Review Article

Validity of digital interceptive orthodontic/therapeutic protocols post global pandemics: A review

Noor R. Al-Hasani [1], **Sumayah Abdul-Jabbar** [2], **Ali I. Ibrahim** [3,4*]

1 Department of Basic Sciences, College of Dentistry, University of Baghdad, Baghdad, Iraq.
2 School of Cancer and Pharmaceutical Sciences, Institute of Pharmaceutical Science, King's College London, Franklin-Wilkins Building, London, UK.
3 Department of Orthodontics, College of Dentistry, University of Baghdad, Baghdad, Iraq.
4 Centre for Oral, Clinical and Translational Sciences, Faculty of Dentistry, Oral & Craniofacial Sciences, King's College London, London, UK.
*Correspondence author: ali.ismail@codental.uobaghdad.edu.iq

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Abstract: Background: Aggressive global pandemics such as COVID-19 can disrupt societies tragically, imposing a suspension to almost every field throughout the world; the orthodontic treatment and follow-up is no exemption. Objectives: To provide practical recommendations about resuming treatment for orthodontic patients during the "Return-to-Practice" phase and emphasize the validity of certain digital interceptive measures post global pandemics to minify the risk of infection spread. Materials and Methods: Sources of information pertaining to orthodontic/therapeutic implications during the COVID-19 pandemic were searched using electronic databases including COVID-19 Open Research Dataset (CORD-19 2020), Google Scholar, Scopus, PubMed, MEDLINE, reports from Centers for Disease Control (CDC), World Health Organization, in addition to recommendations by the American Association of Orthodontists (AAO) and British Orthodontic Society (BOS). Results: Many viruses are transmitted predominantly via droplets and secretions (cough, sneeze), providing the virus a path through the mucous membrane of the mouth, nose, and eyes. The virus can survive for days on plastic and stainless-steel objects. Tele-orthodontics has proven successful in performing many tasks that can be valid and helpful even post the pandemic. Conclusions: With the high expectations of a pandemic recurrence, attempts to reinforce tele-orthodontics, digital prescription and patient follow-up, and adherence to strict infection control measures are mandatory steps towards reducing contamination within dental/orthodontic practices.

Keywords: COVID-19, Dental/orthodontic treatment, Infectious diseases, Digital follow-up and prescription, Community pharmacists

Introduction

COVID-19 has disrupted society tragically since its outbreak, imposing an interruption for almost everyday life activities. It's typical during the implementation of dental and orthodontic treatment procedures that large quantities of droplets and aerosols to be produced [1]. Consequently, facilitating the dissemination of the virus leading to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This in turn imposed great risks of infections to both dentists/orthodontists and patients [2-4]. So, it's no surprise that many countries enforced an immediate and mandatory pause of non- emergency dental care [5-7]. Orthodontic treatment is a well-recognized non urgent treatment that requires regular fellow up visits of about every 4-6 weeks for an average duration of 1.5 years or sometimes longer [8-11]. Therefore, this interruption to the services imposed great challenges to the provision of care and adjustments/activation of the braces and in turn the efficiency of the treatment.

Orthodontic emergency can appear in the form of any problem/pain arising from orthodontic appliances or accessories. Not responding to such issues can be intolerable or detrimental to the patient [12].

The prevention and timely management of orthodontic emergencies are pivotal not only to minimize the burdens of patients, but also to avoid the long treatment approaches by maintaining the effectiveness of orthodontic appliances [13,14]. Under such circumstances, various interceptive digitally based modalities of treatment emerged, which can be effectively harnessed (even post the pandemic) to minimize the risk of infections. Therefore, it is crucial to provide practical recommendations about resuming treatment for orthodontic patients during the "Return-to-Practice" phase and emphasize the validity of certain interceptive measures post COVID-19 pandemic to minimize the risk of infection spread. Aim of the present study was to provide practical recommendations about resuming treatment for orthodontic patients during the "Return-to-Practice" phase and emphasize the validity of certain interceptive measures post COVID-19 pandemic to minimize the risk of infection spread. In addition, the study investigated the patient education methods used by pharmacists and validity of digital prescriptions during and post the pandemic.

Methods of searching the literature

Reviewing the peer-reviewed publications matching the search terms was conducted up to January 2024. Research information was collected from different databases including COVID-19 Open Research Dataset, Google Scholar, Scopus, PubMed, MEDLINE, updated reports from CDC, WHO, in addition to recommendations by the American Association of Orthodontists (AAO) and British Orthodontic Society (BOS). The search involved the following items: coronavirus, COVID-19, SARS-CoV-2, dental/orthodontic treatment, infection control, digital follow-up and prescription, contamination, transmission, recommendations and management. Abstracts of pertinent studies to the search terms were screened, and those relevant to the confines of this review were then retrieved in full text. The recommended protocols to manage various orthodontic implications during the "lockdown phase" of COVID-19 pandemic were evaluated to suggest a feasible, practical and safe orthodontic/therapeutic care provision for patients during and post the pandemic.

Results from literature

Possible transmission routes of SARS-COV-2 during orthodontic practice

There are ample routes of transmission of any virus at an orthodontic practice. The nature of the lengthy procedure implies that the patient mouth and nose are in close proximity to both the orthodontist and the assisting staff for a long period of time. In addition, communication, coughing and sneezing will disperse droplets into the air. Intraoral orthodontic procedures such as impression taking, oral scanning, bracket and attachment bonding or removal, archwire changing, anchorage screw implantation, and others provide a direct contact with infected patient saliva or blood. Also, the furniture and surfaces in the practice increase the risk for virus transmission [15,16]. The fecal-oral route is also less obvious transmission rout. This is a consequence of self-operation by patients, such as the placement and removal of the clear aligners, elastics and other removable appliances.

Consequently, effective control protocols to stop the transmission of SARS-CoV-2 through these routes are required [2]. A major control strategy that can be adopted is the use of personal protection equipment (PPE) such as gloves and masks. Furthermore, patients' management can also enhance this through ensuring patients attend only at the time of their appointment, wait outside until called in and leave straight after appointment. Patients should not bring other members with them and practice hand hygiene [15,16].

Infection control during orthodontic procedures

Brackets debonding, archwire/ligature wire deformation or shifting, oral mucosa irritations, and anchorage implants loosening were among the list of orthodontic procedures that were recommended to manage as an emergency during the epidemic period of the COVID-19 [17-20]. However, it is suggested to assess and evaluate the severity of the emergency before attending the practice. This can be achieved through digital videos and pictures. This way some emergencies can be eliminated by recommending treatment at home via providing digital instruction [19]. Below is a summary of how to minimize infection transmission when carrying out emergency procedures.

Bracket or attachment bonding and removal

Low-speed handpieces or the manual devices are better alternatives to high-speed handpieces and high-pressure 3-way syringes as they reduce the formation of droplets and aerosols. Therefore, they should be used when carrying out bonding or removal of the brackets, trimming of the attachments, or interproximal reduction. When it is necessary to utilize high-speed handpieces, however, it is recommended to use alternative designs such as anti-retraction handpiece provided with anti-reflux designs or specially designed anti-retractive valves, in order to ensure that any backflow tendency of oral microbes into the waterlines of the handpiece or dental unit is reduced to minimum [18].

It's important to acknowledge that such techniques can also generate a splash of saliva or blood, so on top of level III personal protective measures (Figure 1), the use of high-volume saliva ejectors and the four-handed or six-handed cooperation technique should be embraced to minimize of halt the cross -contamination as well as to enhance productivity level. Air disinfection should also be carried out using air sterilizer and window opening during procedures. The practice of "one room -one patient- one disinfection" should also be adopted [10].

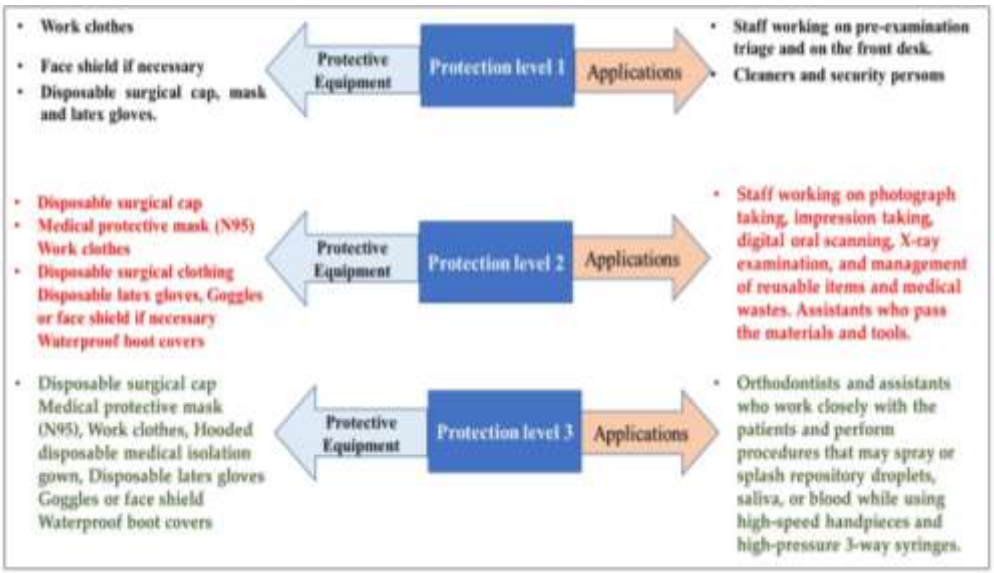

Figure 1. Recommended levels of protection and suggested equipment for various applications. [10]

Archwire changing and bending

Archwires that are individually packaged are strongly advised. Furthermore, spraying them with 75% alcohol should be practiced prior to any adjustments such as bending or adding designs. Double gloves are advised during bending in case of glove tear or potential skin wound from the archwires [10].

Removable appliance adjustment

Clear aligners as well as any other removable appliances tend to be in direct contact with both the saliva and oral mucosa. This increases their risk for infection transmission. Therefore, such appliances should be washed then sprayed with 75% alcohol or 100 mg/L chlorine containing disinfectants in addition to extra care should be taken during wear and removal to prevent pharyngeal reflex [10].

Measures to increase social distancing

Separation and partitions are a necessity in an orthodontic clinic with several chairs in close proximity in an open space with shared facilities. Such structural refurbishment implies a cost. In addition, a reduction in income is a consequence of a reduction in the number of patients in the clinic to maintain interpersonal distance. This is a deviation from the typical workflow of a orthodontic clinic that often operates on the bases of seeing patients simultaneously. The combination of those changes can have a negative financial impact on the survival of practice [10,21].

It is also necessary to reduce the number of companions at appointments such that adults attend alone, and children are accompanied by only one adult. This may make it challenging for a parent with multiple children who can't bring them along and must arrange babysitting for them. Furthermore, the recommendation of the parents to wait outside in the waiting room prevent them from being involved in the decision-making process nor provide them with adequate information as well as moral support for their children during the procedure.

The impact of COVID-19 Pandemic on Patients Receiving Orthodontic Treatment

In an online cross sectional study, based on the type of used orthodontic appliance, the patients were grouped to 3 categories: fixed appliance (F.A), removable appliance (R.A), and clear aligner (C.A) groups [19]. Patients with R.A and C.A groups faced less orthodontic problems than those with F.A. This might be attributed to the nature of the F.A itself because this type of appliance consists of several parts that could be broken/failed or caused oral mucosal irritation [19-21]. Also, patients with F.A experienced gingival enlargement problems, as expected, due to the presence of fixed attachments and inadequate oral hygiene [22]. Figure 2 illustrates the orthodontic problems and the strategies followed by the patients to manage the problems according to the type of appliance used.

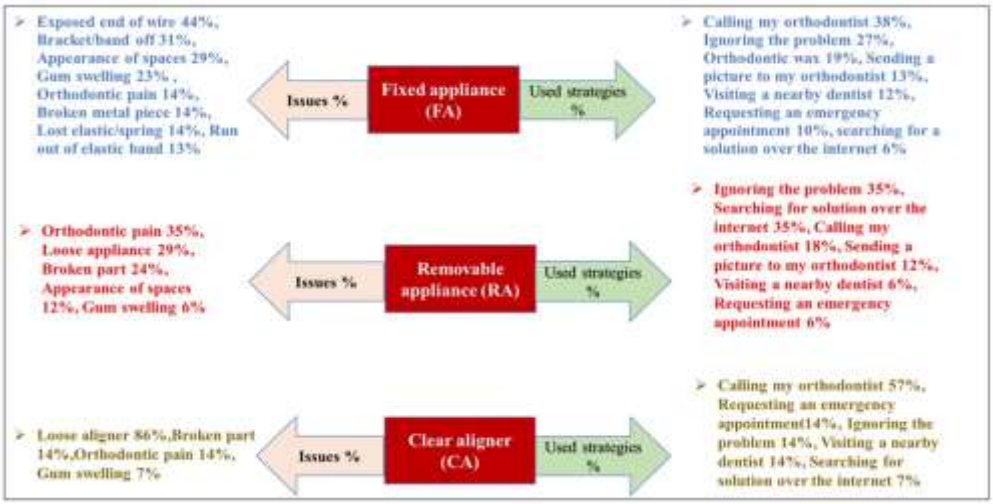

Figure 2. Orthodontic emergencies and the used strategies to address them [19].

In addition, the most commonly reported emergent situations reported by orthodontists were for patients with pre-adjusted stainless steel fixed appliances (F.As) and those with esthetic F.As (Figure 3).

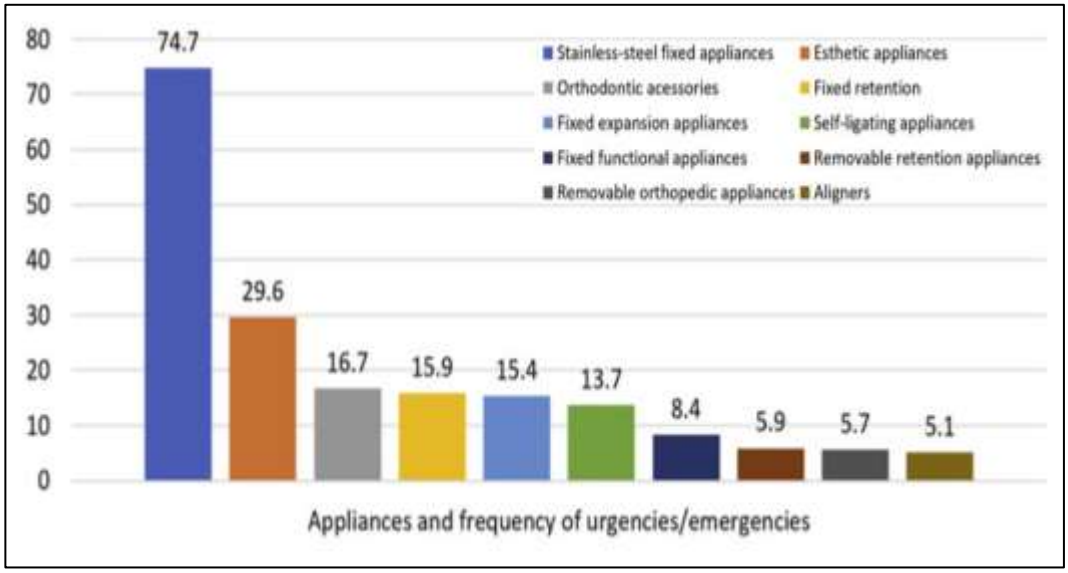

Figure 3. Type of appliance and frequency of urgency or emergency [23].

The most frequently used preadjusted orthodontic appliance for the last 3 decades is the fixed appliances with stainless steel brackets and the ceramic brackets come secondly [24,25]. In a study conducted by Keim et al (2014) demonstrated that some kind of self-ligating system was used by most of the orthodontists (63%), while just 20% of them used esthetic brackets [26]. Accordingly, the recorded emergencies followed the trends of the commonly used appliance in the time of the crises. So, some kinds of active orthodontic mechanics, active expanders, and functional appliances require regular supervision and follow up because unsupervised ones can lead to annoying orthodontic problems [23].

Regretfully, despite the clear and precise instruction demonstrating by the orthodontists to patients and their career, the orthodontic appliance breakage (represented by bracket failure) still representing the most frequently recorded orthodontic problem as can be seen in figure 4 [23,27-29]. In another study, retightening or replacement of the archwires were also reported as an orthodontic emergency in with a percentage of 13% of the archwire problems [30,31].

Tele-orthodontics

Is a maneuver that can be used the digital and remote technology to communicate and facilitate orthodontic consultation, care and treatment instead of face-to-face appointment [32-34]. The orthodontists' perceptions and attitudes were evaluated by many studies, which reflected a positive outcome as the vast majority of the participated orthodontists supported the use of tele-orthodontics, especially, when there is restriction on direct contact orthodontics services like what was happened in COVID-19 pandemic [35-37]. On the other hand, using tele orthodontics, utilized new ethical and legal concerns [38,39]. In Europe, standardization of the clinical photography rules were established by national protocols and the Data Protection Act, regulated and focused on the storage of the obtained medical data [40]. According to the act, "Personal data shall be processed fairly and lawfully. Appropriate technical and organizational measures shall be taken against unauthorized or unlawful processing of personal data."

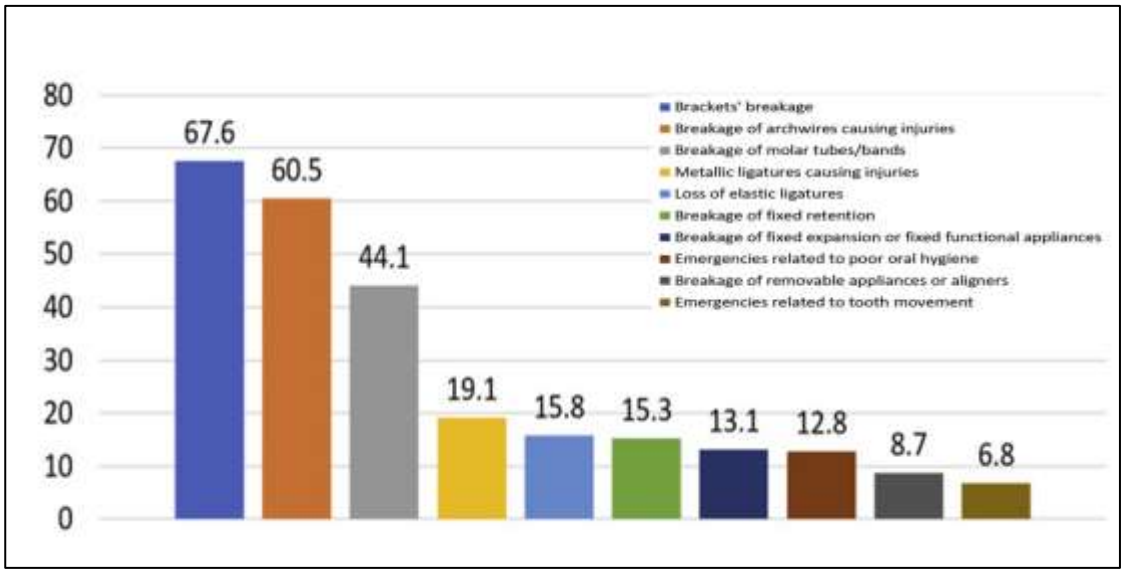

Figure 4. Most frequent urgencies and emergencies [23].

Protecting the privacy of patients while using tele orthodontics or tele dentistry is an important issue. So, it has been strongly recommended to get the consent of patients about the expected use (diagnostic or educational purposes) of their medical photographs, person who will be processing their images and how the images will be send [41-43]. In this concern, the American Telemedicine Association recommended to label the images with watermark and transfer the patients' images using private encryption or networks [44].

Tele dentistry is widely discussed in the literature in the context of dental caries prevention by following up patients in rural area, dental education and remote diagnosis and treatment [45-47]. In contrast, there is limited studies discussed the tele orthodontics, which was limited to diagnostic and phase planning approaches [48]. In a study conducted by Saccomanno et al. (2020) who studied the mixed approach of using the conventional way in addition to tele-orthodontics to provide orthodontic care, they divided the appointments into two kinds based on the ability of being conducted by telematic way. This type of appointment was suitable for aligners, palatal expanders and functional appliances, as well as the use of auxiliaries such as elastics in one of multibracket appliance treatment phases that depend on the patients without a need for orthodontists' direct intervention. Furthermore, Saccomanno et al adopted this approach for young patients because it helps in making preliminary screening of them as they cannot usually attend the dental clinic in a timely appointment. One of the used methods to achieve this was the video meetings because it permits to closely evaluate their respiratory habits, the chewing and swallowing patterns, and their general dental health. All of these screened elements can support drawing an initial diagnosis about the malocclusion and the initial plan that can be followed for treating orthodontic patients [48].

During lockdown, when the face-to-face appointment was difficult to be achieved, tele-orthodontics was approved to be the best way of communication between the orthodontists and their patients in order to manage some orthodontics issues and how to troubleshoot themes [49-51]. In addition, tele orthodontics can offer forms reviewing, delivering of trays by post, delivery the explanation of elastic uses [48-51]. Also, this telemetric appointment managed time wasting issue for parents and orthodontists and supported the notification services and follow up while the national lockdown during the last pandemic in order to keep the patient compliance up [48].

In spite of these benefits that can be achieved with tele orthodontics, some orthodontics steps should be achieved by in person appointment such as the first visit, taking dental impression, brackets managing process (bonding and debonding of brackets), interproximal reduction and wire replacement [48].

Digital prescriptions and pharmacist role in supporting orthodontic treatment during and post COVID-19 pandemic

As the pharmacists is the drug experts and their essential role in patient education in different medical problems [52], the pharmacist role in dentistry has been investigated in many studies [53-58]. In a study conducted in 2016 that explored the role of community pharmacists in preventing and treating oral diseases, the authors found that the participated pharmacists played a pivotal role in providing dental care advice and patient education because the community pharmacy is considered as the first station for public to ask about their health concerns [59]. Moreover, it was reported that the community pharmacists were enthusiastic to expand their knowledge about the dental care services by establishing a pharmacist-dentist collaboration to boost pharmacists' education regarding the oral care provision [59]. Another study conducted in 2017 to explore the importance of enrolling a pharmacist in the dental care team demonstrated that the pharmacist role was effective in augmenting the delivered primary care to patients [54].

In orthodontics, the main role of a pharmacist might be dispensing analgesics to alleviate the pain developed by orthodontic appliances [60]. This type of pain is directly proportional with the force applied by the appliance that may require pharmacological intervention [61,62]. The most commonly used drugs are the over the counter (OTC) analgesics and non-steroidal anti-inflammatory drugs (NSAIDs) [11,62,63]. Mofti et al found that paracetamol and ibuprofen are the most frequently used and effective analgesics with a parallel effect in alleviating the orthodontic pain [62]. However, they focused on the importance of a clinician knowledge of the suitable analgesic protocol that should be individualized for each patient with overlooking of the pharmacist role in organizing this issue as a medication expert [62]. So, the best health profession that can help in designing an individualized treatment plan for each patient is the pharmacist as it has been considered as the medication expert [64,65]. Having said that, still there is limited research that is focused on the role of the pharmacists/community pharmacists in managing some of the orthodontic problems, which urges a comprehensive study that can precisely evaluate the role of pharmacists in augmenting the orthodontic treatment plan in usual and urgent situations such as COVID-19 pandemic.

Discussion

A recent example of a severe pandemic is the outbreak of a novel coronavirus (COVID-19) by the end of 2019 in Wuhan, China that spread later widely around the world and led to serious public health concerns [66]. Each affected country/area adopted various policies and strategies, mainly partial or complete lockdowns, to manage the pandemic and reduce the number of affected cases. Moreover, many global recommendations were released by the WHO focusing primarily on social distancing as a gold-standard precaution and other effective methods of controlling the spread of infections such as maintaining regular hand-hygiene, carrying personal disinfectants, face masks use, and following proper cough-control etiquette [67].

Pandemics can impose huge limitations to general healthcare provision including dental care, especially providing treatments to the patients; an example is the orthodontic practice where frequent, regular return-visits must be scheduled for the activation and/or adjustment of an orthodontic appliance [1]. A pandemic can, hence, put the patients at risk of missing or delaying an appointment. Early management of acute dental emergencies must be prioritized to avert patients from accident and emergency services and to avoid hospital admissions. In contrast, any elective treatment, including orthodontics, can be deferred until official permissions are released by federal, provincial, and local health regulatory authorities. Urgent orthodontic

therapy might be provided by strict adherence to emergency plans premised on robust communication and triage. Whenever possible, attempts to remotely provide treatment advice must be sought first and, wherever necessary, in-person patient treatment may only be delivered following the attainability of infection control and preventive measures [68]. Examples of orthodontic patient emergencies may include detached/broken fixed attachments, loose appliances, expanders or palatal appliances impinging on the soft tissue, broken/ill-fitting or lost removable appliances including clear aligners/retainers, an archwire poking the cheek, and broken/detached fixed retainers.

During COVD-19 pandemic, dentists recommended treating just the unpostponable cases such as pulpitis or severe periodontitis. Orthodontic complaints were considered as not true emergencies, so a phone and/or video call or texting the orthodontist with images could be the best solution in addressing such cases during pandemic [69]. As pain is one of the most commonly reported complaints during orthodontic treatment, digital prescriptions played an important role in alleviating this problem especially when the required analgesics necessitate a dentist prescription in order to be dispensed. A study conducted in the UK to evaluate the prescribing behavior of antibiotics and analgesics in treating dental problems during COVID-19 outbreak illustrated that the pandemic limitations on oral care provision led to a marked increase in prescribing antibiotics and analgesics. This finding highlighted the importance and some of the advantages of digital prescriptions in usual and urgent situations such as pandemics, and it was premised on the NHS digital data that depends mainly on using digital prescriptions [70]. The advantages can be summarized in 3 points: firstly, it can provide rapid pharmacotherapy intervention to manage specific dental situations such as the dental pain. Secondly, the medication can be obviously and correctly written, hence the pharmacist can dispense the correct and required drug. Finally, it can be easily used to provide accurate statistics regarding the type, dose, and frequency of prescribed medications for all dental and health situations.

Reliance on tele-orthodontics can be traced back to studies conducted in the early 2000s, and its use has been effectively widespread over the last years [35,38]. A study with remarkable findings revealed the possibility of remotely providing orthodontic therapy by the supervision of a specialist orthodontist over general practitioners via the “Real-time App” in order to reach out those patients of difficult access to orthodontic care [71]. Another effective example is remotely supervising retention check-up through sending mobile images instead of in-person attendance in orthodontic practice [72]. Nowadays, there is a growing need by many patients who look for undergoing orthodontic treatment to adopt accelerated treatment modalities of fewer in-office visits, simultaneously having the orthodontist close to supervise the optimal progress of their treatment outcomes [11,73,74]. This is especially true with the current advances in clear aligners therapy and custom prescription bracket systems that have remarkably minimized chair-side time and in-office visits [75-78]. With these current trends, the urgent need for tele-orthodontics is not merely limited to pandemic lockdown times, but can be valid and expand to cover non-emergency phases. Therefore, tele-orthodontics represents a viable solution for persistent provision of orthodontic care even in normal times to facilitate treatment requirements for both the orthodontist and patient yet ensuring no adverse effects on the quality of orthodontic care.

Orthodontists, as well as all health professionals, must consider the impact of unexpected circumstances on the lifestyle of patients and follow a proper biopsychosocial approach to address the patient's complaint. Pandemics can impose hard financial circumstances upon families such as unemployment or inadequate incomes that may extend for a long time. Hence, when deciding on the appropriate time for starting the treatment or the selection of a suitable orthodontic appliance or when evaluating the cost-effectiveness of certain treatments, orthodontists should take these circumstances into consideration [79]. In spite of the importance of orthodontics, such treatment can be considered only relatively necessary in pandemic circumstances, and orthodontists must not ignore the ethical perspectives behind their profession. From bioethical perspectives, orthodontists must prioritize the psychosocial interests of patients and the community, while continuing to convey the role of oral health in society.

Conclusion

With the high expectations of pandemic recurrence, attempts to reinforce tele-orthodontics, digital prescription and patient follow-up, and adherence to strict infection control measures are mandatory steps towards reducing contamination within dental/orthodontic practices. The future of tele-orthodontics in managing orthodontic patients is promising. The potential of tele-orthodontics application is endless since remote consultations/supervisions can be conducted across the world with minimal obstacles of distances and least appointments. Effective application of digital follow-ups via sending photos, phone video/audio calls or other communication tools is recommended in emergency cases. Digital prescription use in tele-dentistry and tele-orthodontics has been evidenced to be effective and valid in managing some oral health problems even post pandemic. A pharmacist's role should be considered as it can optimize the treatment outcomes of oral health provision. However, further investigations are required to evaluate the health outcomes and cost effectiveness for the health system.

Conflict of interest

The authors report no conflicts of interest.

Author contributions

All authors contributed in designing the study, collecting the data, interpreting the results, writing up the draft of the manuscript, reviewing and finalizing the manuscript.

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None

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فعالية البروتوكولات التداخليه باستخدام الخطط العلاجية وخطط تقويم الأسنان المستخدمه لمرضى تقويم الاسنان بعد جائحة كوفيد-19: مراجعه

الاستاذ المساعد الدكتوره نور رؤوف الحسني ، الاستاذ الدكتور علي اسماعيل ابراهيم ، الدكتوره سميه عبد الجبار

المستخلص:

الأهداف: تحديد التوصيات العملية بخصوص عودة العلاج لمرضى تقويم الأسنان خلال فترة "العودة إلى الممارسة" والتأكيد على صلاحية بعض الاجراءات الاعتراضية بعد جائحة كورونا من اجل تقليل نسب خطورة انتشار العدوى .المواد والطرق: قد تم مسح المصادر المعلوماتيه المتعلقة بتقويم الأسنان/البروتوكول الدوائي و العلاجي خلال جائحة كوفيد-19 باستخدام قواعد البيانات الإلكترونية والتي تشمل مجموعة بيانات البحث المفتوحة لكوفيد-19(CORD-19 2020) ، وGoogle Scholar، وScopus، وPubMed، وMEDLINE، وتقارير مركز مكافحة الأمراض(CDC) ، ومنظمة الصحة العالمية، اضافة إلى توصيات الجمعية الأمريكية لأطباء تقويم الأسنان (AAO) واخيرا الجمعية البريطانية لتقويم الأسنان(BOS) . النتائج: الوسيله الاهم والاساسيه لانتقال فيروس كوفيد-19 هي بواسطة الرذاذ والإفرازات (السعال والعطس)، عندها يتغلغل الفيروس إلى الغشاء المخاطي للفم والأنف والعينين. ان فيروس كورونا له القابيله

للاستقرارلعدة أيام على المواد البلاستيكية والفولاذ المقاوم للصدأ. وبالرغم من هذه الصعوبات لقد أثبت تقويم الأسنان عن بعد نجاحه في أداء العديد من المهام التي يمكن أن تكون صالحة ومفيدة حتى بعد الوباء .الاستنتاجات: مع الاحتمالية العالية بتكرار جائحة كوفيد-19 وتحوراته الجينيه، فإن محاولات تدعيم استخدام تقويم الأسنان عن بعد، بالاضافة الى استخدام الوصفات الطبية الرقمية ومتابعة المرضى ، والالتزام بتدابير مكافحة العدوى الصارمة عدت خطوات مهمه و إلزامية نحو الحد من التلوث داخل ممارسات طب الأسنان / تقويم الأسنان سواء بوجود او عدم وجود الجائحه.