Use of heat treated manual NiTi files in teeth with marked curves: case report

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ABSTRACT

The present paper aims to describe the endodontic treatment of a tooth with marked root dilaceration using manual instruments manufactured in thermally treated NiTi. Patient F.S.L., male, 14 years old, with surgically treated palatal cleft was referred to endodontic treatment of the left maxillary lateral incisor (#22) for prosthetic reasons. Clinical examination revealed a defect in the formation of the crown of the tooth. Initial radiographic examination revealed presence of marked S-shaped root dilaceration. Under local anesthesia and absolute isolation, coronary access and initial exploration of the canal with C-Pilot instrument #10 were performed, followed by the use of pre- curved Flexofile #15 until it the actual tooth length (CRD) was reached. Due to the curvatures, manual instruments of the ProdesignM system were chosen, finishing the preparation with instrument #35/.05. Because of peculiarities related to absolute isolation, the use of 2.0% chlorhexidine digluconate was associated with 0.9% saline solution and CRD was used as the working length. After difficulties with preparation, the canal was filled 1.0 mm below the CRD by the single cone technique associated with cement AH Plus. At the end, coronary access was sealed with glass ionomer cement. Final radiograph revealed preservation of initial anatomy. In view of the above, it can be concluded that Prodesign M system was effective in modeling the curved canal, respecting its original anatomy even in the presence of sharp curvatures, thus justifying its use.

Keywords: Endodontics. Tooth abnormalities. Root canal therapy. Alloys.

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Introduction

The objective of endodontic therapy is to prevent and control infection within the root canal system. The accomplishment of such aim is dependent on the clinician's experience in dealing with root canal anatomy and its variation. For treatment to be successful, correct identification, cleaning, shaping and filling of the root canal are indispensable.

On the other hand, endodontic therapy might not be as successful when, for instance, the condition to be treated is wrongly diagnosed, unsatisfactory restorations are maintained, or when an instrument is fractured inside root canals. These factors related to failure are worsened by the complex anatomy of root canals, mainly by its variations, such as root dilacerations.[1] A dilacerated root is defined as an angle of 20° or more formed between the root and the long axis of the tooth.[2] Santana, Consolaro, and Tavano classify root dilacerations in slight (20 - 40°), moderate (41-60°), and severe (> 61°). Root dilacerations are considered relatively rare, with a prevalence of approximately 1 to 4.9% for all dental groups. However, in patients with cleft palate, this prevalence reaches 78.3%.[4]

Root dilaceration is an anatomical characteristic that hinders treatment of an endodontic infection, contributing to higher failure rates.[5] Since dilacerated roots present accentuated curvatures, they are more difficult to be cleaned and shaped, which can culminate in deviations and instrument fracture.[4,6,7] In cases of root dilacerations, tomographic examination is recommended to complement diagnosis, once it can indicate the need for modified access cavity, pre-curvature of instruments, and thermoplastic filling.[8] Root dilacerations are still a challenge even to the most qualified endodontist, since in the literature there is limited information concerning instrumentation and filling techniques to such cases.

Regarding endodontic instrumentation, nickel-titanium (NiTi) files are the instruments of choice for the treatment of curved root canals due to their flexibility and centralized wear of root canal walls.[9] The advantages of NiTi files are their superelasticity and shape memory.[10] Towards these excellent material properties is the disadvantage of fracture risk, which is related to cyclic fatigue and to low resistance to torsion that NiTi instruments present. Thus, different methods of manufacturing NiTi instruments were developed to design files with higher flexibility, resistance to fatigue, and better efficiency in cutting tissues. Innovations in the fabrication of NiTi instruments comprise the different thermic treatment modalities to produce R-Phases and M-wire leagues, in addition to controlled shape memory.[9]

Recently introduced into the market, ProDesign M instruments (Easy Dental Equipment, Belo Horizonte, MG, Brazil) open a new line of manual instruments made from NiTi allow with a technology of controlled shape memory. Technically, these differences allow a centrally wear of canal dentin walls when instrumentation is being performed. According to the manufacturer, these new instruments have to be used with clockwise rotational movements.

The aim of this study is to report a clinical case of a patient presenting cleft lip-palate and a tooth with root dilaceration. This tooth underwent endodontic treatment with manual instruments made with thermally treated NiTi.

Case report

A male 14-year-old patient was referred to the endodontist to receive treatment in his left lateral maxillary incisor (#22). The main reason for endodontic treatment was that the patient presented a cleft-lip palate, and the incisor would receive prosthesis, once it presented malformation in the crown. The patient had underwent surgery to have cleft palate corrected 12 years ago and was under concomitant orthodontic and prosthetic follow-up. The patient's legal guardian signed an informed consent allowing the endodontist to perform treatment.

Intraoral examination revealed the patient was using orthodontic appliance in which a resin crown was fixed and used to temporarily substitute the crown of tooth #22 (Fig 1A). It was also seen that the patient was using a fixed palatal appliance (Fig 1B). Pain was not reported, although the tooth presented extensive coronary destruction. At radiographic examination, moderate (55°) root dilaceration with an image suggestive of double-curvature was detected. Periapical tissues exhibited preserved lamina dura and well-defined periodontal ligament space (Fig 2).

After infiltrative anesthesia with 1.8 ml of 2% Mepivacaine and 1:100 000 epinephrine (Dentsply Maillefer), field isolation was performed with rubber dam. Due to the presence of fixed palatal appliance, two perforations were made to insert the crowns of teeth #13 and #23. Subsequently, with the aid of a scis-

sor, both perforations made in the rubber dam were connected. The field was isolated and the rubber dam was attached to the palatal appliance and to patient's gingiva using a cyanoacrylate adhesive (Fig 3).

The access cavity was performed with a diamond drill bur (#1014; KG Sorensen, Sao Paulo, Brazil). Chlorhexidine gel (2%) was used as intracanal irrigant solution (Biophormula, Fortaleza, CE, Brazil) interleaved with 0.9% (Eurofarma, Sao Paulo, SP, Brazil). saline solution. The root canal was initially explored with a #10 C-pilot file (VDW GbmH, Munich, Germany), which was inserted into the root canal until 2 mm before the apparent radiographic length of the tooth. The real length of the incisor (15.5 mm) was determined using an electronic foramen locator (RomiApex A-15; Romidan, Kiryat Ono, Israel) coupled with a #15 K-Flexofile instrument (Dentsply, Maillefer, Ballaigues, Switzerland) (Fig 4).

Chemical-mechanical preparation of the root canal was performed with Prodesign M instruments. Due to root dilaceration, both the sequence suggested for anterior (#35/.01 e #35/.05) and posterior (#25/.01, #15/.05 e #25/.06) teeth were used in the cervical and medium thirds of the tooth with clockwise rotary movements. The root canal of the incisor was wide and presented a glide path, which was detected when the #15 endodontic file was used to explore the canal. Thus, #25/0.1 instrument was used, and irrigation was performed with saline solution followed by chlorhexidine. The root canal was explored again with #15/.05, #25/.06, #35/.01, and #35/.05 instruments. Thereafter, #15/.05, #25/.06, #35/.01, and #35/.05 instruments were used sequentially. The two latter were inserted up to 16.5 mm of the root canal. In between every change of instrument, the canal was again irrigated with saline solution followed by chlorhexidine, and by review of the real length of the tooth.

At the end of instrumentation, extra long MX gutta-percha points (Odous de Deus, Belo Horizonte, MG, Brazil) were tested for adaptation and standardized at #35 before performing root canal filling. After irrigating the canal with 17% EDTA for three minutes as well as performing a final wash with saline solution, the root canal was dried with standardized sterile absorbable paper points. AH Plus sealer (Dentsply-De Trey, Konstanz, Germany) was used as sealing material and handled according to the manufacturer´s instructions. The sealer was inserted into the canal with the gutta-percha cone and had walls coated with gentle apical pressure until the desired length for filling was achieved (real dental length – 1.0 mm). Afterwards, any excess of gutta-percha points was cut by a heat carrier up to the canal orifice and vertically compacted by a hand plugger – Schilder (Odous de Deus). The pulp chamber was then cleaned and sealed with light-curing glass cement ionomer. Final filling radiograph was taken and evinced that root canal curvature was preserved (Fig 5). The patient was advised to return to a prosthodontist for definite dental crown manufacturing.

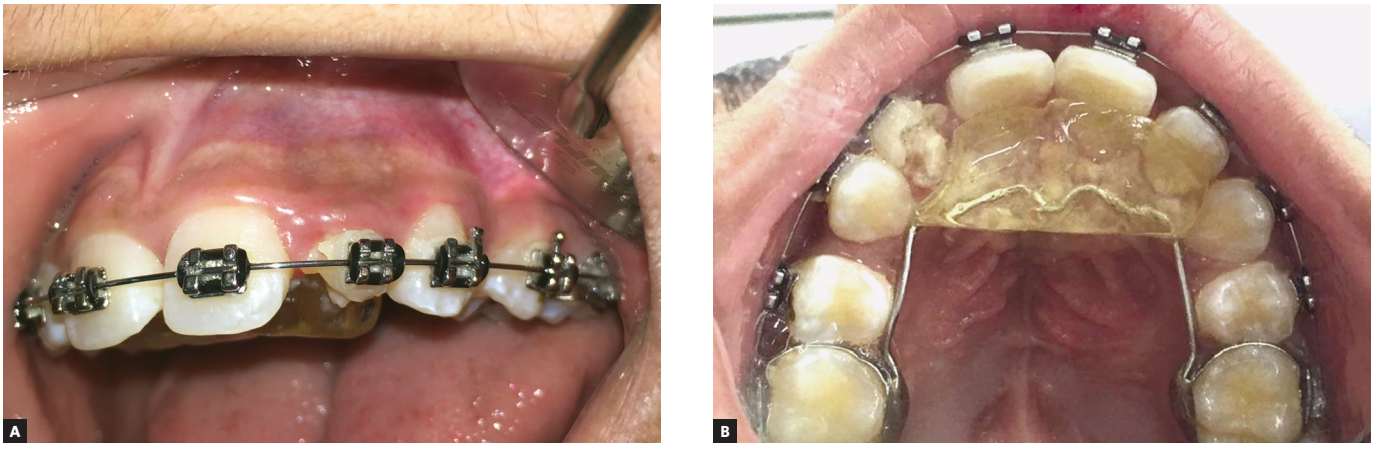

Figure 1. Intraoral examination (**A**) Fixed palatal appliance (**B**).

Figure 2. Initial periapical radiography.

Discussion

Previous knowledge of endodontic anatomy is imperative and a prerequisite factor for successful planning of endodontic treatment on curved dental roots. In the reported case, periapical radiograph revealed moderate root dilaceration of a lateral maxillary incisor of a patient with a previously treated palatal fissure. As per studies from Silva et al, permanent incisors are most affected by light dilaceration (73.1%), followed by moderate dilaceration (17%) and severe dilaceration (9.7%). Also, 90.2% of dilaceration cases are present in the apical third, whereas 95.1% are distally oriented: characteristics reported herein. In face of the clinical findings, difficulties with endodontic treatment result from field isolation to filling steps. The use of different techniques and instruments (ProDesign M) for conducting this case was decisive for satisfactory clinical outcomes.

As our patient wore fixed palatal appliance, we opted for modified rubber dam placement by using the split rubber dam technique, which consists of the fusion of two or more holes in the rubber dam that correspond to the teeth either side of that which is being isolated. A slit is

Figure 3. Modified absolute isolation.

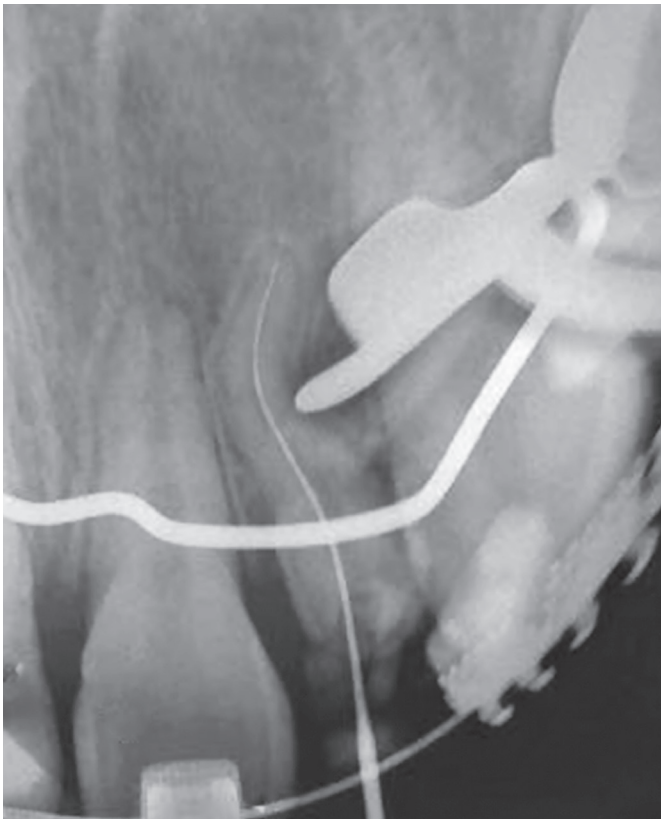

Figure 4. Odontometry periapical radiography.

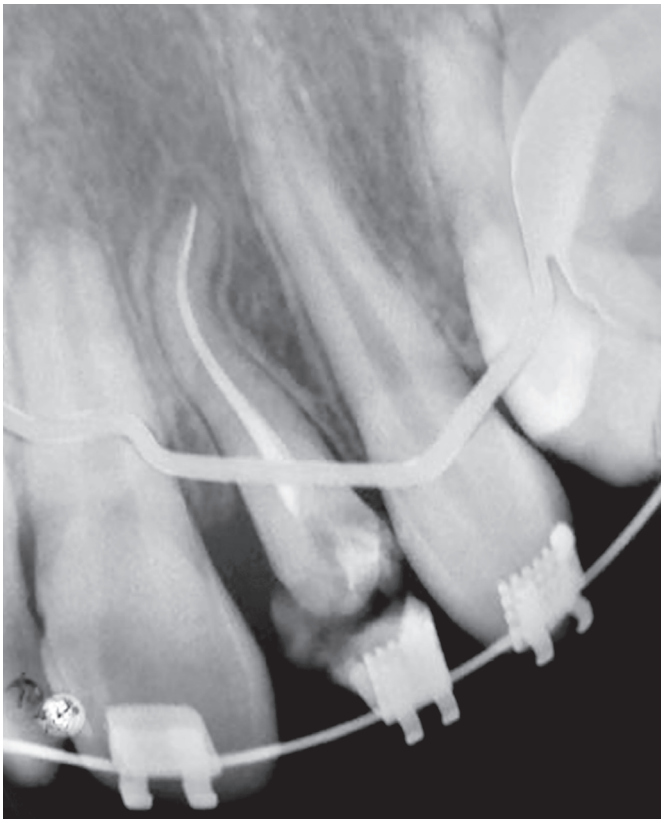

Figure 5. Final periapical radiograph.

cut in the dam to join the two holes and the rubber dam can be retained with clamps. The split gives poor isolation, favoring infection, so a caulking agent (cyanoacrylate) was employed to prevent saliva infiltration and ingestion of any chemical substances used during root canal irrigation.[13]

Root canal exploration of dilacerated roots is hampered by canal wall location. When a manual endodontic instrument is inserted into the canal, it can be blocked due to changes in anatomy. According to Chaniotis et al, using a small caliber pre-curved file for root canal exploration is a relevant step that allows for root curvature preservation rather than directing the cutting in a straight line. The extension of pre-curve necessary for each instrument depends on the location of the curvature along root canal length.[8] For the case reported herein, #10 C-pilot files were employed at 2.0 mm before the apex foramen, followed by distally pre-curved #15 Flexofile instruments to allow for thorough exploration of canal curvature. During instrument insertion, a small oscillatory movement was performed up to the working length. Chaniotis et al observed that attempts to achieve larger diameters of apex instrumentation in dilacerated teeth with stainless steel files can result in extreme torsions, with the use of Ni-Ti instruments being recommended to facilitate maintaining the original anatomy of a curved canal during instrumentation.

The evolution of Ni-Ti instruments in the last two decades conducted to new concepts of instrumentation and techniques for root canal preparation.[11] Mechanical instrumentation using Ni-Ti files shows high disinfection levels and lower apex deformation indexes, and apex perforation.[15] Recently, a new thermomechanical processing of Ni-Ti files resulted in the creation of a new edge with unique properties also known as memory-controlled edge, which is flexible and resistant to fatigue. According to Bürklein et al, these instruments can turn around curvatures in a passive manner causing minimal changes to root canal anatomy. ProDesignM files are recommended for endodontic treatment, including moderately curved root canals. Three kits are

available in the market, two for anterior teeth (#35/.01 and #35/.05; #40/.01 and #40/.05) and one for posterior ones (#25.01, #15.05 and #25.06). According to the manufacturer, these files should be used in a clockwise motion until achieving the working length. The choice for ProDesign M instruments arose from the complexity of curves in dental roots and risk of fractures of rotary instruments. The presence of root dilaceration intensifies the problems related to mechanical instrumentation. Therefore, ProDesign M becomes an option as an extremely flexible instrument, presenting superior fatigue resistance values compared with conventional Ni-Ti files, enabling higher control on instrumentation movements and decreasing fracture risk.[17-21]

The irrigating solution used here was 2% chlorhexidine digluconate gel associated with 0.9% saline solution. Such option was mainly due to difficulty performing field isolation. According to Gatelli et al, chlorhexidine digluconate presents broad-spectrum antimicrobial activity, substantivity, which may last for 12 weeks, and reduced toxicity. Chlorhexidine digluconate, in its liquid or gel form, was more efficient and non-toxic when compared to sodium hypochlorite. Even so, it does dissolve organic tissues, chlorhexidine digluconate maintain debris in suspension.[23] According to Chaniotis et al, in cases of root dilaceration, copious irrigation in between instrument changes is necessary to guarantee complete root canal cleaning through debris removal, dentine scrapings, and planktonic microorganisms. This observation is also related to the apical limit for instrumentation. We opted for instrumentation at the foramen level; in other words, at the extension pointed by the electronic foramen locator as 0.0 mm. This choice is directly related to risks of instrumentation extension loss during the procedure. By maintaining this limit at the apex foramen, the risk of obstruction was minimized.

Knowing this scenario, ProDesign M instruments have been valuable to root canal preparation. Flexibility and cyclic fatigue resistance correspond to what is expected regarding the maintenance of root canal original anatomy. Besides, these instruments enable superior enlargement capacity of the root canal compared with stainless steel instruments. Thus, their features make ProDesign M a reliable and simple approach for root canal treatment when the use of mechanically activated instruments is hindered.

Conclusion

Endodontic treatment of root dilaceration requires not only vast knowledge of dental root anatomy, but also an accurate selection of instruments and techniques for these procedures. Therefore, ProDesign M arose as an option for negotiation of curvature, presenting crucial characteristics for achieving clinical success.

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