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Letter to the editor

Managing vertical root fracture in dentistry during the SARS-CoV-2 pandemic

The severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2) has had a great negative impact on daily life from the beginning of December 2019 until now, with dentistry being no exception to this trend. As a respiratory infection and because of the virus's high potential for mutations, controlling the virus is a major challenge during the pandemic. Limiting the production of dental aerosol could help curb the spread of the virus in dental practices. In this respect, telemedicine consultation and using povidone-iodine as a nasal and oral antiseptic can also help eradicate SARS-CoV-2. In addition, an appropriate treatment plan is essential for successful treatment to reduce the occurrence of root fractures.^{1–3} This brief letter focuses on the topic of managing vertical root fracture (VRF) in dentistry.

Dentinal cracks can occur when the tensile stress on the root canal wall exceeds the tensile stress in the dentin, which can lead to a vertical or horizontal root fracture. The final diagnosis of a root fracture, particularly a VRF, is challenging for clinicians. In this regard, based on the data collected from 39 VRFs in the maxillary second premolars and 43 in the mandibular mesial roots of the first molars from 31 dental practices, the mean duration time from initial symptom to the diagnosis of VRF was as follows: 1) 18.3 ± 22.5 months in the premolars and 2) 16.1 ± 17.8 months in mandibular teeth. The symptoms were ascertained by 1) intraoral examinations (tooth mobility, pocket depth (≥ 4 mm), sinus tract, and abscess), 2) subjective symptoms (spontaneous pain, pain on chewing, swelling, and other vague complaints), and 3) radiographic signs (destruction of lamina dura, widening of PDL, abnormality in the vicinity and shape of the apical root, halo (J-shape) radiolucency, and apical periodontitis like radiolucency). In addition, 80% of VRFs were diagnosed within 24 months.⁴ In cases of suspected VRF, an appropriate treatment plan should be considered to minimize the risk of tooth extraction.

Although VRF is a predisposing factor for tooth extraction, preservation of teeth with root fractures is challenging. In a recently published case report to address this issue, tooth number 21 was diagnosed with VRF. The

symptoms were ascertained by clinical (pocket depth 8–10 mm on the palatal side, tooth mobility, and sinus tract) and radiographic (vertical fracture line on the palatal side with large bone destruction) examinations. The intentional replantation was applied with the following procedures: 1) atraumatic extraction, 2) removing granulation tissues, 3) excising 3 mm of the apical root, 4) preparing 3 mm retrograde root canal cavity and filling it with iRoot BP Plus, 5) enlarging the VRF line to a width of 1.5 mm, 6) preparing trapezoidal retention forms on the fracture line, 7) using composite resin to fill into the fracture line and trapezoidal forms, 8) removing the surface of the resin to a depth of 1 mm, 9) covering the rest of resin surface with iRoot BP Plus, and 10) replacing the tooth into the socket and splinting it. The follow-up examinations within 1 year showed that the tooth remained asymptomatic. This approach may provide a new treatment plan in the case of VRF, although more investigation is required in this regard.⁵

VRF risk after apical surgery was investigated by conducting a retrospective study based on 864 patients, including 1058 treated teeth with apical surgery. The study reported that the prevalence of VRF was 4% (42 of 1058 teeth) in patients (55% female and 45% male) with a mean age of 52.00 ± 13.97 years. Among the 42 teeth, 33.3% and 26.2% were mandibular first molars and maxillary second premolars, respectively. The VRF was also observed in the mesial root of the mandibular first molars. Apical surgery did not significantly negatively affect the structure of the teeth.⁶ Therefore, in the case of VRF, endodontic surgery can be useful to preserve the teeth, especially in multi-rooted teeth.

In a laboratory study, Kilic et al. investigated the effect of root canal preparation (i.e., size and taper of files) on the fracture resistance of middle mesial canals in 55 mandibular molars. The samples were divided into 5 groups, and the middle mesial canals were prepared with files 25.04, 25.06, 30.04, and 30.06. The vertical force was applied to the roots. The results showed no significant difference in the occurrence of vertical root fracture

<https://doi.org/10.1016/j.jds.2022.12.020>

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between group 25.04 and the control group (unprepared root canals). Reducing the apical diameter and taper in the middle mesial canals increased the fracture resistance of roots.⁷ Hence, using the final apical preparation with file size 25.04 is safer to reduce VRF in the mesial roots of the mandibular molars.

In another clinical study, Silva et al. evaluated the various factors (i.e., dentinal thickness, post, missing teeth adjustment, and implant adjustment) in developing VRF in obturated teeth using cone-beam computed tomography. The study included 81 samples with VRF and 81 samples without VRF (as the control group) to assess the risk factor of VRF. The results revealed that the dentin thickness ≤ 1.3 mm is associated with VRF. Other factors were not significantly different in VRF development. Thus, a safe dentin thickness (≥ 1.4 mm) plays a crucial role in avoiding VRF in treated teeth.⁸

To evaluate VRF in root filling material, Sebastian et al. assessed the fracture resistance of 60 mandibular premolars in four endodontic sealers. The samples were divided into four groups ($n = 15$) and prepared with the One Shape system (25/0.06). Then, the teeth were filled with single cone gutta-percha using the following sealers: 1) AH Plus, 2) MTA Fillapex, 3) Dia-ProSeal, and 4) Gutta-Flow 2. A vertical force was applied to the samples using a universal testing machine with a spherical tip ($d = 3$ mm). The findings showed that obturated teeth with GuttaFlow have a high fracture resistance. Therefore, applying GuttaFlow as a root-filling material is recommended to reduce VRF.⁹

It is also reported that the high concentration of irrigation solution (i.e., NaOCl) can affect the structure of the teeth and lead to dentinal cracks. In this regard, their propagation can even lead to VRF. Selecting an appropriate irrigating solution concentration should be considered during primary or secondary root canal therapy.¹ The prevalence of VRF in treated root canals is greater than in vital teeth. Since orthograde retreatment may adversely affect the tooth structure, appropriate protocols for root canal instrumentation should be used to preserve root tissue as much as possible. The following procedures can play an important role in preventing VRF: 1) conservative (ninja) access cavity preparation, 2) proper cleaning, shaping, root filling, and coronal restoration, 3) accurate evaluation of the occlusal plane, and 4) reduction of parafunctional habits and deflective contacts.³ Consequently, clinicians should minimize the predisposition of teeth to VRF during the pandemic. Under the assumption of VRF, clinicians should consider treatment options.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgments

None.

References

1. Nasiri K, Wrbas KT. Successful root canal therapy during COVID-19 pandemic. *J Dent Sci* 2022;17:1079–80.
2. Nasiri K, Dimitrova A. The role of povidone-iodine in managing of SARS-CoV-2 pandemic. *J Dent Sci* 2022;17:1437–8.
3. Patel S, Bhuvra B, Bose R. Present status and future directions: vertical root fractures in root filled teeth. *Int Endod J* 2022; 55(3):804–26.
4. Yoshino K, Ito K, Kuroda M, Sugihara N. Duration from initial symptoms to diagnosis of vertical root fracture in dental offices. *Bull Tokyo Dent Coll* 2018;59:59–61.
5. Zhong X, Yan P, Fan W. New approach for the treatment of vertical root fracture of teeth: a case report and review of literature. *World J Clin Cases* 2022;10:5816–24.
6. von Arx T, Maldonado P, Bornstein MM. Occurrence of vertical root fractures after apical surgery: a retrospective analysis. *J Endod* 2021;47:239–46.
7. Kilic Y, Karataslioglu E, Kaval ME. The effect of root canal preparation size and taper of middle mesial canals on fracture resistance of the mandibular molar teeth: an in vitro study. *J Endod* 2021;47:1467–71.
8. Silva LR, de Lima KL, Santos AA, et al. Dentin thickness as a risk factor for vertical root fracture in endodontically treated teeth: a case-control study. *Clin Oral Invest* 2021;25:1099–105.
9. Sebastian VM, Nasreen F, Junjanna P, Hassan A, Rajasekhar R, Maratt VH. Comparative evaluation of root reinforcement using MTA-based, epoxy resin-based, and silicone-based endodontic sealers in canals instrumented with single-file rotary system: an in vitro study. *J Contemp Dent Pract* 2021;22:1098–104.

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Received 28 December 2022

Final revision received 28 December 2022

Available online 3 January 2023