

## The COVID-19 pandemic suggests opportunities for researchers to investigate pertinent topics in orthodontics

Maryam Saki; Hooman Zarif Najafi

After initially appearing in China, COVID-19 quickly escalated to a pandemic with a wide range of symptoms reported.<sup>1</sup> The complete clinical manifestations of COVID-19 are not yet clear, and the transmission risk is not adequately understood.<sup>2</sup> Efforts are still underway to develop a vaccine or antiviral agent for COVID-19.<sup>3</sup>

Previously published reviews and editorials have demonstrated how the dental profession and our specialty have been affected by the pandemic.<sup>4–10</sup> However, to fully understand the far-reaching consequences, there are many new opportunities for research projects related to orthodontics that should be undertaken by scientists and clinicians to investigate how we, as a specialty, can best cope with the multifaceted problems facing us during the COVID-19 pandemic. Some suggestions for topics that should be explored follow in this guest editorial.

First, it is recommended that studies be undertaken to determine how the pandemic might be affecting patients currently involved in orthodontic treatment. This could help clinicians to adopt appropriate measures to better care for their patients. Therefore, it is proposed that the effects of the COVID-19 pandemic, the associated lockdown, delayed appointments, and effects on the consequent treatment results for orthodontic patients be investigated. The associated issues might cause psychological distress to patients and clinicians. During the middle stages of orthodontic treatment, patient enthusiasm and motivation tend to decrease progressively, often leading to worsening of oral hygiene practices.<sup>11</sup> Psychological aspects and factors related to the overall patient experience during treatment have been related to patient compliance issues.<sup>12</sup> With the added psychological burdens caused by the pandemic, oral hygiene and orthodontic patient compliance are possible areas for research. Previously, emotional stress has been associated with reduced orthodontic tooth movement, more severe orthodontic root resorption,<sup>13</sup> more considerable

orthodontic pain experience,<sup>14</sup> and periodontal disease.<sup>15</sup> The doctor–patient relationship and psychological status of patients can affect their overall satisfaction with treatment outcomes.<sup>16,17</sup> Therefore, many aspects of orthodontic treatment might be affected by the pandemic and can be studied, including patient and clinician psychological status, total treatment duration, orthodontic tooth movement, effect of treatment on periodontal tissues, root resorption, pain experience, satisfaction with the treatment results, and the actual quality of treatment outcomes provided during the pandemic. Case-control and prospective cohort studies with historical controls are suggested for these purposes.

Second, since maintaining clinician–patient rapport through virtual communication has been proposed as a means of improving the situation, virtual media is another area of research suggested. Can virtual communication affect patient oral hygiene or compliance during treatment? Applications and computer-assisted oral hygiene instructions have already been successful.<sup>11,18</sup> However, virtual communication through social media is another area for further research. What are the best timelines (duration and frequency) for these communications to be the most effective? Is virtual examination as effective as physical examination for purposes of diagnosis and treatment planning? Digital orthodontic study models (e-models) have previously been approved as a valid alternative to traditional plaster study models in treatment planning.<sup>19</sup> However, virtual examination is still a new concept requiring further study. Clinical trials are the suggested study design for this purpose.

Third, in-office measures to reduce the chance of viral transmission are another area of further investigation since preventive approaches have been strongly recommended. Are other alternatives available in orthodontic practice to reduce transmission during traditionally high aerosol-producing procedures, such as bonding, debonding, and adhesive removal? For instance, clear aligners may not require attachments in mild orthodontic malocclusions. Studies comparing the efficacy of clear aligners with fixed orthodontic treatment are few and heterogeneous, and their quality is debatable.<sup>20</sup> Therefore, it is suggested that treatment efficacy be compared between fixed orthodontic

---

Maryam Saki, Orthodontist, Health System Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

Hooman Zarif Najafi, Associate Professor in Orthodontics, Orthodontics Research Center, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran.

© 2020 by The EH Angle Education and Research Foundation, Inc.

treatment and clear aligners without attachments in mild cases with high-quality, standardized study protocols. In moderate to severe cases, aerosol-producing procedures can be modified by using other devices instead of the routine protocols. Lasers have already been studied and shown to have some degree of efficiency for enamel etching,<sup>21–23</sup> conditioning of loose metallic<sup>24</sup> and ceramic brackets,<sup>25</sup> and adhesive removal from enamel surfaces.<sup>26</sup> In some studies, lasers have been investigated and suggested to limit the pulpal temperature changes within the histopathological limits if used without water cooling.<sup>27–29</sup> In addition to efficiency, the aerosol production with these devices should be compared to routine protocols. In vitro studies and clinical trials are suggested to address this area.

Finally, it is suggested that office protocols to prevent viral transmission be investigated when aerosol production is inevitable. Air filtration systems<sup>30</sup> and negative pressure facilities<sup>31</sup> have been suggested in the literature to prevent viral transmission. Which of these methods or combinations most effectively reduces the viral load in the office? What is the best time interval between routine orthodontic patient appointments and those with aerosol-producing procedures with and without additional filtration facilities in the office? Another area of research could be investigating how oral rinses recommended to combat COVID-19 affect fixed orthodontic appliances. Both 0.2% povidone iodine or 1.0% to 1.5% hydrogen peroxide have been recommended for patients due to the vulnerability of COVID-19 to oxidation. However, their safety for orthodontic patients may be another area for research. Also, the possible effect on orthodontic bonding procedures and orthodontic appliance susceptibility to corrosion and metal ion release is important. Only one study has reported the effect of povidone iodine mouthrinse on orthodontic bond strength.<sup>32</sup> The effect on orthodontic bond strength of hydrogen peroxide as an oral rinse has not been studied; however, studies have reported mixed data regarding enamel bleached with hydrogen peroxide, from having no effect on orthodontic bond strength to decreased bond strength.<sup>33,34</sup> Some mouthwashes can result in galvanic corrosion of fixed appliances.<sup>35</sup> In vitro studies and studies in clinical settings are recommended for elucidating these effects.

In conclusion, at least temporarily, modifications in research areas of interest within the specialty of orthodontics should be considered and implemented to help provide evidence-based standard guidelines and treatment strategies to combat COVID-19. The authors hope this article will inspire and help potential investigators in this regard.

## REFERENCES

1. Liu Y, Yan L-M, Wan L, et al. Viral dynamics in mild and severe cases of COVID-19. *Lancet Infect Dis*. 2020;20:656–657.
2. Adhikari SP, Meng S, Wu Y-J, et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: a scoping review. *Infect Dis Poverty*. 2020;9:1–12.
3. Watkins J. Preventing a covid-19 pandemic. *BMJ*. 2020;368:m810.
4. Suri S, Vandersluis YR, Kochhar AS, Bhasin R, Abdallah MN. Clinical orthodontic management during the COVID-19 pandemic. *Angle Orthod*. 2020 Apr 27.
5. Caprioglio A, Pizzetti GB, Zecca PA, Fastuca R, Maino G, Nanda R. Management of orthodontic emergencies during 2019-NCOV. *Prog Orthod*. 2020;21:10.
6. Saltaji H, Sharaf KA. COVID-19 and orthodontics—a call for action. *Am J Orthod Dentofacial Orthop*. 2020 Apr 30.
7. Graham J, Paschal J, Paquette D. Proposed clinical guidance for orthodontists and orthodontic staff in the post-COVID-19 environment: a clinician's perspective. *J Clin Orthod*. JCO 2020;54:264–267.
8. Turkistani KA. Precautions and recommendations for orthodontic settings during the COVID-19 outbreak: a review. *Am J Orthod Dentofacial Orthop*. 2020 May 13.
9. British Orthodontic Society. PPE and decontamination for non-aerosol generating procedures in orthodontics (non-AGPs). Available at: <https://www.bos.org.uk/Portals/0/Public/docs/Advice%20Sheets/COVID19%20FACTSHEETS/Recovery%20Phase%20Advice/PPE/New%20non%20AGP%20PPE%20and%20Decontamination%20BOS%2011%205%2020.pdf>. Published May 11, 2020. Accessed July 11, 2020.
10. Guo Y, Jing Y, Wang Y, et al. Controls of SARS-CoV-2 transmission in orthodontic practice. *Am J Orthod Dentofacial Orthop*. 2020 Jun 5.
11. Zotti F, Dalessandri D, Salgarello S, et al. Usefulness of an app in improving oral hygiene compliance in adolescent orthodontic patients. *Angle Orthod*. 2016;86:101–107.
12. Chow J, Cioffi I. Pain and orthodontic patient compliance: a clinical perspective. *Semin Orthod*. 2018;24:242–247.
13. Vandevska-Radunovic V, Murison R. Emotional stress and orthodontic tooth movement: effects on apical root resorption, tooth movement, and dental tissue expression of interleukin-1 alpha and calcitonin gene-related peptide immunoreactive nerve fibres in rats. *Eur J Orthod*. 2010;32:329–335.
14. Cioffi I, Michelotti A, Perrotta S, Chiodini P, Ohrbach R. Effect of somatosensory amplification and trait anxiety on experimentally induced orthodontic pain. *Eur J Oral Sci*. 2016;124:127–134.
15. Vettore MV, Leao AT, Monteiro Da Silva AM, Quintanilha RS, Lamarca GA. The relationship of stress and anxiety with chronic periodontitis. *J Clin Periodontol*. 2003;30:394–402.
16. Keles F, Bos A. Satisfaction with orthodontic treatment. *Angle Orthod*. 2013;83:507–511.
17. Al-Omiri MK, Abu Alhaja ES. Factors affecting patient satisfaction after orthodontic treatment. *Angle Orthod*. 2006;76:422–431.
18. Moshkelgosha V, Mehrvarz S, Saki M, Golkari A. Computer-based oral hygiene instruction versus verbal method in fixed orthodontic patients. *J Dent Biomater*. 2017;4:1.

19. Whetten JL, Williamson PC, Heo G, Varnhagen C, Major PW. Variations in orthodontic treatment planning decisions of Class II patients between virtual 3-dimensional models and traditional plaster study models. *Am J Orthod Dentofacial Orthop.* 2006;130:485–491.
20. Rossini G, Parrini S, Castroflorio T, Deregiibus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: a systematic review. *Angle Orthod.* 2015;85: 881–889.
21. Ayar MK, Yildirim T. Effects of Er, Cr: YSGG laser pulse frequency on microtensile bond strength to enamel. *Oper Dent.* 2017;42:53–61.
22. Saveanu CI, Tanculescu O, Anistoroaei D, et al. Enamel conditioning by phosphoric acid and Er, Cr: YSGG laser irradiation-EDS and SEM studies. *Rev Chim.* 2019;70:3129–3331.
23. Almoammar S. Influence of phototherapy on bond strength and failure modes of enamel bonded to ceramic and metallic brackets with different surface treatment regimes. *Photo-diagnosis Photodyn Ther.* 2019;26:214–217.
24. Ahrari F, Basafa M, Fekrazad R, Mokarram M, Akbari M. The efficacy of Er, Cr: YSGG laser in reconditioning of metallic orthodontic brackets. *Photomed Laser Surg.* 2012;30:41–46.
25. Ahrari F, Fekrazad R, Kalhori KA, Ramtin M. Reconditioning of ceramic orthodontic brackets with an Er, Cr: YSGG laser. *Lasers Med Sci.* 2013;28:223–228.
26. Koide K, Tanaka S, Endo T. Use of the Er, Cr: YSGG laser for removing remnant adhesive from the enamel surface in rebonding of orthodontic brackets. *Odontology.* 2019;108: 1–9.
27. Louie TM, Jones RS, Sarma AV, Fried D. Selective removal of composite sealants with near-ultraviolet laser pulses of nanosecond duration. *J Biomed Opt.* 2005;10:014001.
28. Geraldo-Martins VR, Tanji EY, Wetter NU, Nogueira RD, Eduardo CP. Intrapulpal temperature during preparation with the Er: YAG laser: an in vitro study. *Photomed Laser Surg.* 2005;23:182–186.
29. Freitas PM, Soares-Geraldo D, Biella-Silva AC, Silva AV, Silveira BL, Eduardo CD. Intrapulpal temperature variation during Er, Cr: YSGG enamel irradiation on carries prevention. *J Appl Oral Sci.* 2008;16:95–99.
30. Elias B, Bar-Yam Y. *Could Air Filtration Reduce COVID-19 Severity and Spread.* Cambridge, MA: New England Complex Systems Institute; 2020.
31. Saki M, Haseli S, Iranpour P. Oral radiology center as a potential source of COVID-19 transmission: points to consider. *Acad Radiol.* 2020;27:1047–1048.
32. Demir A, Malkoc S, Sengun A, Koyuturk AE, Sener Y. Effects of chlorhexidine and povidone-iodine mouth rinses on the bond strength of an orthodontic composite. *Angle Orthod.* 2005;75:392–396.
33. Trakiniene G, Daukontiene S, Jurenas V, et al. The effect of the teeth bleaching with 35% hydrogen peroxide on the tensile bond strength of metal brackets. *Sci Rep.* 2017;7:1–6.
34. Bishara SE, Oonsombat C, Soliman MM, Ajlouni R, Laffoon JF. The effect of tooth bleaching on the shear bond strength of orthodontic brackets. *Am J Orthod Dentofacial Orthop.* 2005;128:755–760.
35. Schiff N, Boinet M, Morgon L, Lissac M, Dalard F, Grosogeat B. Galvanic corrosion between orthodontic wires and brackets in fluoride mouthwashes. *Eur J Orthod.* 2006;28:298–304.