Brazilian Dental Journal (2014) 25(6): 571-574
http://dx.doi.org/10.1590/0103-6440201302436

ISSN 0103-6440

Obturation Over an S1 ProTaper Instrument Fragment in a Mandibular Molar with Three Years of Follow-up

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This paper describes root canal filling performed over a large S1 ProTaper file fragment in a second mandibular molar with irreversible pulpitis. An S1 ProTaper file was fractured during the instrumentation of the mesiobuccal canal. Approximately 10 mm of file fragment remained in the apical and middle thirds of the canal. The obturation was performed over this fragment using thermomechanically compacted gutta-percha and sealer. Radiographic findings and the absence of clinical signs and symptoms at 3-year follow up indicated successful treatment. Cone-beam computed tomography images revealed absence of periapical lesion and details of intracanal file fragment related to root fillings and apex morphology. In this case, the presence of a large intracanal fractured instrument did not have a negative impact on the endodontic prognosis during the follow up evaluation period.

Key Words: endodontic treatment, nickel-titanium instrument, instrument fracture, obturation.

Introduction

The advent of superelastic nickel-titanium (NiTi) rotary files has become more predictable and efficient the endodontic management of curved canals. NiTi rotary preparation reduces procedural complications, allowing suitable shaping while preserving root canal anatomy (1,2). However, a major concern with the use of these NiTi files is the possibility of fracture, which may jeopardize root canal preparation (3).

The continuous cycle of tensile, shear and compressive forces, as well as torsional load transferred onto the file during instrumentation, can fracture the brittle and ductile NiTi files (4-7). Thus, adequate straight-line access and preparation of a glide path with passive use of NiTi rotary files into the canal are essential steps to prevent the occurrence of fracture (4,8). Furthermore, monitoring of reused files is important to identify signals of fatigue (3-5). If the operator fails to observe these factors, the chance of NiTi file fracture during clinical use increases (4). In such situation; an attempt to bypass or remove the intracanal fragment should be initially considered (3,9).

Removal of the fractured fragment may be attempted using drills, extractors, and ultrasonic devices (9). The use of the operating microscope as adjunct to these procedures increases the chances of intracanal instrument removal (10,11). However, unsuccessful attempts at removal of a fragment can affect the root dentin integrity, especially in the apical third of the canal (3,9,10). Thus, it is preferable to abandon instrument removal in these cases as long as the prognosis is still favorable (3).

In this report is described a case in which root canal filling was performed over a large intracanal fragment of NiTi rotary S1 ProTaper file in a mandibular molar. At 3-year follow up, clinical, radiographic and cone-beam computed tomography (CBCT) examinations were performed.

Case Report

This case was managed by a student in a professional development course in endodontics of the Brazilian Dental Association, Montes Claros, MG, Brazil. A 48-year-old woman with a noncontributory medical history complained of pain episodes in the mandibular left second molar and was referred for endodontic treatment. During clinical examination, the tooth revealed slight response to percussion and was asymptomatic to palpation. The mean probing pocket depth presented normal limits, and no sinus tract was observed. The pulp sensibility test (Endo-Ice, The Hygienic Corporation, Akron, OH, USA) generated intense pain that did not subside rapidly. A periapical radiograph showed an extensive carious lesion on the distal face of the tooth under amalgam restoration. A slightly widened periodontal ligament space was also observed (Fig. 1A). Based on the clinical and radiographic findings, the diagnosis of symptomatic irreversible pulpitis was established. Endodontic treatment, including pulpectomy, cleaning, shaping and obturation of the root canals in one appointment, was proposed to the patient.

Endodontic access was performed under local anesthesia and rubber-dam isolation. The previous restoration and carious dentin were removed, followed by reconstruction of the proximal walls with glass ionomer cement (Vidrion R, SS White Dental Products,

Rio de Janeiro, RJ, Brazil). After identification of root canal entrances, the mesiobuccal, mesiolingual and distal canals were explored with a #10 K-file (Dentsply-Maillefer, Ballaigues, Switzerland) based on root length established at preoperative radiograph. Following this, the root canals were prepared up to the middle third with a motor-driven device (X-Smart, Dentsply-Maillefer), using the S1 and S2 ProTaper instruments (Dentsply-Maillefer) with a brushing motion. Recapitulation was performed with a #10 K-file. The root canals were irrigated with 2.5% NaOCl after the use of each rotary and manual instrument. The working length was established using an electronic apex locator (Novapex, Forum Technologies, Rishon Lezion, Israel) and confirmed by periapical radiograph (Fig. 1B). While the operator performed the instrumentation, the S1 file was inadvertently forced apically into the mesiobuccal canal, resulting in fracture of the instrument. The file fragment was approximately 10 mm long and was in the apical and middle thirds of the canal (Fig. 1C). The patient was informed of the iatrogenic mishap and the conclusion of treatment was rescheduled. The canals were dressed with a commercially prepared antibiotic-corticosteroid product (Otosporin, Farmoquímica S/A, Rio de Janeiro, RJ, Brazil) and the tooth was provisionally sealed with a non-eugenol temporary filling material (Cimpat, Septodont, Saint Maur, France).

After 2 days, the tooth was reopened under local anesthesia and rubber dam. The root canals were flushed with 2.5% NaOCl to remove the intracanal dressing. Following this, straight-line access to the fractured instrument was achieved with #2 to #4 Gates-Glidden drills (Dentsply-Maillefer) after removing coronal tooth structure in the mesial wall using an Endo-Z bur (Dentsply-Maillefer). Bypassing the instrument fragment was attempted repeatedly with a #10 K-file, but without success. An approximately 4-mm space was created lateral to the fragment, but a ledge formation and overenlargement in the mesiobuccal canal were observed. As a surgical microscope was unavailable, further removal procedure, including the use of ultrasonic tips, was not performed because of the risk of root perforation. Thus, the decision was to maintain the fractured file within the canal, and the mesiobuccal canal was prepared using a #40 K-file (Dentsply-Maillefer) at a working length of 13 mm. Shaping of the mesiolingual and distal canals was completed with F2 files. During instrumentation, the root canals were irrigated with 2.5% NaOCl and the smear layer removed using a 14.3% EDTA solution (pH 7.2) for 3 min. The root canals were then irrigated again with 2.5% NaOCl and dried with paper points. Non-standardized gutta-percha cones (Odous, Belo Horizonte, MG, Brazil) and sealer 26 cement (Dentsply, Petropolis, RJ, Brazil) laterally condensed (Fig. 1D) followed by thermomechanical compaction were used for root canal fillings. The tooth was then provisionally sealed as previously described, and the patient was referred for permanent restoration of the tooth.

Radiographic and clinical findings (Fig. 1E-F) and the absence of clinical signs and symptoms at 3-year follow up indicated successful treatment. Normal periapical status (Fig. 2A), the limit of obturation, and the file fragment at the cervical and middle thirds of the mesiobuccal canal are displayed on sagittal cone beam computed tomography (CBCT) images (Fig. 2B). Coronal CBCT slice shows a space in the apical portion of the mesiobuccal canal that suggests a double curvature (Fig. 2C) not observed on the periapical

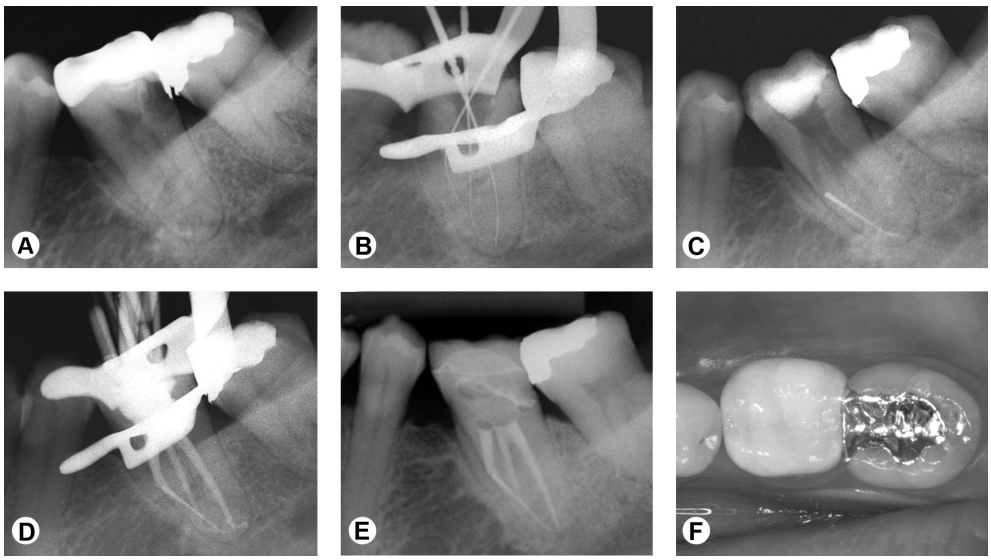

Figure 1. A: Preoperative radiograph. B: Radiograph of working length determination. C: Radiograph showing the fractured instrument in the mesiobuccal canal. D: Radiograph showing root filling procedures. E: Radiograph at 3-year follow up. F: Clinical aspect at the 3-year follow up.

radiograph. A three-dimensional rebuild performed from the CBCT images shows details of the intracanal file fragment related to obturation at the mesiobuccal canal (Fig. 2D) and the internal configuration of the root canal fillings (Fig. 2E).

Discussion

ProTaper rotary files fractures are more prevalent in molars than in premolars or anterior teeth (4,12). Among the shaping ProTaper files, the S1 file is more frequently fractured during root canal instrumentation (4). The diameter of these files increases from the apical to coronal area, which results in the highest stress being placed on the coronal portion during the preparation of curved canals (13). Thus, instrument fractures can be expected in this area resulting in a long fragment near the apical area of root canal, as observed in this case report.

Inadequate access preparation and root canal instrumentation favored the S1 file fracture in the present case. The removal of all overlying dentin is a critical step during access to mandibular molar canals. Insufficient dentin removal of the access cavity lateral walls hinders proper visualization and localization of the mesial canal orifices (14). This invariably results from inability of the operator to adequately direct the instrument, with increased stress during its insertion into the mesial canals (Fig. 3A). Conversely, sufficient dentin removal results in straight-line access and favors the instrumentation (Fig. 3B) reducing torsional stress on the file (3,4). However, an inexperienced operator frequently fails during access preparation, which results in locking the rotary NiTi file and consequently its deformation and fracture. The operator who performed the treatment in the present case had received previous training, but competence in NiTi rotary use was not completely assimilated, representing the learning period of the operator (15).

A root canal with a high degree of curvature, added

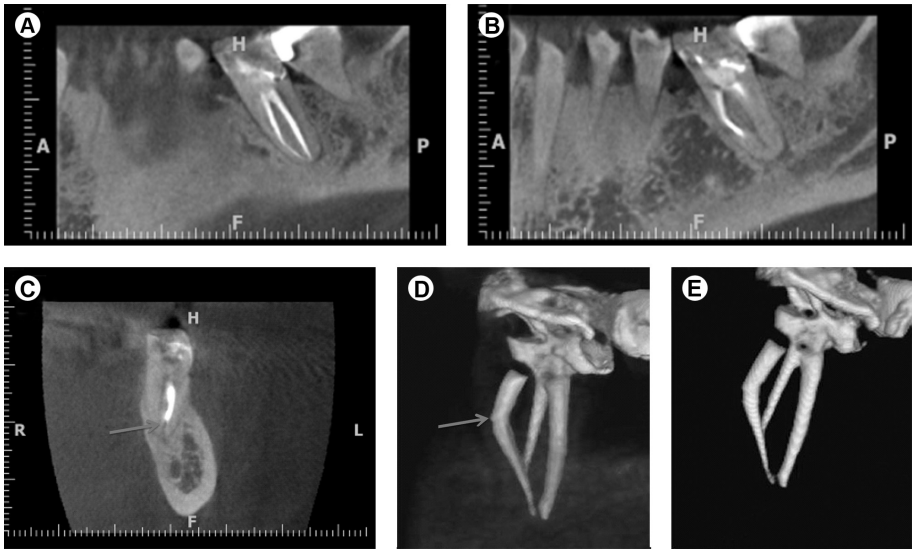

Figure 2. A: Sagittal CBCT view showing normal periapical status. B: Sagittal CBCT view showing the limit of obturation and the file fragment at the cervical and middle thirds of the mesiobuccal canal. C: Coronal CBCT view showing a space in the apical portion of the mesiobuccal canal (arrow), suggesting a double curvature not observed at periapical radiograph. D: 3D rebuild showing in detail the limit of obturation and the file fragment (arrow). E: 3D rebuild showing the internal configuration of the root canal fillings.

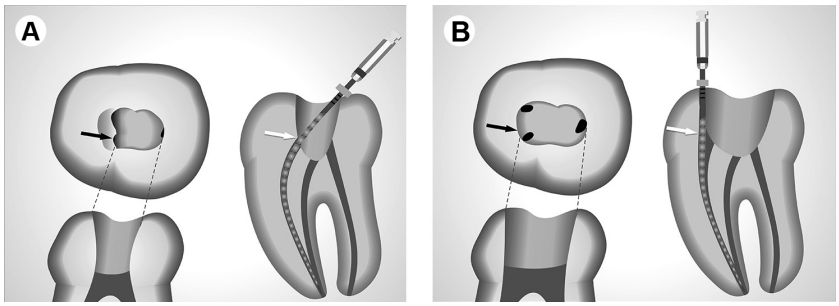

Figure 3. A: Inadequate access cavity with the presence of an overlying dentin in the mesial wall (black arrow). The file undergoes an angular deflection at root canal entrance (white arrow). B: Removal of coronal tooth structure in the mesial wall (black arrow) favors the visualization and location of root canal orifices. This procedure allows straight-line access into the canal (white arrow) and reduces torsional stress on the file.

to an incorrect instrumentation technique, increases the chance of NiTi instrument fracture. Despite the moderate curvature of the mesial root observed in the preoperative periapical radiograph in the present case, CBCT images at follow up suggested an abrupt curvature in the mesiobuccal canal. This situation adversely affects the cyclic fatigue resistance of the instrument, generating concentration of stress and predisposing the instrument to fracture (16-18).

Three approaches can be used to solve intracanal instrument fracture: removing the instrument, bypassing the instrument, and preparing and filling the canal over the fractured fragment (3,9). Attempts to remove the fractured fragment could lead to excessive removal of root dentin, reducing root strength and predisposing to root fracture or perforation (9,19). Although the use of operating microscope and ultrasonic tips may attenuate these problems, location of the fragment apical to root canal curvature, as the observed in this case, hampers its removal (11). Bypassing the instrument is also difficult when a long fracture fragment remains apical to the curvature (9). Based on these factors, instrumentation and filling over the fractured instrument were performed in the present case. The use of thermomechanical compaction technique provided a hermetically dense filling around the intracanal fragment, as verified on 3D CBCT images at follow up.

The decision to leave the file fragment in the root canal was strongly influenced by preoperative conditions of this case, which included a vital tooth. Proper disinfection of the root canal, followed by hermetic sealing, is essential to successful endodontic treatment. However, occurrence of instrument fracture during the instrumentation and filling procedures may compromise these steps. The chance of treatment failure is higher when fragments prevent a thorough cleaning and shaping of the entire root canal system (20). However, it has been demonstrated that an apical location of the fragment does not necessarily jeopardize endodontic prognosis, mainly in cases without preoperative periapical lesions (3,20).

Although retention of the intracanal fractured instrument did not compromise a successful endodontic outcome in the present case, efforts should be made to avoid iatrogenic events caused by the use of rotary files without attaining straight-line access. Professional training emphasizing all endodontic procedures is mandatory.

Resumo

Este relato de caso descreve a obturação do canal radicular realizada sobre um grande fragmento da lima ProTaper S1 em um segundo molar inferior com pulpite irreversível. Uma lima ProTaper S1 fraturou durante a instrumentação do canal mésio-vestibular. Aproximadamente 10 mm de remanescente do fragmento da lima permaneceu nos terços apical e médio do canal. A obturação foi realizada sobre este fragmento usando guta-percha compactada termomecanicamente e cimento endodôntico. Achados radiográficos e ausência de sinais e sintomas clínicos após 3 anos de acompanhamento indicaram o sucesso do tratamento. Imagens de tomografia computadorizada de feixes cônicos revelaram a ausência de lesão periapical e detalhes do fragmento da lima intracanal relacionados à obturação do canal radicular e à morfologia do ápice. Neste caso, a presença de grande instrumento fraturado intracanal não teve impacto negativo no prognóstico endodôntico durante o período de acompanhamento.

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Received February 23, 2014
Accepted October 21, 2014