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Management of Intricate S-shaped Root Canals - An Endodontist's Challenge

Dental Science

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ABSTRACT

The unique morphology of S-shaped root canals often poses utmost challenges in their endodontic management. Common causes of failures in such cases are primarily related to procedural errors such as ledges, fractured instruments, canal blockages, zip and elbow creations. Knowledge of dental anatomy and its variations is essential for the success of endodontic treatment. A clinician is required to have an insight of the morphology of tooth related to its shape, form and structure before commencing treatment. Routine periapical radiographs aids in assessing these morphological variations in the root canal system. This article gives a review of the literature and reports an interesting case of S-shaped root canals of adjacent teeth in the same patient

KEYWORDS:

S Shaped canal, Bayonet, third molar

Introduction

A 19-year-old female reported to the Department of Conservative Dentistry and Endodontics, with pain in relation to lower left posterior teeth. Medical history was non-contributory. After administrating infiltration anesthesia, the optra dam was placed and the access cavity preparation was performed with size 2 round burs. The initial negotiation and scouting of the S-curved canals were achieved with sizes .06, .08, and .10 K stainless steel hand files (Dentsply Maillefer, Ballaigues, Switzerland). The working length was verified using the Root ZX apex locator (J. Morita Inc., Kyoto, Japan) and confirmed radiographically(figure 1). Hand-filing was achieved by slowly inserting the K files (Dentsply Maillefer, Ballaigues, Switzerland) to the working length followed by gentle passive strokes upon withdrawal. This facilitated an unobstructed glide path to be created along the S-curve with minimal transportation during shaping.

After hand-filing, the sizes 1 and 2 Pathfinder rotary files (Dentsply Maillefer, Ballaigues, Switzerland) were used to working length, followed by scouting with sizes 10/.04 and 10/.06 Race files (FKG Dentaire, La Chaux-de-Fonds, Switzerland) to working length. No further enlargement of the S-curved canals was performed. 6% NaOCl was used to irrigate between each file used. Canal blocking was prevented by using multiple recapitulations with a precurved .08 stainless steel K files (Dentsply Maillefer, Ballaigues, Switzerland) between each rotary file use.

The irrigation efficacy was enhanced after completion of the shaping procedures by passive ultrasonic activation of the irrigant with a size .15 ultrasonic K file (Satelec Acteon Group, Merignac Cedex, France). The canals were next flooded with 17% EDTA solution for 2 minutes followed by a final rinse of sterile water. The canals were dried with size .20 sterile paper points and obturation was performed with the Continuous Wave of Condensation Technique. [12]

Two fine feathered tip gutta percha points (SybronEndo, Orange, CA, EUA) were gauged to .20 and fitted with AH Plus sealer (Dentsply DeTrey, Konstanz, Germany) to working length. An extra fine tip mounted on the Elements Obturation unit (SybronEndo, Orange County, CA) was used at a setting of 200°C 5 mm short of the working length. The apical gutta percha was compacted by using a size 35 Dovgan plugger (G. Hartzell & Son, Concord, CA). Backfilling was performed using high-speed injection of thermoplasticized gutta percha by the Extruder Elements Unit (SybronEndo, Orange County, CA) through a .25 gauge needle (Figure 2).

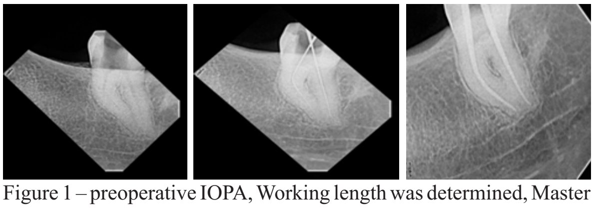

Figure 1 – preoperative IOPA, Working length was determined, Master cone was confirmed

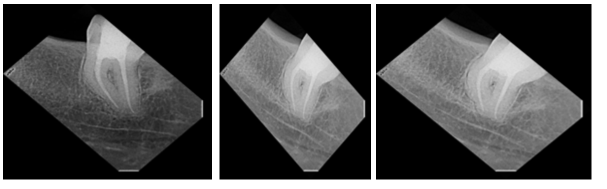

Figure 2 postoperative radiograph followed by 3 months & 6 months radiograph.

Discussion

It is uncommon to observe a tooth with a straight root and a straight root canal because most teeth exhibit some curvature of the root canal. In addition, most canals have multiple planes of curvature throughout their length [1]. Endodontic therapy will be successful only when a thorough disinfection of the entire root canal system is achieved. However, the presence of curvatures may pose difficulty in root canal instrumentation and cleaning.2

The term dilaceration first used by Tomes in 1848, refers to an angulation or a sharp bend or a curve in the root or crown of formed tooth or a deviation or bend in the linear relationship of a crown of a tooth to its root.3 Tooth is considered to have a dilaceration toward the mesial or distal direction if there is a 90° angle or greater along the axis of the tooth or root. Dilaceration can also be defined as a deviation of the apical part of the root by 20° or more. The condition is believed to be consequent to trauma during the period of tooth formation, when the position of the calcified portion of the tooth is changed and the reminder of the tooth is formed at an angle.

Root canal curvatures may be apical, gradual, sickle-shaped, severe-moderate-straight curve, bayonet / S-shaped curve and dilacerated curve. Curved root canals exhibit great difficulty in cleaning, shaping and obturation of the root canal system. The final results of the instrumentation of curved root canals may be influenced by several factors such as the flexibility and diameter of the endodontic instruments, instrumentation techniques followed during the management, location of the foramina opening, and the hardness of dentin. Ledge formation, blockages, perforations and apical transportation are undesirable occurrences that have been observed after the preparation of curved root canals. Therefore determining the degree of curvature of root canal before starting the endodontic treatment is mandatory.

Several methods have been advocated to determine root canal curvature using periapical radiographs. Schneider proposed a method to calculate the curvature based on the angle that is obtained by two straight lines. Schneider's method involves firstly drawing a line parallel to the long axis of canal in the coronal third of root canal. A second line is drawn from the apical foramina to intersect the first line. The Schneider's angle is measured with the intersection of these lines on a hard copy of the diagnostic radiographic printout. Accordingly, the degree of root canal curvature is categorized as:
Straight: 5° or less

Moderate: 10-20° and
Severe: 25-70°.

Schneider angle, when used in combination with the radius and length of the curve, may provide a more precise method for describing the apical geometry of canal curvature. Gunday et al., introduced the term "canal access angle" (CAA) and its related parameters which provide more information about the coronal geometry of canal curvature [11]. Determining the curvature of the root will permit the maintenance of the curves during root canal preparation and prevents structural deformations of endodontic instruments. Thus, diagnosis of root dilacerations before endodontic treatment has a critical importance in either preventing complications during treatment or ensuring a good treatment result [10].

The success of root canal treatment depends largely on complete biomechanical debridement of the canals and the elimination of microorganisms from the root canal system. Preparation of curved canals presents one of the greatest challenges in endodontics and is fraught with difficulties. The shortcoming of periapical radiographs is that only the curvatures in mesio-distal plane is visible, although curvatures in the bucco-lingual plane are also evident in many teeth. In dilacerated teeth, it is often difficult to explore and negotiate the root canals. This inability to continuously follow the root canal curvature might result in blocking of the canal, ledging, apical cavitation such as transportation and/or zipping, perforation, and instrument separation [4].

According to Vertucci [12] maxillary premolars are the teeth with the maximum anatomic variations. One such variation that occurs often in the maxillary premolars is the 'S' shaped or bayonet shaped root canal. The S-shaped canal has two curves, with the apical curve being very difficult to negotiate. The chances of strip perforation are very high in these root canals. Guttman [13] suggested preflaring the coronal 1/3rd of the canal (at the expense of the tooth structure) to reduce the angle of curvature. Once this procedure is completed, it is easy to negotiate the remainder of the root canal. It is important to formulate a customized treatment plan for the management of curved canals. Prior to initiation of treatment, the degree of curvature has to be ascertained. In the case presented we have followed Schneider method of curvature determination, because of its simplicity and wide acceptance [9,10].The roots of 14 were doubly curved (Bayonet or 'S' shaped) and the root of 15 showed a sharp curvature at middle third, with severely curved root canals in relation to both the teeth. After determining the degree of curvature, we have followed various techniques for the management of curved canals [14,15].

Endodontic file has the tendency to straighten up in the canal, and hence it is difficult to control removal of dentine along the entire length of file in push pull motion. The incidence of procedural errors can be reduced by:

1. Decreasing the restoring force by means of which straight file has to bend against the curved dentine surface and
2. Decreasing the length of the file which is aggressively cutting at a given span.

Decreasing the force can be done by the following-

(a) Precurving the file: A precurved file traverses the curve better than a straight file. Precurving is done in two ways:
- Placing a gradual curve for the entire length of the file
- Placing a sharp curve of nearly 45° near the apical end of the instrument

(b) Extravagant use of smaller number files as they can follow canal curvature, because of their flexibility. The smaller size files should be made super loose in the canal before using larger files to negotiate the canal without force.

(c) Use of intermediate size of files: It allows smoother transition of the instrument sizes to cause smoother cutting in curved canals, e.g. cutting 1 mm of No. 15 file makes it No. 17 file as there is an increase of 0.02 mm of diameter per mm of length.

(d) Use of flexible files (NiTi files, Flex R files): As these files help in maintaining shape of the curve and avoid procedural errors like ledge, elbow or zipping of the canal.

Decreasing the length of actively cutting files is achieved by the following:

(a) Anti-curvature filing.

(b) Modifying the cutting edges of the instrument by dulling the flute on outer surface of apical third and inner portion of middle third, which can be done by a diamond file.

(c) Changing the canal preparation techniques, i.e. use of coronal pre-flaring and crown down technique.

Tendency to create narrow canal shapes minimizing access of irrigants and creating potential to allow debris to be pushed apically. Attempts at overcoming the deficiencies of these instruments resulted in a number of preparation techniques that aimed to reduce iatrogenic defects and produce canals with a more flared shape.

A significant advancement in root canal preparation with hand instruments was made with the introduction of balanced force movements of files. The balanced force movements of the file are :– clockwise 60°, so that it binds against the wall and advances apically – anticlockwise 120° with apical pressure, so as to crush and break off the engaged dentinal wall.

-clockwise 60° without apical advancement, allows flutes to be loaded with debris and removed from the canal.

The balanced force technique is less prone to cause iatrogenic damage, decreases the extrusion of debris apically and maintains the instruments centrally within the root canal.

Conclusion

Severe root curvature may pose substantial difficulty in cleaning and shaping as well as obturation of the root canal. A thorough knowledge about internal anatomy of the tooth, appropriate instrumentation techniques and customized treatment planning depending upon the degree of curvature will help manage curved canals, prevent complications and enhance the quality of the treatment.

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