Journal of Endodontics

Printed in U.S.A.
Vol. 29, No. 5, May 2003

Identifying Multiplanar Root Canal Curvatures Using Stainless-Steel Instruments

Charles E. Jerome, DDS, and Robert J. Hanlon, Jr., DMD

Information obtained from careful observation of stainless-steel hand file deformation can be a critical step in efficient root canal space debridement. Secondary and tertiary canal curvatures that occur most often in the proximal view have been reported in the literature. Except in teeth that are clinically rotated, there is currently no method for observing the proximal view of root canal systems. This article presents a simple clinical procedure for detecting the three-dimensional anatomy of root canal spaces. We refer to the procedure as file molding.

Effective root canal space debridement is the foundation for successful endodontic treatment. Understanding anatomical variations, specifically with regard to canal space curvature, has a direct impact on the safe and efficient completion of difficult cases. Studies of morphological variations in spatial planes not revealed by two-dimensional radiographic images have been reported in the literature (1, 2). These variations have been termed tertiary or multiplanar curvatures. Multiplanar curvatures can cause loss of length and ledging during hand file instrumentation (1) and are more likely to cause instrument separation from torsional failure with nickel-titanium rotary file techniques.

Radiographic working length images can at least show severe two-dimensional reverse curvatures; however, severe two-dimensional curvatures are often accompanied by proximal tertiary curvatures (2).

The increasing popularity of the electronic apex locator (EAL) is decreasing the routine use of radiographic images for length determination; therefore, severe two-dimensional curvatures, as seen on radiographic images, are less likely to be observed and interpreted for case difficulty.

Regardless of the type of instrumentation (i.e. rotary files or all hand instruments), initial canal exploration and enlargement is usually accomplished with small K-type files in sizes 6 through 15. As small stainless steel instruments are withdrawn from the canal, they are sometimes molded into a shape that copies the multidirectional anatomy of the canal space. Experienced practitioners have no doubt observed this. The purpose of this article is to present some simple ideas for understanding the role that small stainless-steel instruments play in alerting a clinician to the presence of multiplanar canal curvatures. This information can be used to influence the selection of hand and rotary files and further limit instrument breakage in multiplanar canal curvatures.

PROCEDURE

A contemporary crown-down instrumentation technique is desirable to facilitate effective file molding. Although advocated previously by Morgan and Montgomery (3) for hand instrument use, crown-down instrumentation is now a widely accepted procedure for initiating the various rotary file techniques. Elimination of the coronal-third curvature with a crown-down apical access allows the smaller stainless-steel files to be less constrained in the coronal third. Less constraint in the coronal third allows the molded shape to be preserved as the file is withdrawn through the canal.

Use of a specific type of stainless-steel instrument is an important element in file molding. Although not the most popular instrument for initial debridement, the reamer has merit when used to copy canal curvatures. Because the flutes are not twisted as tightly as the traditional K file, the reamer has less memory and is more adaptable to a three-dimensional shape. The reamer, in this respect, has a more dead soft property than the K file and is the antithesis of nickel-titanium file memory.

Although a reamer also has fewer cutting rakes per unit length than a file, it is as effective in crushing and removing dentin. Because there is more space between the flutes, there is better transport of debris along the instrument (4). For this reason, it can be an effective initial instrument to probe tight and curved canals.

The purpose of the reamer in this technique modification is not necessarily to remove dentin by instrumenting the canal, but to take advantage of the characteristics of the reamer to hold a shape and copy the canal anatomy.

A simple test to verify the differences in properties between a file and reamer can be made. Compare the reamer to the file of the same manufacturer by precurving them on a mirror handle or file-bending instrument. The reamer more easily deforms into a curved shape and maintains that shape. Differences in instrument performance can also be observed in the curvatures of extracted teeth. Examples of two instruments that we found to be effective for file molding are the size 10 Premier Reamer (Premier, King of Prussia, PA) and the size 8 Kerr Reamer (Kerr, Romulus, MI).

Figure 1 is the conventional or clinical buccolingual view of a mandibular first molar, illustrating a typical uniformly progressive distal curvature of the mesiobuccal canal. This is a primary curvature as described by Cunningham and Senia (1). Figure 2 is a

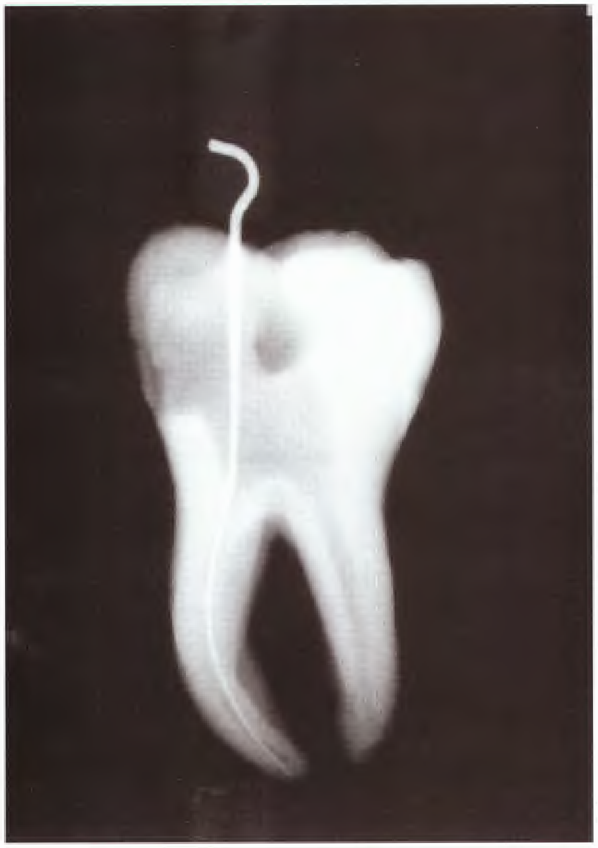

FIG 1. Buccolingual view of a mandibular first molar with a primary distal curvature of the mesiobuccal canal.

FIG 2. Proximal view of the same tooth and canal in Fig. 1. The reverse curvature seen apically is a tertiary curvature.

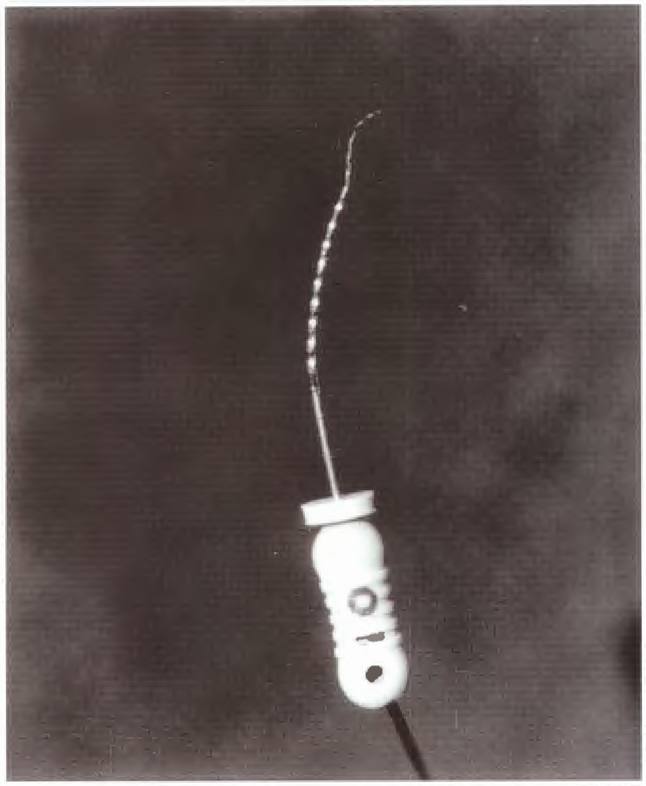

FIG 3. The stainless-steel reamer molded into a three-dimensional shape is the same instrument seen in Fig. 2.

FIG 4. Clinical example of an obturated tooth #31. The two-dimensional curvatures were not evident on the pretreatment image.

proximal view of the same tooth illustrating the reverse curvature of the mesiobuccal canal. The reverse curvature, as seen apically, is described as a tertiary curvature (2). The secondary curvature occurs between the initial coronal-third curvature and the apical-reverse curvature.

Primary, secondary, and tertiary curvatures occurring in both proximal and clinical planes are referred to as multiplanar. Figure 3 illustrates the three-dimensional shape of the mandibular first molar copied in a size 10 Premier Reamer. The most accurate three-dimensional shape can be molded into the reamer if it is used in a push-pull rather than watch-winding motion.

DISCUSSION

Angled radiographs with instruments at full apical length can provide valuable feedback in cases with multiplanar curvatures. Although three-dimensional curvatures cannot be seen on two-dimensional radiographic images, severe reverse curvatures in a single plane will be evident. Kartal and Cimilli (2) concluded that the presence of secondary curvatures in certain canals was often accompanied by a curvature in the proximal view as seen radiographically. Pretreatment radiographic images can illustrate root curvatures, but subtle curvatures are not usually revealed until instruments have been placed into canal spaces and examined radiographically.

EAL are increasingly replacing radiographic images for instrumentation length control. As the EAL becomes an indispensable aide for locating the canal minor diameter, angled radiographs with instruments placed to length are less likely to be scrutinized for severe two-dimensional curvatures. The value of careful file molding in this regard is evident.

The obturated example shown in Fig. 4 was completed with EAL length control and no working length radiographic image. The mesial root had severe multiplanar curvatures that were determined with file molding. The pretreatment radiograph revealed what appeared to be a simple conical or fused root. The more complex anatomy would have been evident had an image been exposed with instruments in the canal; however, file molding provided the information necessary to minimize ledging or possible instrument separation.

File molding can be accomplished at any time during instrumentation. This technique report does not suggest that a small reamer must be the first instrument placed in the canal or that it be the first instrument placed to full length. However, it may be important to have information about multiplanar curvatures as early as possible to prevent canal space ledging and instrument separation.

Drs. Jerome and Hanlon are partners in the private practice, Escondido Endodontics. Address requests for reprints to Dr. Charles E. Jerome, Escondido Endodontics, 488 E. Valley Parkway, Suite 307, Escondido, CA 92025.

References

1. Cunningham CJ, Senia ES. A three-dimensional study of canal curvatures in the mesial roots of mandibular molars. J Endodon 1992;18:294–300.
2. Kartal N, Cimilli HK. The degrees and configurations of mesial canal curvatures of mandibular molars. J Endodon 1997;23:358–62.
3. Morgan LF, Montgomery S. An evaluation of the crown-down pressureless technique. J Endodon 1984;10:491–8.
4. Cohen S, Burns RC, eds. Pathways of the pulp. 8th ed. St. Louis: CV Mosby, 2002:527.