVID-19 pandemic period; Comparison – C: Pre-pandemic period; Outcome – O: the impact of the COVID-19 pandemic on dental trauma attendance; Study design – S: Observational study.

Search strategy

In July 2022, searches were performed in the PubMed/Medline, Scopus, Web of Science, Embase, and Lilacs databases, without an year of publication or language limitations. Searches were also carried out in the Open Grey referring to gray literature. The elaboration of the search strategy (Supplementary material) was performed using Medical Subject Headings (MeSH) and their respective terms, combined with Boolean operators (AND, OR): "Tooth injuries," "Dental trauma," "Dental-alveolar trauma," "Traumatic dental injury," "Tooth fracture," "Tooth avulsion," "Tooth luxation," "Tooth concussion," "Tooth intrusion," "Tooth extrusion," "COVID-19," "COVID-19 pandemic". Manual searching in the manuscripts was performed to verify the included studies' references.

Eligibility criteria

Observational studies that evaluated dental trauma during and before the COVID-19 pandemic were selected. Of these studies, those that also presented data from the pre-pandemic period were used as controls for comparative analysis. Case reports, case series, letters to the editor, comments, editorials, and literature reviews were excluded. Furthermore, studies that mentioned craniofacial, maxillofacial,

or dentoalveolar trauma, yet without specifying the damage to dental structures, were not considered. Clinical trials were not considered due to ethical limitations regarding exposure parameters.

Study selection

The study selection process was performed using the Rayyan software (https://www.rayyan.ai/). Files from each database were imported and duplicates removed. The initial step was selecting the studies by title and abstract, followed by reading the full-text of each potentially eligible article. Articles that did not meet the selection criteria were excluded with justification. Study selection was performed by two independent reviewers (ACG and LRMB) and disagreements were resolved by a third reviewer (DSC).

Data extraction

Data extraction from the included studies employed a standardized collection form with the following information: author, year, country, period, sample characteristics, dental trauma, tooth affected, cause of trauma, and treatment. The data extraction was performed by three reviewers (DSC, IAFM, and LEDS) and revised by a fourth reviewer (FLCDA).

Quality assessment

Quality assessment was performed using the Joanna Briggs Institute Critical Appraisal Checklist for Cross-Sectional Studies[15] by two independent examiners (DSC and IAFM). The responses to the items in the checklist were "yes," "unclear," "no," or "not applicable." The questions evaluated and their respective answers were assessed using the RevMan 5.4 software (Review Manager 5.4, The Cochrane Collaboration).[16]

Meta-analysis

Meta-analysis was performed on the studies and presented comparative results in the pre-COVID-19 and COVID-19 periods for the frequencies of dental trauma diagnosed from the total number of dental emergencies. Subgroup analysis was also performed to assess the types of dental trauma in these same periods. The analyses and their respective forest plots were performed using the RevMan 5.4 software (Review Manager 5.4, The Cochrane Collaboration) considering odds ratios (ORs) as a pooled measure of effect, with a confidence interval of 95%, and using a random-effects model.

To quantify statistical heterogeneity, the I^2 test was used, classifying heterogeneity as low (I^2 close to 25%), moderate (I^2 close to 50%), high (I^2 close to 75%), or without statistical heterogeneity (I^2=0%).

Results

Figure 1 shows the flowchart of the study selection process following the PRISMA guidelines. Initially, 643 articles were identified in the databases, 337 duplicates were removed, and 306 studies were maintained for the title and abstract reading. After excluding 246 articles, 57 full-texts were read to verify the eligibility criteria, and 25 were excluded with justification (Supplementary material). No further studies were included, which may be a result from database searches originated in references. Thus, 32 studies were included in qualitative analysis, and 12 articles were included in quantitative analysis.

Figure 2 shows the information extracted from the selected studies**.** The studies were carried out in 13 countries (Qatar, Saudi Arabia, England, United Kingdom, Italy, Switzerland, Israel, India, China, Germany, Russia, United States, and Romania). Among the included articles, the United Kingdom and England (n=11) and China (n=6) presented most of the studies. Regarding the study periods, 20 studies[12,13,17-21,23,25-27,29-32,34,36,38,40,42] performed evaluations involving just the pandemic period and 12 studies[5,6,9,10,22,24,28,33,35,37,39,41] performed comparative analyses involving also previous (pre-pandemic) periods. Sample characteristics varied according to age group, with 12 studies[6,13,18,24,26,27,30-32,38,40,41] carried out in emergency dental services provided to children/adolescents from 0 to 21 years old. The other studies were performed in dental centers for the general public, with an age range from 0 to 95 years old. Dental care patients observed were mainly males in both the pre-COVID-19 and COVID-19 periods.

Qualitative analysis of the articles that do not compare the pre-COVID-19 period showed a prevalence of dental trauma, diagnosed in dental emergency services, ranging from 1.1%[18] to 54.9%[31]. The results varied as to the dentition and type of trauma involved. Only seven studies[13,19,24,30-32,40] mentioned the type of dentition, four studies[13,24,32,40] reported that dental trauma was more common in

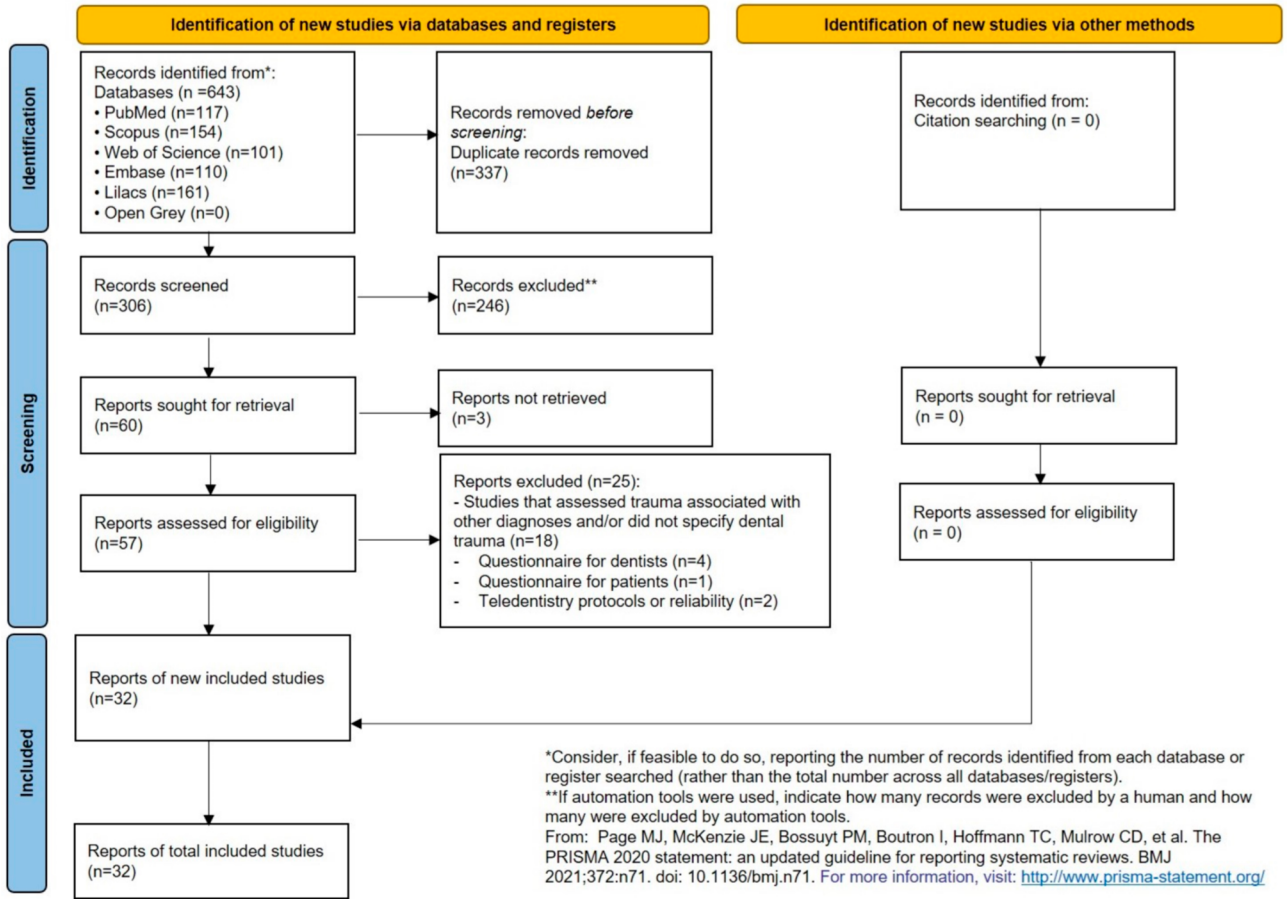

Figure 1- Flow diagram of literature searches in accordance with PRISMA 2020

primary dentition, and three studies[19,30,31] reported that dental trauma was more common in permanent dentition. The trauma type was specified in nine studies,[6,9,10,20,23,30,31,34,39] described as either enamel/dentine fracture, enamel-dentine-pulp fracture, crown root fracture, root fracture, concussion, subluxation, extrusion, lateral luxation, intrusion, or avulsion.

Only two studies[9,31] mentioned the affected teeth, presenting higher prevalence of the anterior teeth in the maxillary arch. The cause of trauma was evaluated by four studies,[9,10,31,35] whether falls or trips, bicycle accidents, assaults, traffic accidents, interpersonal violence, sports accidents, etc.

The specific treatments for dental trauma are mentioned in eight studies,[18,22,24,26,31,32,36,39] and included counseling, antibiotic/analgesic prescription, splinting, dressing, restorative procedures, and extractions. For dental emergencies in general, the main treatments reported were pulpotomy, pulpectomy, direct pulp cap, intraoral radiograph, and other conservative treatment management strategies.

Figures 3 and 4 show the quality assessment. The criteria evaluated in questions 1, 2, 3, 4, and 7 were present in all studies. The questions related to confounding factors were not applicable to the selected studies. The highest methodological variability was regarding the performance of statistical analysis, which was not mentioned in nine studies.[10,13,18-21,24,30,36]

Regarding quantitative analysis, 10 studies[5,6,22,26,28,33,35,37,39,41] were included to assess the frequency of a dental trauma diagnosis (Figure 5), with odds ratio of 0.76 and confidence interval from 0.52 to 1.12. Despite a lower number of dental emergencies during the pandemic, meta-analysis presented no statistically significant differences in dental trauma between the pre-COVID-19 and COVID-19 periods. However, a considerable level of heterogeneity obtained by the I^2 test indicated that the studies included were heterogeneous (I^2=84%) in their reported effect size.

For subgroup analyses that classified dental trauma (Figure 6), all participants in the two studies[9,10] included experienced traumatic dental injuries. The meta-analysis results presented no statistical differences by type of trauma in the evaluated periods, with only moderate heterogeneity (I^2=41%), odds ratio of 1.15, and confidence interval of 0.80 to 1.65. Only the intrusive luxation subgroup by occurrence of

Author/ Year	Country	Period	Sample characteristics	Dental trauma	Affected Tooth	Cause of trauma	Treatment
Ali, et al.[17] 2022	Qatar	First wave of the COVID-19 lockdown (5 months)	850 calls for teledentistry service	Dental trauma: 2.24%	-	-	Overall, dental splint, examination and instructions, dental extraction, root canal treatment, placement of dental splint.
Alzahrani, et al.[18] 2021	Saudi Arabia	March 26 until May 7, 2020	95 children and adolescents up to 14 years old (51.6% male; age range: two to 14 years old; mean: 8.1)	Dental trauma: 1 (1.1%)	-	-	Dental trauma was treated with extraction only
Amin, et al.[19] 2021	United Kingdom	April 2 until June 10, 2020	156 patients collected from the telephone triage proforma – 65% referrals were accepted for a face-to-face assessment (mean age of referrals was 42.3 years old; 47% male)	Dental trauma Deciduous tooth: 1 Permanent tooth: 9 Minor dental trauma: 4	-	-	Overall, of the 102 patients accepted for treatment, 73 had extractions, seven had extirpations, and 20 had other treatment. Two traumas of permanent teeth were rejected (minor dental trauma).
Ball, et al.[20] 2021	United Kingdom	April 6–11, 2020 (period 1) and May 11–15, 2020 (period 2)	Period 1: 159 patients (age range: 17–83 years old; 54% female) Period 2: 215 patients (age range: 16–84 years old; 50% female)	Period 1 Fractured tooth: 8 Vertical root fracture: 3 Dental trauma: 1 Period 2 Fractured tooth: 10 Vertical root fracture: 1 Dental trauma: 10	-	-	Overall, the most common treatment was extraction, followed by pulp extirpations, temporary filling, trauma management, analgesia, antibiotics, and no treatment.
Blackhall and Singh[21] 2021	United Kingdom	Start of the first lockdown until the easing of tight lockdown (six-week period)	211 patients (54.5% male; mean age: 38 years old; range: 0 – 95 years old)	Dental trauma: 42 (19.9%)	-	-	Overall, 145 patients received direct intervention, and 66 received conservative counseling and management strategies
Cagetti, et al.[22] 2021	Italy	Pre-COVID-19: March 25 until April 5, 2019 Lockdown: March23 until April 3, 2020 Reopening: June 8 until June 19, 2020 Second wave: November 9 until November 20, 2020	901 admissions from urgent dental care service Pre-COVID: 285 Lockdown: 93 Reopening: 353 Second wave: 170 Overall, a higher number of males in all time periods, with a mean age of, respectively, 43.74, 46.65, 39.90, and 40.65 years old	Dental trauma Pre-COVID-19 period: 4 Reopening: 0 Second wave: 4 Lockdown: 5	-	-	Dental trauma 2019: two dental visits + counseling and two restorative treatments 2020, first period: zero 2020, second period: three dental visits + counseling and one restorative treatment 2020, third period: four dental visits + counseling and one orthodontic fixed retainer
Carter, et al.[23] 2020	England	March 23 until May 3, 2020	1,746 patient triages (1,595 telephone and 151 face-to-face), resulting in 1,322 clinical consultation; 50% male and female; mean age of 36.5 years old; range 0 – 89 years old	Avulsed, dislocated, or fractured teeth: 60 (4.5%) Cracked, fractured, loose, or displaced tooth fragments: 17 (1.3%)	-	-	Overall, extractions, pulp extirpations, prescribed antibiotics, dressing were accomplished. Trauma advice: 7% (n = 18)
Davies, et al.[24] 2021	England	(COVID-19 -lockdown) March 26 until June 26, 2020	220 photographic triage - pediatric patients (56.31% male; average age of seven years old; range: 3 months – 21 years old)	Dental trauma Primary dentition trauma: 38 (17%) Permanent dentition trauma: 21 (10%)	-	-	Were evaluated 36 patients in a face-face consultation, in which 15 received dental trauma treatment
Eggmann, et al.[25] 2021	Switzerland	Pre-lockdown: February 07 until March 16, 2020 Lockdown: March 17 until April 24, 2020 Post-lockdown: April 27 until June 06, 2020	3,109 dental emergency visits (mean age: 43.7 years old across the three periods; higher prevalence of males)	Dental-alveolar injury Lockdown: 30 (2.7%) Post-lockdown: 57 (5.2%)	-	-	Overall, intraoral radiograph, restorative treatment, examination/ counseling, simple tooth extraction, and endodontic treatment were the most accomplished in all periods
Elalouf, et al.[26] 2022	Israel	Before lockdown (19 March to 30 April 2019), during lockdown (19 March to 30 April 2020), and after lockdown (1 May to 12 June 2020)	Pediatric clinic visits Before lockdown: 446 During lockdown: 359 After lockdown: 351	Before lockdown: 37 During lockdown: 18 After lockdown: 18	-	-	Dental procedures for trauma Before lockdown: crown (n=1), extraction (n=7), filling (n=2), and pulp treatment (n=6) During lockdown: extraction (n=7), filling (n=5), and pulp treatment (n=6) After lockdown: extraction (n=2), filling (n=3), and pulp treatment (n=2)

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Figure 2- Data extracted from the included studies

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Goswami, et al.[27] 2021	India	COVID-19 lockdown: March 23, until August 31, 2020	356 pediatric patients aged 0–14 years (57.58% males)	Traumatic dental injuries: 8.42% (n=30)	-	-	Overall, medical treatment (mainly analgesics and antibiotics), extraction, root canal access opening, irrigation, and dressing of root canal, and non-traumatic restorative treatment were accomplished. Trauma management was carried out in 7.97% (n=30) of total cases.
Guo, et al.[28] 2020	China	During COVID-19: February 1 until February 10, 2020 Pre-COVID-19: January 1 until January 10, 2020	2,537 patients COVID-19: 970 (56.7% male; the average age of 41.2 years old) Pre-COVID-19: 1,567 (52.5% female; the average age of 37.5 years old)	Dental trauma COVID-19: 102 (10.5%) Pre-COVID-19: 222 (14.2%)	-	-	-
Hahn, et al.[29] 2021	Germany	Pre-lockdown: February 3 until March 15 Lockdown: March 16 until April 26, 2020 Post-lockdown: April 27 until June 7, 2020	1,299 patients Pre-lockdown: 576 (54.2% male; mean age of 45.2 years old) Lockdown: 309 (57.6% male; mean age of 45.5 years old) Post-lockdown: 414 (50.5% female; mean age of 43.2 years old)	Dental trauma Pre-lockdown: 93 (16.2%) Lockdown: 51 (16.5%) Post-lockdown: 71 (17.2%)	-	-	-
Ilyas, et al.[30] 2020	United Kingdom	March 30 until April 20, 2020	34 children	Luxation (permanent): 3 Complicated crown fracture (permanent): 3 Complicated crown fracture (primary): 3 Luxation (primary): 2 Uncomplicated crown fracture (permanent): 1	-	-	Overall, extractions, splints placed, and pulp caps were accomplished
Ilyas, et al.[31] 2021	United Kingdom	March 23 until June 14, 2020	Screening of 420 phone calls for pediatric dental-facial emergencies, resulting in 171 (40%) face-to-face consultations, of which 102 dental-facial trauma patients; 55.3% females; age range: 1 until 16 years	56 (54.9%) dental-alveolar injuries Permanent teeth: 73.2% Primary dentition: 26.8% Type of injury Lateral dislocation: 26.7% Avulsion: 21.4% (91.6% in the permanent dentition) Complicated coronary fractures: 21.4% Enamel/dentin fractures: 16% Extrusion: 7.1% Intrusion: 3.5%	Most patients (73%) sustained an injury to the anterior teeth with 69% in the maxillary arch	Fall or trip: 48.2% Scooter or bicycle: 26.7% Exercise regime: 10.7% Alleged assault: 5.6%	Dental-alveolar injuries Splinting (n=16) Conservative (n=11) Extraction (n=10) Dressing (n=9) Cvek pulpotomy (n=5) Direct pulp cap (n=1)
Kamalova,et al.[32] 2020	Russia	March 20, until April 24, 2020 (one week in each clinic)	166 pediatric dental patients (51.2% male; mean age of 7.6; range: 1 to 17 years)	Dental trauma: 12 cases (6.3%) Primary teeth: 10 Permanent teeth: 2	-	-	Dental trauma Conservative treatment (2 permanent teeth and 5 primary teeth) and extraction (5 primary teeth)
Kumar, et al.[33] 2021	India	Group I: February 14 until March 17, 2019 Group II: April 14 until May 13, 2019 Group III (pre-lockdown): February 14 until March 17, 2020 Group IV (lockdown): April 14 until May 13, 2020 (COVID-19)	Dental emergencies Group I: 395 patients (52.8% male) Group II: 406 patients (51.2% male) Group III: 387 patients (52.8% male) Group IV: 265 patients (58.7% male)	Dental trauma Group I: 6 (1.5%) Group II: 9 (2.2%) Group III: 5 (1.2%) Group IV: 1 (0.3%)	-	-	-

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Langella, et al.[34] 2021	United States	March 30 until May 8, 2020	466 patients from emergency triage phone (56% female; mean age of 46.6 years old; range: 1–92 years old)	Tooth fracture resulting in pain or causing soft tissue trauma: 32 (12%) Dental trauma with avulsion/ luxation: 1 (0.4%)	-	-	Overall, the most frequent procedures were extractions (13.9% of clinical encounters) and surgical follow-up (13.5%)
Lentge et al.[35] 2021	Germany	March 23 until April 19, 2020 Control: same period in 2018 and 2019	939 patients (61.58% male; the average age of 39.54 years old) 2020: 190 2019: 419 2018: 330	Dental trauma 2020: 24 (12.63%) 2019: 20 (4.77%) 2018: 25 (7.57%)	-	24/03/1900 04:00 Falling (56.10%), sports/hobby (25.61%), interpersonal violence (12.20%), alcohol (8.54%), traffic accident (4.89%) 24/03/1900 03:00 Falling (48.19%), sports/hobby (24.10%), interpersonal violence (16.87%), alcohol (3.61%), traffic accident (3.61%) 24/03/1900 02:00 Falling (71.19%), interpersonal violence (10.17%), sports/ hobby (8.47%), alcohol (5.08%), traffic accident (0%)	-
Madi, et al.[5] 2021	India	Pre-pandemic period: September 24, 2019 until March 23, 2020 Pandemic period: March 24, until September 24, 2020	Urgent dental care Pre-pandemic: 2291 (53.93% male; mean age 39.02 years old) Pandemic: 543 (54.45% male; mean age 39 years old)	Fractured tooth and avulsed tooth Pre-pandemic period: 126 (5.5%) Pandemic period: 0 (0%)	-	-	-
Pajpani, et al.[36] 2020	United Kingdom	April 3 until June 12, 2020	1,311 referrals were received from the urgent dental care center, which 884 were accepted for treatment (56% female)	Dental trauma: 9%	-	-	Dental trauma requiring aerosol-generating procedure (n=7)
Patel, et al.[13] 2021	United Kingdom	March 25 until May 29, 2020	464 patients from pediatric dental emergency service (via telephone or in-person)	82 cases of dental trauma: Permanent teeth – 37 Primary teeth – 45	-	-	Overall, patients were treated remotely by telephone with pain management advice; home use of temporary restorative kits for minor trauma until teeth; oral health instructions. Among the treated patients, the most required primary tooth extraction (26 cases) and trauma-dressing/ Cvek/extirpation (21 cases). Permanent tooth extraction was performed in seven patients
Petrescu, et al.[37] 2020	Romania	April 1 until May 1, 2020 Control: April 1 until May 1, 2019	2019: 172 patients (56.33% male) 2020: 787 patients (53.59% male)	Dental-alveolar trauma 2019: 2 (1.16%) 2020: 40 (5.08%)	-	-	In general 2020: examination/ consultation only (30.36%) and sedative filling (29.28%) 2019: filling (35.64%) and pulpectomy (33.33%)
Samuel, et al.[6] 2021	India	March until July 2020 Control: March until July 2019	Pediatric patients 2019: 2483 patients (mean age: 7.4 years old; 52.8% males) 2020: 548 patients (mean age: 8.8 years old; 49.7% males)	Tooth fracture 2019: 67 24/03/1900 04:16 Dental trauma with avulsion/luxation 24/03/1900 03:04 24/03/1900 04:02	-	-	Overall, the procedures performed were: pulpectomy (1268 cases in 2019), and emergency extractions (242 cases in 2020). Splinting of teeth following trauma was performed in six cases (four in 2019 and two in 2020)

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Simpson, et al.[38] 2020	England	March 23 until May 3, 2020	369 pediatric consultations (56% telephone, 34% face-to-face); 52% male; mean age of seven years old; range: 0 –16 years old	Dental trauma: 50 (24%)	-	-	In general, 49% of face-until-face consultations resulted in extractions
Walter, et al.[12] 2021	Germany	February until July 2020	3014 patients (51% male; age range: 2 – 94 years old)	Acute dental trauma: 64 (5%)	-	-	Treatments were categorized as endodontic, restorative, periodontal, surgical, trauma, and pharmacological interventions as well as inpatient consultations or checkups with minor questions
Woolley and Djemal[10] 2021	United Kingdom	Pandemic period: April 13 until June 8, 2020 Control: April 15 until June 10, 2019	Patients that experienced traumatic dental injuries Pandemic period: 28 patients (57.1% female; mean age: 34 years; age range: 18 – 68 years old) Control: 52 patients (52.9% male; mean age: 25 years; age range: 19 – 78 years old)	2020 Enamel/dentine fracture: 27 teeth Enamel-dentine-pulp fracture: 6 Crown root fracture: 2 Root fracture: 1 Concussion: 8 Subluxation: 2 Extrusion: 3 Lateral luxation: 6 Intrusion: 8 Avulsion: 2 2019 Enamel/dentine fracture: 48 teeth Enamel-dentine-pulp fracture: 11 Crown root fracture: 4 Root fracture: 3 Concussion: 5 Subluxation: 9 Extrusion: 3 Lateral luxation: 22 Intrusion: 4 Avulsion: 28	-	2020: falls (72.0%), bicycle accidents (24.0%), and assault (4.0%) 2019: falls (36.1%), assault (23.4%), road traffic accidents (17.0%), bicycle accidents (12.8%), and sports accidents (10.6%)	-
Wu, et al.[39] 2021	China	SARS-COV-2 group: January 20 until March 8, 2020 Pre-SARS-COV-2 group: January 21 until March 10, 2019	Pre-SARS-COV-2 group: 1716 patients (50.9% male; mean age of 24.7 years) SARS-COV-2 group: 2442 patients (50.6% male; mean age of 33 years old)	Fracture of tooth Pre-SARS-COV-2 group: 58 patients (3.2%) SARS-COV-2 group: 23 patients (0.9%)	-	-	Tooth fracture treatment Antibiotics/analgesics: 6.1% (2019) and 26.1%, (2020) Local treatment: 53.4% (2019) and 30.4%, (2020)
Yang, et al.[40] 2020	China	February 2 until March 31, 2020	474 online consultations for pediatric dentistry (190 dental emergencies)	Dental trauma Deciduous teeth:17 children (3.6%) Permanent teeth: 2.1%	-	-	-
Yang, et al.[9] 2020	China	COVID-19: January 23 until April 7, 2020 Control: January 23 2019 until April 7, 2019	158 patients treated for traumatic dental injuries 2019: 120 (60% male; mean age of 26.3 years old), 2020: 38 (60.5% male; mean age of 21.6 years old)	2019 Enamel infraction: 4 Uncomplicated crown fracture: 19 Complicated crown fracture: 27 Crown-root fracture: 6 Root fracture: 5 Periodontal tissues: 101 Concussion: 18 Subluxation: 23 Extrusive luxation: 20 Lateral luxation: 10 Intrusive luxation: 6 Avulsion: 24 Supporting bone: 15 Gingival or oral mucosa: 39 2020 Enamel infraction: 0 Uncomplicated crown fracture: 2 Complicated crown fracture: 10 Crown-root fracture: 4 Root fracture: 0 Periodontal tissues: 29 Concussion: 3 Subluxation: 9	Upper central incisors in primary teeth (2020: 14; 2019: 16) and permanent teeth (2020: 26; 2019: 138), followed by the upper lateral incisors; posterior teeth trauma (2019: 4; 2020: 2)	2019 falls (35.0%), traffic accidents (36.7%), sports accidents (18.3%), occupational accident (5%), interpersonal violence (4.2%), and others (0.8%) 2020 falls (89.5%), traffic accidents (7.9%), and interpersonal violence (2.6%)	-

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				Extrusive luxation: 5 Lateral luxation: 3 Intrusive luxation: 4 Avulsion: 5 Supporting bone: 1 Gingival or oral mucosa: 10			
Yang, et al.[41] 2022	China	April 20 to July 31, 2020 The corresponding period in 2019	Paediatric dental visits 01/01/1900 09:40 01/01/1900 09:39	Tooth trauma 2020: 245 (3.78%) 2019: 711 (6.07%)	-	-	-
Yu, et al.[42] 2020	China	February 22 until March 2, 2020	96 patients	Complicated crown fracture: 2 (2.10%) Dislocation of tooth: 3 (3.10%)	-	-	-

Figure 2- Data extracted from the included studies

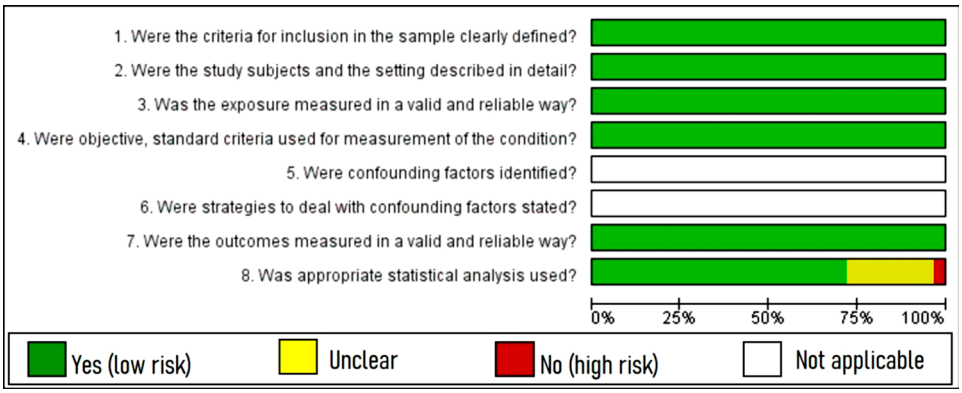

Figure 3- Distribution of the quality assessment among studies included according to pre-established criteria for Systematic Reviews (Joanna Briggs Institute Critical Appraisal Checklist for Analytical for Cross Sectional Studies).

trauma in the COVID-19 period was without statistical heterogeneity (I^2=0%).

Discussion

This study presented no differences in the frequency of dental trauma diagnosed in the total number of dental emergencies between the evaluated COVID-19 pandemic period and the pre-COVID-19 period. Likewise, we observed no differences in the subgroups by type of dental trauma in these same periods.

Most of the studies included presented high quality assessment. The studies showing moderate quality lacked reporting statistical analysis. We did not apply criteria on identification and strategies dealing with confounding factors in the included studies, since the articles did not mention (and did not find) variables that could influence a diagnosis of dental trauma.

The COVID-19 pandemic had repercussions on all the health services, especially in dental care regarding dental trauma and urgent care, which continued working during the pandemic.[4] In this study, we observed a worldwide concern regarding the care of patients with dental trauma, with studies carried out in emergency services in many countries, including the United Kingdom, China, India, Saudi Arabia, and Germany.

Dental trauma is a public health problem and requires activities such as planning, intervention, prevention, management, and considering the causes of trauma. Dental trauma needs further study to assess frequencies and factors involving sex, age, and type of trauma. This study presented a predominance of dental trauma in male patients, as previously reported in the literature.[8,43] The literature reports greater involvement of children and adolescents in dental trauma, with a large age range.[44,45] In this systematic review, 12 studies[6,13,18,24,26,27,30-32,38,40,41] involved dental services provided only to children and adolescents, while the others were carried out in dental centers for the general public and presented a broad age range.

The results showed fewer traumatic events at dental emergencies during the COVID-19 pandemic. This decrease may be due to social isolation, reduced risk factors for trauma, reduced violence, less

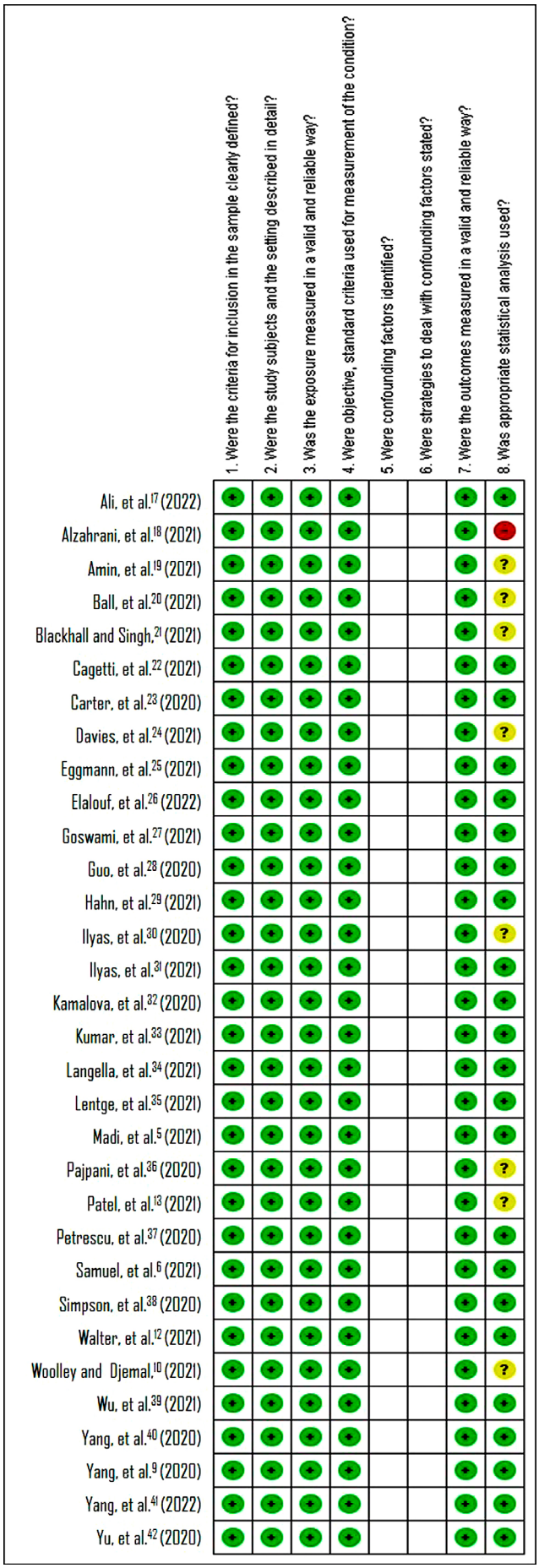

Figure 4- Quality assessment for Systematic Reviews (Joanna Briggs Institute Critical Appraisal Checklist for Analytical for Cross Sectional Studies): author's judgments for each included study

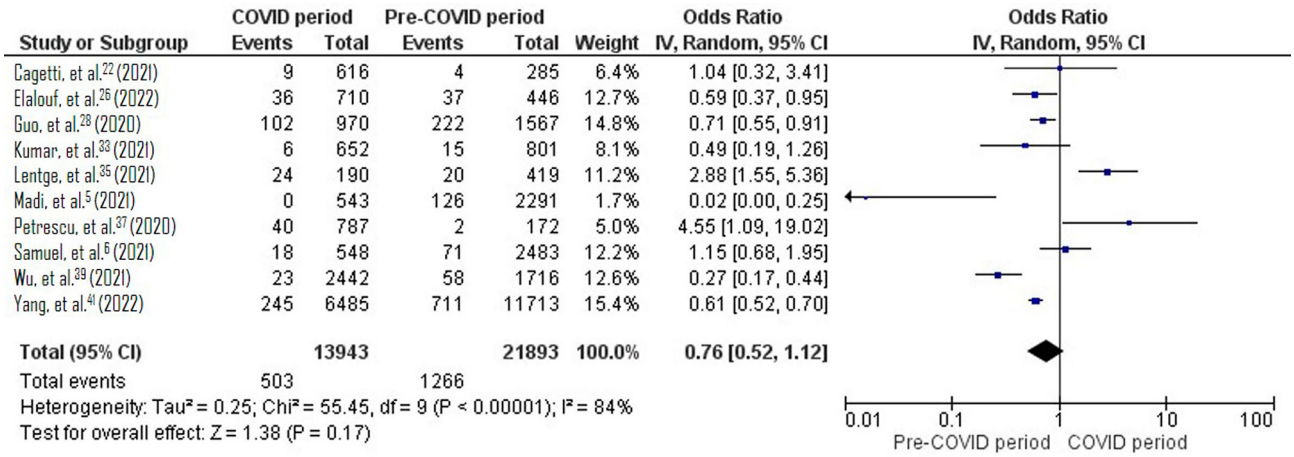

Figure 5- Forest plot summarizing the frequency of dental trauma diagnoses in dental emergencies during the pre-COVID-19 and COVID-19 periods

practice of sports with physical contact, and reduced outdoor activities.[10,41] Although the trauma numbers and emergency dental visits were lower during the COVID-19 pandemic, there were no differences in the frequency or types of dental trauma diagnosed before and during the pandemic, which is likely due to the lower number of events in the sample size. Since we evaluated a convenience sample, i.e., a population seeking care in trauma services, the studies only present internal validation. Therefore, is necessary to interpret such results with caution, as they cannot be assumed for the world population. Considering this heterogeneity, the statistical test used for meta-analysis was the random-effects model.

Primary studies quantified traumatic injury causes, such as sports, hobbies, traffic, occupational accidents, interpersonal violence, falling, tripping, alcohol, and exercise. However, in general, the cause evaluation was not specifically described for dental trauma, only for dental emergencies. Moreover, most of the studies ignored possible causes or performed no comparative analyses between the periods, showing a limitation of primary studies and, consequently, of this systematic review.

The most affected teeth by trauma are the upper central incisors, due to their vulnerability, i.e., their position in the arch.[46,47] This was also revealed in the two primary studies in this review, which reported the highest trauma frequency in maxillary anterior teeth, both in primary and permanent dentition.[9,31]

Traumatic injuries involve damage to dental structures and may affect the crown and/or the root of the dental element, which are associated or not with damage to the support structure, and may cause dislocations, avulsion, or alveolar fractures.[48] Due to the diversity of impacts that can occur, treatment of dental trauma presents great variability. The patient requires adequate diagnosis, planning, case follow-up, and the most appropriate guidance for treatment.[31,48] Dental pulp involvement is an important factor that guides decision-making, and must be correctly diagnosed, whether at the time of trauma or not, since intervention is not always immediate endodontics.[49] Imaging exams are also important diagnostic tools to verify the involvement of dental structures and the extent of injury.[48]

After evaluation and diagnosis, the appropriate treatment must be offered as soon as possible, especially in cases of major structural damage, such as coronary fractures with pulp exposure, dental dislocations, and avulsion, which are types of dental emergencies. Time is a crucial prognostic factor to reduce the chance of pulp necrosis or an early loss of the affected tooth.[49-51]

Knowledge is also essential for correct management of trauma and treatment success. One study performed by a questionnaire for dentists revealed the need to improve the professionals' knowledge about dental trauma management, especially avulsion.[52,53] Likewise, health professionals presented insufficient knowledge concerning traumatic dental injuries.[54] This reflects the need to implement educational programs for health professionals to enable adequate care during the management of traumatic dental injuries.[52-54]

To minimize this problem, one study proposed a dental trauma course for medical students, which yielded wide acceptance by students and positive perceptions for their future professional careers.[55] Another strategy used for the implementation of teaching about dental trauma while still in graduation

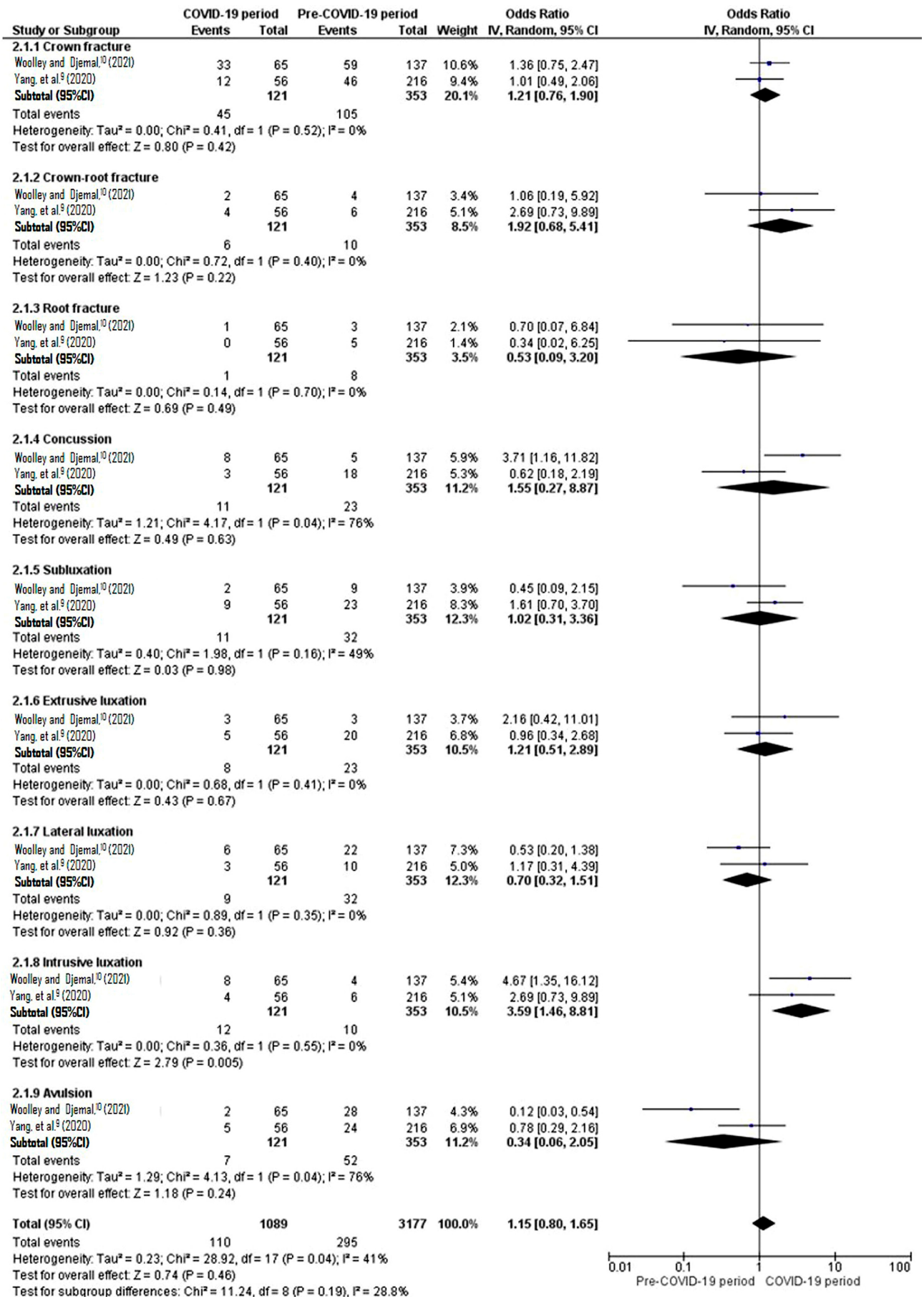

Figure 6- Forest plot summarizing the subgroup analysis for the type of dental trauma during the pre-COVID-19 and COVID-19 periods

was the development of an online mobile application with traumatic dental injury instructions for Dentistry students. Evaluation of the results demonstrated an improvement in diagnosis and treatment of such injuries.[56] Besides health professionals and students, preventive care and basic guidelines in trauma management should also be disseminated to the general population.

Due to the wide dissemination of the SARS-CoV-2 virus, in some dental services there was a need to assess priority emergency care and teledentistry was a good strategy.[57] Teledentistry is a viable, accessible, and low-cost alternative[58] that some of the studies included[19,23,24] as a way to initially assess the patients, to provide guidance, such as counseling and drug-prescriptions (only analgesics/anti-inflammatory drugs), and to screen for clinical evaluation, since not all dental trauma cases are urgent and some can be managed remotely.

Teledentistry does not replace face-to-face care due to the need to carry out a careful clinical examination, with palpation and percussion tests, as well as complementary exams such as the acquisition of radiographs to obtain an accurate diagnosis. Despite the risks of transmission of COVID-19 in the dental environment, face-to-face care is necessary and must be available in emergency services with the use of adequate PPE by the entire dental team to protect health professionals and prevent the transmission of SARS-CoV-2. It has also been shown that when the appropriate PPE is used and biosafety protocols are implemented during emergency dental care services, although aerosols can be produced, this does not increase the risk contamination to professionals, as no contamination was reported during the studies cited.[6,59]

Studies that assess dental trauma in the context of the COVID-19 pandemic are of great relevance. Knowledge of this condition allows elaboration of preventive assistance strategies based on the population's needs, allowing better targeting of care and better clinical case resolution.

Despite their importance, certain critical details remained unreported in various studies including: the type of dentition (deciduous or permanent), the most affected dental element, and in cases of trauma; the causes and treatments performed. This made it difficult to compare the results. Some studies included data on dental trauma as associated with other emergency conditions, making it impossible to use the information. Moreover, for being emergency services, samples were obtained by convenience, and according to the demand of the service, with no sample calculations performed; an intrinsic limitation in primary studies. Thus, future studies with better detailing of such characteristics, and allowing comparative analyses remain necessary.

Conclusion

Based on the present findings, this study revealed that the COVID-19 pandemic has not impacted on the frequency or type of dental trauma compared to previous periods. Further well-designed studies should be conducted to evaluate the particularities involved in patients who suffered dental trauma to help guide educational and preventive health care strategies for the most affected populations, optimizing planning and interventions.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

The datasets generated during and/or analyzed during the current study are available in the SciELO Data repository, [DOI 10.48331/scielodata.78SHP1].

Authors' contributions

Campos, Débora: Conceptualization (Equal); Data curation (Equal); Methodology (Equal); Writing – original draft (Equal). **Muniz, Isis:** Data curation (Equal); Formal analysis (Equal); Methodology (Equal); Writing – original draft (Equal). **Gomes, Amanda:** Data curation (Equal); Methodology (Equal); Writing – original draft (Equal). **Beserra, Letícia:** Data curation (Equal); Methodology (Equal); Writing – original draft (Equal). **Santos, Luyra dos:** Data curation (Equal); Methodology (Equal); Writing – original draft (Equal). **Batista, André Ulisses Dantas:** Writing – original draft (Equal); Writing – review & editing (Equal). **Gominho, Luciana:** Writing – original draft (Equal); Writing – review & editing (Equal). **Salazar-Silva, Juan Ramon:** Writing – original draft (Equal); Writing – review & editing (Equal). **D'Assunção, Fabio:** Conceptualization (Equal); Supervision (Equal); Writing – original draft (Equal); Writing – review & editing (Equal).

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