

The incidence of dental fractures in the Italian population during the COVID-19 pandemic: An observational study

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Abstract

Background: The COVID-19 infection has become a pandemic after breaking out in China in the past months of 2019 and spreading rapidly worldwide. To counter this pandemic, several governments worldwide have taken several drastic measures to try to stop the spread of the virus, including a very strict lockdown that has caused a sudden and, in many cases, negative change in people's daily lives. In the literature, several studies have shown how the pandemic has significantly impaired many people's mental health, causing short- and long-term stress, anxiety, and sleep disturbances.

Introduction: This study aims to analyze the correlation between the stress caused by the COVID-19 pandemic and the parafunctions of the temporomandibular joint and masticatory muscles, which in turn, have led to an increase in the incidence of fractures and dental injuries. The ultimate goal is to understand the best choice the dentist must make in the preventive and therapeutic fields.

Materials and Methods: A questionnaire called "Incidence of tooth fractures during the COVID-19 pandemic" was prepared using the Google® Forms platform. This questionnaire consists of 13 questions. This electronic questionnaire was addressed to all dentists in the Campania Region (ITA) and disseminated through social networks such as WhatsApp® or Facebook® or E-mail.

Results: A total of 730 dentists completed the survey. Of these, 450 (61.7%) stated that the number of patients reporting muscle and joint pain in the morning had increased during the COVID-19 pandemic. 414 (56.7%) dentists noted an increase in parafunction and 392 (53.6%) an increase in dental fractures during the pandemic period.

Discussion and Conclusions: As can be seen from the study results, an important correlation was found between the stress resulting from the COVID-19 pandemic and dental fractures. The dental elements treated endodontically, depending on the extent of the damage, require restoration, which is also the best preventive strategy in the case of dental fractures.

Keywords: COVID-19 pandemic; dental fractures; parafunctions; survey

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INTRODUCTION

The breaking out of COVID-19 infection in China in late 2019 led to its spreading rapidly worldwide, becoming a pandemic. The virus responsible for the disease was recognized and named severe acute respiratory syndrome coronavirus.^[1] Consequently, several governments worldwide adopted a series of drastic measures to counter the spread of the virus, including a very stringent lockdown

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that caused a sudden and, in many cases, negative change in people's daily lives.

From a psychological point of view, several studies have shown how the pandemic has led to a considerable impairment of many people's mental health, provoking short- and long-term stress, anxiety, and sleeping disorders.^[2] In Italy, which witnessed one of the highest incidences of infection and related deaths among European countries, estimates calculate an increase in anxiety and depressive disorders of over 25% during the 1st year of the pandemic.^[3]

Concurrently, mental health assistance was severely impaired, and the treatment interval for mental health conditions widened. On the dental side, a study conducted in April 2020 recorded a higher percentage of moderate/severe psychological distress in dental patients compared to the prepandemic period. Moreover, most people considered the dental office high risk and feared going to the dentist because of COVID-19.^[4] In many cases, remote patient monitoring measures using digital devices have been proposed and adopted by dentists worldwide.^[5,6]

In general, such apprehension led to muscle tension with consequent repercussions on the stomatognathic apparatus, including increased muscle tension, appearance or worsening of parafunction and bruxism, and an increased incidence of dental fractures. Parafunctional activities include bruxism, clenching, and certain oral habits. Some of these activities are responsible for temporomandibular disorder (TMD) symptoms.^[7]

Parafunctional is considered a set of abnormal movements repeated over time by the voluntary muscles of the stomatognathic apparatus. In comparison, bruxism refers to an activity performed by the masticatory muscles that may occur during sleep or while awake.^[8] Moreover, it is a condition, in which one grinds one's teeth, rubbing the lower arch against the upper arch or (clenching) occluding the arches with excessive force. Bruxism episodes, their duration, and intensity can be different, individual to each patient. The onset of bruxism can affect 6%–20% of the population at any age from the eruption of deciduous teeth. It is a pathology that affects the orofacial section, generating what is described as parafunctional behavior that induces an overload at the level of the temporomandibular joint (TMJ) and the masticatory muscles, in which these structures are synergistically involved in part physiological and stereotyped movements of teeth grinding and clenching.^[9]

The attribution of a specific etiology for bruxist parafunction has always been the subject of numerous conflicting opinions. Despite the many theories formulated over the years, none are considered absolute and univocal

for this pathology. Therefore, the etiology of bruxism can be considered multifactorial, according to recent literature. Several studies report that emotional stress and anxiety generate muscular tension.^[10] Despite the difficulty in interpreting the literature, mostly due to persistent disagreement regarding the definition and diagnosis of this disorder, most authors agree on the multifactorial nature of the etiology of bruxism. Lobbezoo and Naeije recognize peripheral factors: morphological factors fall into this category, and central factors are divided into pathophysiological and psychological factors. Considering all the scientific evidence, Lobbezoo and Naeije^[11] concluded that bruxism appears to be regulated mainly at the central level and not at the peripheral level. According to some authors, from a psychoanalytic point of view, parafunctional activity represents a regression to the oral phase of development (or the pathological continuation thereof), in which the mouth and face are used to vent frustration, stress, and anger.^[12]

The hypothalamus controls the individual's emotional state, the reticular system, and above all, the limbic system. The influence of these centers is affected by activating the spindle motor fibers (i.e., gamma efferents), which cause the intrafusal muscle fibers to contract. The spindles are thus sensitized so that the muscles can be contracted reflexively following any slightest muscular stretching. This results in muscular hyperactivity which, in cases of particular emotional tension, can lead to teeth grinding or clenching, even in the absence of any occlusal interference. In fact, a patient's emotional state influences both parafunctional activities when awake and during sleep; occlusal interference seems to activate only those when awake. Thus, it can be asserted that parafunctional activities and psychological stress have a clear correlation also confirmed by several authors.^[13] Stress is caused by a series of physical or psychological alterations that result from changes in the body's internal homeostasis produced by biological, metabolic, psychological, or social events.^[8] It now appears evident that neurotransmitter alterations of adrenalin, noradrenalin, serotonin, and GABA play a prominent role in the pathogenesis of bruxism.^[14] Specifically, it has been shown that these neurotransmitters are also involved in regulating the sleep/wake cycle, the regulation of the stress response, and autonomic activities.^[15] These clinical pictures are responsible for trauma and wear to the dental elements involved in grinding, with a consequent weakening of residual dental tissue. One of the main challenges for the dentist is to identify whether the patient has daytime or night bruxism in accordance with the patient's reason for the dental consultation, which could be tooth damage, pain, or noise complaints.^[16]

Tooth wear is an extremely common finding and can range from small shiny areas of the enamel surface, known as abrasion veneers, to extensive tooth structure failure. Not

only natural teeth are affected but also restorations such as fillings, crowns, fixed partial dentures, and removable dentures.^[17] In eccentric bruxism, fractures can occur both in intact teeth and in teeth weakened by the presence of large fillings (e.g., mesio–occlusal–distal), especially in the presence of endodontically treated teeth or extensive dental restorations, which increases the risk of tooth fractures.^[18]

Denture elements, especially porcelain crowns, can also fracture. In recent years, an increasing number of researchers are focusing attention on bruxism as a potential risk factor for implant failure, given that the main cause of implant failure is implant overload and that much greater forces are developed during bruxism than are normally present during mastication.^[19]

Therefore, this study aimed to analyze the correlation between the stress caused by the COVID-19 pandemic and the parafunctions of the TMJ and the masticatory muscles, which in turn led to an increased incidence of dental fractures and injuries. Finally, to understand the best choice for the dentist to implement in the preventive and therapeutic field. This study aims to analyze the correlation between the stress caused by the COVID-19 pandemic and the parafunctions of the TMJ and the masticatory muscles, leading to an increased incidence of dental fractures and injuries. The ultimate goal is to understand the best choice for the dentist to implement in the preventive and therapeutic fields. One of the main challenges for the dentist is to identify whether the patient has daytime or night bruxism in accordance with the patient's reason for the dental consultation, which could be tooth damage, pain, or noise complaints.^[16]

Tooth wear is an extremely common finding and can range from small shiny areas of the enamel surface, known as abrasion veneers, to extensive tooth structure failure. Not only natural teeth are affected but also restorations such as fillings, crowns, fixed partial dentures, and removable dentures.^[17] In eccentric bruxism, fractures can occur both in intact teeth and in teeth weakened by the presence of large fillings (e.g., mesio–occlusal–distal). As is well known, nonvital teeth fracture more easily. Denture elements, especially porcelain crowns, can also fracture. In recent years, an increasing number of researchers are focusing attention on bruxism as a potential risk factor for implant failure, given that the main cause of implant failure is implant overload and that much greater forces are developed during bruxism than are normally present during mastication.^[19]

This study aims to analyze the correlation between the stress caused by the COVID-19 pandemic and the parafunctions of the TMJ and the masticatory muscles, leading to an increased incidence of dental fractures

and injuries. The ultimate goal is to understand the best choice for the dentist to implement in the preventive and therapeutic fields.

MATERIALS AND METHODS

A questionnaire called “Incidence of dental fractures during the COVID-19 pandemic” was prepared using the Google® Forms platform. This questionnaire consisted of 13 questions: the first aimed at investigating whether there had been an increase in the number of reports of patients reporting pain in the TMJ and masticatory muscles in the morning; the second was addressed to those who answered yes to the first question and aimed at investigating how much the onset of pain in the joint and muscles had affected the patients' lives.

The assessment used a numerical scale where one indicates no pain, and five indicates exaggerated pain. In the third section, questions were asked again to all respondents to investigate whether there had been an increased incidence of abrasions, parafunction, and dental fractures. Patients who had been diagnosed with dental fractures during the period of the COVID-19 pandemic were then asked whether or not they had been subjected to fractures previously. The next questions aimed to determine which tooth had been most affected: healthy, previously restored, or endodontically treated teeth, whether they had fiber or metallic endodontic posts, whether they had been protected by prosthetic restoration, and which type of fracture was the most diagnosed. This electronic questionnaire was addressed to all dentists in the Campania Region (ITA) and disseminated through social networks such as WhatsApp® or Facebook® or E-mail.

RESULTS

A total of 730 dentists completed the survey. Of these, 450 (61.7%) stated that the number of patients reporting muscle and joint pain in the morning had increased during the period of the COVID-19 pandemic. On a scale of 1–5, 435 (59.5%) reported that this severely impaired the patient's quality of life, indicating a value of 4 and 5. Four hundred and fourteen (56.7%) dentists noted an increase in parafunction and 392 (53.6%) an increase in dental fractures during the pandemic period. Patients diagnosed with dental fractures during COVID-19 were already subject to fractures, according to 404 (55.3%) dentists, whereas the other 326 (44.7%) were at their first episode. The teeth reported as most frequently fractured were the upper first premolars according to 419 (57.4%) dentists, followed by the lower first molars with 273 responses (37.4%), then the upper second premolars with 214 responses (29.3%), followed by the upper first molars with 200 replies (27.4%), then the upper incisors with 182 replies (24.9%), then the

lower second molars with 103 replies (14.1%), then the upper incisors with 80 replies, followed by the lower first premolars reported by 98 dentists (13.4%), then the lower incisors reported by 80 dentists (10.9%), then we have the upper second molars with 76 answers (10.4%), then the lower second premolars with 59 answers (8.1%), and finally the canines with 23 answers for the upper (3.1%) and seven answers for the lower (0.9%). In the next question, 157 operators (21.5%) answered that the fractured teeth were generally healthy, 324 (44.3%) claimed that the teeth had restorations, and 249 (34.2%) reported that the fractured teeth had root canal treatments.

The next question showed that 145 dentists (19.9%) responded that teeth with root canal treatment typically had fiber posts. 164 (22.5%) reported that teeth typically had metal posts when treated endodontically, and 421 (57.6%) claimed that fractured teeth did not have posts. In the next question, 646 dentists (88.5%) claimed that multirooted teeth had only one pin, whereas 84 dentists (11.5%) claimed more than one pin. In the eleventh question, 125 dentists (17.1%) answered that a tooth with root canal treatment had a prosthetic restoration, whereas 605 dentists (82.9%) answered that the treated tooth did not have a prosthetic restoration. For 317 operators (43.4%), the most frequent type of fracture was coronal; for 260 operators (35.8%), the most commonly encountered fracture was vertical root fracture; for 108 operators (14.8%), there were fractures limited to the crown, and for 45 operators (6.1%) reported horizontal root fractures. The last question asked the dentists about the extent of the fracture: For 418 dentists (56.5%), the fracture allowed functional recovery, whereas for 318 dentists (43.5%), the extent was such that the tooth element had to be extracted. All data are summarized in Table 1.

DISCUSSION

The COVID-19 infection, having broken out in China in the past months of 2019, has become a global pandemic in 2020. Italy was one of the first nations affected and quickly became the country in Europe with the highest number of infected and dead. Authorities in various states around the world have taken a series of drastic measures to combat the spread of this virus; therefore, the world population has been forced into a very hard lockdown that has caused a sudden and negative change in people's lives, very often affecting their mental health.^[1]

The COVID-19 pandemic, in addition to its health consequences, had a strong impact on the psychological aspects of individuals by increasing the risk of developing psychiatric or other mental health disorders, such as depression, anxiety, and sleep disorders.^[20] In particular, the

state of social isolation during the lockdown led a large part of the population to suffer from stress-related disorders as people tried, through forced adaptation mechanisms, to adjust their status to the distressed condition they were experiencing.^[21] Consequently, the stress led people to develop psychosocial adaptation attitudes detrimental to their mental health, particularly increased social use, decreased economic quality of life, and an inability to cope with and manage social relationships.^[22]

In the US, an increase in the prevalence of depression was found from 8% in the period before the COVID-19 pandemic to 27.8% after the pandemic outbreak.^[23] In China, an increase in the prevalence of depression and posttraumatic stress disorder was encountered in university students due to restrictive measures, reduced sleeping hours, and uncertain and incomplete regulations by the authorities, especially at the beginning of the pandemic.^[3] Evidence shows an important correlation between stress, oral parafunctions, and myofascial pain.^[7]

Several articles in the international literature have highlighted the importance of biopsychosocial factors in the degree of individual pain perception related to the development and progression of TMD.^[24] A correlation has also been observed in patients with TMD between pain induced by masticatory muscle disorders and conditions of psychological distress, such as depression and anticipatory pain anxiety.^[25] Patients suffering from TMJ disorders present as being less able to adapt psychologically to changes than the control group of healthy people.^[26]

Specifically, several studies have shown an association between bruxism and TMD with stress and psychological disorders.^[2] A survey conducted in Italy in May 2020 (after the start of the COVID-19 pandemic) revealed an association between high levels of stress and the presence of TMJ pain, with more patients reporting an increase in discomfort caused by TMJ pain during lockdown than during the prepandemic period, with 22.8% of respondents complaining of TMJ pain and 21.7% reporting an increase in discomfort associated with it.^[27]

The current study found an important correlation between stress following the COVID-19 pandemic and dental fractures.

In general, the majority of patients diagnosed with dental fractures during the pandemic had already been subject to dental fractures in the past. Furthermore, the teeth most prone to such fractures were the upper first premolars, followed by the lower first molars and upper second premolars, and the fractured teeth had restorations or root canal treatments in most cases. Most fractured teeth had no pins or, to a lesser extent, metal pins. The most frequently encountered types of fractures were coronal and vertical

Table 1: Presenting survey questions

Survey question	Frequency (%)
Has the number of patients reporting muscle-joint pain in the morning increased during the COVID-19 pandemic period?	
Yes	450 (61.7)
No	280 (38.3)
How much did it affect the patient's quality of life? (on a scale of 1 to 5)	
1	7 (0.9)
2	44 (6)
3	244 (33.4)
4	237 (32.5)
5	198 (27.1)
Did you notice an increase in dental wear during the COVID-19 pandemic period?	
Yes	414 (56.7)
No	316 (43.3)
Have you noticed an increase in parafunctions in the COVID-19 pandemic period?	
Yes	480 (65.7)
No	250 (34.3)
Have you noticed an increase in dental fractures in the COVID-19 pandemic period?	
Yes	392 (53.6)
No	338 (46.4)
Patients diagnosed with dental fractures during the COVID-19 period were	
Already subject to dental fractures	404 (55.3)
On their first episode of fracture dental	326 (44.7)
What are the most frequently fractured teeth?	
Upper incisors	182 (24.9)
Lower incisors	80 (10.9)
Upper canines	23 (3.1)
Lower canines	7 (0.9)
First upper premolar	419 (57.4)
Lower first premolar	98 (13.4)
Second upper premolar	214 (29.3)
Second lower premolar	59 (8.1)
Upper first molar	200 (27.4)
Lower first molar	273 (37.4)
Second upper molar	76 (10.4)
Lower second molar	103 (14.1)
The fractured teeth were	
Healthy	157 (21.5)
With restorations	324 (44.3)
With root canal treatment	249 (34.2)
The teeth with root canal treatment had	
Fiber posts	145 (19.9)
Metal posts	164 (22.5)
No posts	421 (57.6)
The multirooted dental elements that had posted had	
Only one post	646 (88.5)
More than one pin	84 (11.5)
The teeth with root canal treatment	
Had a prosthetic restoration	125 (17.1)
Did not have a prosthetic restoration	605 (82.9)
What type of fracture was most commonly found?	
Cracks limited to the crown	108 (14.8)
Coronal fractures	317 (43.4)
Horizontal root fractures	45 (6.1)
Vertical root fractures	260 (35.8)
The extent of the fracture	
Was such that the tooth had to be extracted	318 (43.5)
Allowed for a functional recovery	418 (56.5)

root fractures. Vertical fractures occur most frequently in cases where certain predisposing factors are present such as incorrect root canal obturation procedures, particularly excessive lateral condensation force of the root canal filling material, or even operative errors during pin insertion with incorrect and excessive postspace preparations, deterioration, or pin expansion phenomena.^[28,29]

Additional elements to be considered to avert vertical root fracture occurrence are excessive root canal preparation during the shaping phase. In fact, it is reported in the literature that excessive instrumentation with endodontic files and subsequent overinstrumentation with a large loss of dentinal tissue is the most likely cause of vertical fractures in endodontically treated teeth.^[30] As for vertical fractures

in nonendodontically treated teeth, these are described as extensions of previous coronal fractures. In the cases of vertical root fractures reported by Wei and Ju^[31] and Yang *et al.*,^[32] the main cause was incongruous restorations with the presence of improper occlusal balance and in patients with severely compromised teeth, with decompensation of the occlusal forces applied to the fractured elements. From the data collected in the present study, these fractures occur in 40% of cases in teeth that have not been endodontically treated, and the male sex appears to be more affected, probably due to factors such as greater chewing force, increased friction, and habitual chewing of hard foods.^[18]

The primary therapeutic approach is coronal restoration, which can be direct or indirect. The former are called so because they are applied by dentists and are widely used to recover tooth structure with less extensive coronal damage; they have evolved considerably over the years. In the past, the main material used for direct posterior tooth restorations was amalgam, which, however, as Hansen pointed out in 1988,^[33] had a very high percentage of cusp fractures in endodontically treated and reconstructed teeth without cusp coverings, with premolars with mesio–occluso–distal cavities, in particular, reaching values of over 70%. It was gradually abandoned due to esthetic issues as well as its possible toxicity. Recently, direct restorations have been carried out using resin compounds for both the anterior and posterior sections.^[34] These materials have been developed to be stronger, with better physical and mechanical stability and more effective in general.^[35-37] The international scientific literature agrees that the basic prerequisite for success in terms of restoration integrity, thus averting events such as fractures, is the maintenance and preservation of as much healthy tooth structure as possible.^[38]

Nowadays, indirect prosthetic restorations are the most commonly used to restore endodontically treated teeth (particularly posterior teeth). They are only used for anterior teeth if there is a significant loss of substance). They allow the integrity of the tooth element to be repaired while protecting the cusps and residual structure. To carry out an indirect restoration with a crown, the residual structures must have a minimum thickness of 1 mm and a height of at least 2 mm.

The materials most commonly used for full crowns are ceramics combined with metal alloys, zirconia, or metal-free composites. Despite the typical problems of indirect techniques, such as the higher costs and time involved and the process of cementation of the restoration, almost all the findings in the literature agree that the intrinsic quality of the restorations,^[39] the durability of the restorations themselves,^[40] and the achievable morphology are far superior to those achievable with direct restorations.^[41] Generally speaking, the basis of postendodontic restorations is a continuous evolution of

adhesive techniques that have made it possible to perform more conservative partial reconstructions in the posterior regions.^[42-44]

Moreover, the materials used (ceramics and composites) offer adequate biomechanical characteristics to withstand masticatory loads and to be cemented to enamel–dentin structures with adhesive-type techniques have come onto the market.^[41,45-47] Technological development has made it possible to create composite materials with biomechanical and physical characteristics capable of improving clinical outcomes. The filler type gives composites characteristics in terms of particle size, percentage to volume, loading, and the type of bond established with the matrix.

Studies on the mechanics of composite resins have shown that formulations containing smaller filler particles but with a higher ratio in percentage between filler and matrix (65% inorganic fillers and 33% matrix) have adequate mechanical properties.^[48] Another very important element to consider is the conversion of resin monomers to polymers during the polymerization phase of composites. Moreover, it has been observed that control over the degree of polymerization of composite materials improves the mechanical resistance to divergent tensile forces, progression of wear processes, maintenance of color stability, and resistance to fracture phenomena.^[49,50]

Currently, digital technologies are increasingly utilized to prepare indirect techniques.^[44] It has recently become possible to use a new type of restoration for endodontically treated teeth: the endocrown.^[51]

It is similar to overlays but has an appendage, inserted into the pulp chamber, of 2–3 mm that provides certain stability and retention and greater strength, leading the tooth-restoration complex to behave like a complete crown.^[52,53]

Moreover, being a recently developed technique, more data on the longevity of this type of restoration still need to be gathered. Nevertheless, it is well known that, in the long term, the results of such restorations on molars are much more satisfactory than those on premolars. Based on some studies, the success rates at 2.5 and 12 years are >85% in molars and 75% in premolars.^[54,55] Another study combined the outcomes obtained in the laboratory with clinical evidence, which revealed a survival of 100% at 1 year, 93% after 4 years, and 86% at 12 years.^[56] It should also be pointed out that ceramic materials show progressive wear as they tend to produce microcracks, which become increasingly evident over the years.

Regarding indirect composite restorations, the success rate is 91% after 5 years.^[57] To date, inlay (which does not include cusp coverage), onlay (with at least cusp coverage), and overlay (full cusp coverage) restorations are widely

used therapeutic solutions for restorations in esthetic areas and for severely compromised elements.^[58] The clinical success of indirect restorations is strongly influenced by performing a proper cementation step, which can be done using dual-curing cement or self-curing types of cement.^[59] This step is crucial to avoid the fracture phenomena of restorations and dental elements.^[60] On the other hand, although the success rate of partial composite restorations is lower than that of ceramic (91% of the former and 94.9% of the latter), the former has improved tremendously in recent years.

In conclusion, as far as restorations made with the digital computer-aided design-computer-aided manufacturing technique are concerned, in terms of survival, the results are not very different from those obtainable with analog methods; it must be said, however, that the load-bearing strength of the teeth treated with indirect restorations is comparable to those obtainable with crowns.^[61]

CONCLUSIONS

The COVID-19 pandemic has deeply affected society and people, especially on a psychological level. Increased stress, anxiety, and fear have also affected oral diseases, promoting the onset of parafunctional and occlusal, and joint disorders. The increase in parafunction has led to an increase in the number of dental fractures, with a higher incidence for teeth previously treated with endodontic therapies. In light of these data, it is appropriate and mandatory for the dentist facing an endorestorative case to consider the patient's psychological state and the impact that social situations, such as COVID-19 and personal situations, may have on oral health.

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Conflicts of interest

There are no conflicts of interest.

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