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Letter to the editor

Management of separated instruments in root canal therapy

The satisfactory outcome of root canal therapy is attributed to diagnostic, appropriate access cavity, cleaning, shaping, and root filling techniques. A separated instrument (SI) is a frustrating complication that can occur during root canal therapy. This issue may hinder the complete cleaning, shaping, and root filling of the root canal system. As SI is adversely affecting the success of treatment, its management is a challenge for clinicians. Therefore, a proper treatment protocol is a priority.[1,2] This brief letter focuses on managing SI in root canal therapy.

The high NaOCl concentration (i.e., $\geq$5%) reduces the cyclic fatigue of endodontic files during canal preparation. In this regard, two related studies have reported the following results: 1) 5% NaOCl leads to early breakage of F1 instruments during root canal preparation, when comparing 5% NaOCl with distilled water, 0.9% NaCl, 0.2% chlorhexidine, and 1% NaOCl. 2) The effect of 17% EDTA and 5.25% NaOCl on EdgeTaper Platinum and ProTaper Gold during canal instrumentation in stainless steel blocks showed that 5.25% NaOCl drastically reduces instrument cyclic fatigue. As a result, using an appropriate concentration of irrigation solution and EDTA during instrumentation should be considered to reduce SI during root canal therapy.[3,4]

To evaluate the effect of penetration variety on irrigating systems in the presence of SIs, Uzunoglu-Ozyurek et al. performed the following procedures on 60 extracted mandibular premolar teeth: 1) preparing the samples up to ProTaper F2, 2) separating F3 files in the apical third of the root canals, 3) subdividing the samples into 5 groups based on different irrigating systems (i.e., EndoActivator, EndoVac, manual needle irrigation, passive ultrasonic activation, and RinsEndo), and 4) mounting the samples to Eppendorf tubes and rinsed with 3-mL Rhodamine B-labelled 2.5% NaOCl. The results revealed that using EndoVac and RinsEndo increases the NaOCl penetration in the apical third of the canals compared to other methods. Thus, using a negative pressure irrigation system (e.g., EndoVac) improves the penetration ability of irrigation solutions in the presence of an irretrievably SI, while preserving periapical tissues from irrigation solutions and debris extrusion.[5]

Reducing the time for removing SI is another important factor. In this context, Terauchi et al. evaluated factors affecting the removal time of SIs. Patients with 128 SIs (75 molars, 28 premolars, and 25 anterior teeth) were included in the study. Treatment protocols were as follows: 1) using CBCT for evaluating and measuring SIs in canals, 2) measuring the curvature of canals, 3) using an operating microscope, 4) using XP-endo Shaper + TFRK-S ultrasonic tips for removing filling material until visualization of SIs, 5) removing SIs with TFRK-12/6/S ultrasonic tips, wire loops, or XP Shaper (individually or in combinations), and 6) recording time for all procedures. The results showed that 89.8% of SIs are removed with ultrasonic tips (mean time 221 seconds). The time for removing the instrument depends on the instrument's length and root canal curvature. SIs over 4.5 mm are recommended to be removed with a wire loop or XP Shaper. As a result, an accurate assessment of the SI and selecting an appropriate treatment protocol can affect the removal time of the SI.[2]

To manage SI in root canal therapy, the following case reports described four different cases as follows: Case 1: 1) detecting SI in the distal canal of tooth No. 36, and 2) using ultrasonic tips No. 2 and 4 (ProUltra ultrasonic) + wire loop (0.14-mm-thick wire) for removing SI. Case 2: 1) detecting the SI in the mesial canal of tooth No. 46, 2) using ultrasonic tip No. 4 and H-files (Nos. 25 and 30) for removing filling material, and 3) applying a 22-gauge (0.7-mm-wide) hypodermic needle and H-file No. 25 to remove SI. Case 3: 1) detecting SI in the distal canal of tooth No. 36 (apical third), and 2) adopting the braiding technique (i.e., applying H-files 25 and 35 simultaneously) to remove SI. Case 4: 1) detecting SI in the distal canal of tooth No. 46 (middle third), and 2) bypassing the SI with K-File No. 8, and preparing the canal with K-files (up to No. 30) and hand file F2. Based on these results, choosing the appropriate technique is the key factor in managing SI in each case.[6]

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Selecting the type of system for safe root canal preparation is another challenge for clinicians. From this perspective, the two studies have reported as follows:

1) In the first study, the cyclic fatigue of 180 new endodontic files (No. 25) with various alloys (i.e., M-Wire, Blue-Wire, Gold-Wire, and R-phase) was investigated. The endodontic files were divided into 6 groups (n = 30): Group 1 (BlueShaper), Group 2 (ESP Files Thermoflex), Group 3 (One Curve), Group 4 (Protaper Next), Group 5 (Protaper Ultimate), and Group 6 (2Shape). Next, the cyclic fatigue was evaluated by preparing the files in a stainless-steel block until the instruments were separated. The results showed that Group 2 is superior in cyclic fatigue. Hence, using the ESP File can facilitate root canal therapy and reduce the risk of SI during root canal therapy.[7] 2) In the second study, cyclic fatigue, flexural resistance, and torsional failure of continuous and reciprocating motions of rotary instruments were assessed. Four systems, namely Hyflex, Genius files, WaveOne Gold, and ProTaper Universal, were included in this study. Also, 15 files from each system were used to evaluate cyclic fatigue and 15 in both flexural resistance and torsional failure. The tests for instruments were performed as follows: 1) cyclic fatigue: under deionized water at 36 °C with a curvature of 60° until fracture, 2) flexural resistance: the files were loaded through universal machine until their tip reached 60° of curvature, 3) torsional failure: a file tip was locked in a torsional machine while the shank continued rotating until fracture. The results showed that Hyflex and Genius files are more resistant to cyclic fatigue and torsional failure than the other systems.[8]

Research has shown that intentional teeth replantation in less than 15 minutes is another reliable tooth-preserving therapy for unsuccessful bypass of SI or apical microsurgery with periapical pathosis.[9] Concerning the information in this brief letter, the management of SI can be summed up as follows: 1) a proper treatment protocol, 2) selecting the appropriate concentration of irrigation solution, 3) using a negative pressure irrigation system (e.g., EndoVac), 4) using individually or in combinations of ultrasonic tips, wire loop method, braiding technique, or XP-endo Shaper to remove SI, 5) using appropriate endodontic system (e.g., Hyflex, Genius, and ESP files), and 6) intentional replantation in the case of unsuccessful bypass of SI with periapical pathosis. Hence, accurate evaluation of the clinical and imaging diagnosis, sufficient clinician knowledge of endodontic procedures, and using a microscope can reduce the possibility of SI during root canal treatment.

Declaration of competing interest

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

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