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A Contemporary Approach to Cleaning and Shaping of the Root Canal System Emphasizing “Early Coronal Enlargement”

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INTRODUCTION

The earliest references to root canal preparation and obturation can be traced to Edward Maynard (1838) who was both a physician and a dentist. Maynard described a technique for pulp extirpation, preparation and obturation. Maynard created barbed broaches, by notching the untempered steel used in making watch springs. He also fashioned reamers by filing piano wire into three and four-cornered metal blanks and then twisting it. This method is not dissimilar to the techniques currently employed in the manufacture of modern endodontic instruments.

Only rudimentary discussions of root canal procedures occurred until Hess²¹ published a compendium of the anatomy of root canals of teeth, which demonstrated the complexity of that anatomy. Hess concluded from those studies that root canal systems could not be adequately cleaned or adequately obturated. That assumption in conjunction with the focal infection theory presented by Hunter²³ and confirmed by Rosenow⁴³ severely undermined the development of endodontics until well after the discovery of penicillin by Sir Alexander Fleming¹⁵ and commercially available antibiotic preparations.

Stewart⁵⁴ discussed the importance of irrigation with sodium hypochlorite during root canal preparation, also designated as chemo-mechanical preparation. The canal was enlarged initially by manipulating the largest reamer that could reach the apical region, which was followed by manipulating a file of the same size. Reamers and files of increasing size were carried to the apex, alternately, until the canal was debri-

ded and enlarged. This technique came to be known as serial filing.

Schilder⁵⁰ was the first clinician to provide a detailed discussion of root canal preparation. Schilder referred to this procedure as cleaning and shaping and outlined specific design objectives, which included the most significant principle of cleaning and shaping, namely, the continuously tapering shape. Schilder was also the first clinician to discuss step-back preparations of the root canal system and recapitulation. Although numerous other authors have contributed greatly to the body of knowledge regarding root canal preparation, the criteria and objectives that were originally described by Schilder remain essentially unaltered. The technique that was described by Schilder entailed serial instrumentation with progressively larger instruments working from the apical extent of the root canal coronally in a step-back fashion. Files were used alternately with reamers. Gates-Glidden drills were used to enlarge the coronal portion of the preparation. The use of the smaller preceding instruments to reestablish patency or recapitulation was also described.

Coffae and Brilliant¹⁰ corroborated the work of Schilder. They demonstrated that a tapering preparation was more efficacious in the removal of debris from the confines of the root canal system than parallel preparations. They also demonstrated that the use of files serially, and in a step-back modality, was more effective in producing the tapering shape, than serial filing alone.

Weine et al.⁵⁶ used clear acrylic blocks to evaluate the effectiveness of various instrumentation tech-

niques. Their conclusions were somewhat disconcerting. They demonstrated that the utilization of standard instruments in either a reaming, a filing, or a reaming and filing modality, produced preparations that were irregular in shape. Furthermore, these preparations were not continuously tapering, with the narrowest part, at a point coronal to the root apex. This point was designated as the elbow of the preparation. The preparation developed at the apex of the root was found to be considerably eccentric in shape, and was reminiscent of a teardrop. The apical preparation was designed as an apical zip. These characteristics were felt to result from the elastic memory of instruments and a predilection to straighten as they are manipulated around curves. To alleviate this problem, Weine suggested removing the flutes from the outer surface of a pre-curved file, and the use of instruments in intermediate sizes, which are not commercially available.

To minimize the problems described by Weine, Abou Rass et al.¹ engaged in a discussion of anti-curvature filing. This method advocated the removal of conspicuous amounts of tooth structure from the outer walls of the curve of a root canal system. This, of course, provided a safer approach to the root apex, in addition to protecting the furcation of multi-rooted teeth.

Marshall and Pappin³² advocated an innovative approach to root canal preparation described as a crown-down technique. This method addresses the canal by expanding the preparation coronally before an attempt is made to reach the apex. Pre-curvature of instruments was found to be unnecessary, however, the apical zip as described by Weine, could still be detected.

A somewhat abstruse, but compelling, article on instrumentation was published by Roane et al.⁴² Roane described a technique for root canal preparation called "balanced force". The technique is a variation of reaming, but purportedly maintains the contour of the canal and does not transport, or zip the apical foramen. Theoretically, the restoring force or elastic memory of the file described by Weine, can be overcome when it is pit against dentinal resistance. The technique is carried out by rotating a file in a clockwise direction, while forcibly engaging the flutes of the instrument. This is followed by a counter-clockwise rotation, while simultaneously applying forcible apical pressure. The counter-clockwise rotation cuts the dentin via shear force or the balanced force. This procedure is continued with each file apically until forcible

resistance is met, at which time the next largest instrument is employed. The precurvature of instruments was not found to be necessary and the technique was not recommended for root canal systems with significant curvature. Some preliminary investigations by the author indicate that, although the technique is an efficient method of enlargement, there is a predisposition to fractured instruments, intracanal obstructions, ledging and transportation when this technique is used injudiciously.

Dedeus¹² has also described a method that is reminiscent of balanced force, but is distinct, utilizing oscillatory movement. A file is carried down the canal by turning the instrument clock-wise, and then counter-clockwise 180 degrees repeatedly until forcibly resistance is met. The instrument is then continuously exchanged for the next largest instrument until the preparation of the desired diameter is achieved. Multiple repetitions of the instrument sequence and recapitulation, is obviously necessary. The method is extremely safe and efficient and renders very round preparations.

In addition to the above, the advent of Nickel-Titanium rotary instrumentation has given clinicians, yet, another tool in developing clean, continuously tapering preparations that duplicate the original canal anatomy. These instruments, however, cannot substitute for a thorough knowledge of root canal anatomy and mastery of the skills necessary to prepare canals manually.

Finally, the author⁵¹ has described a technique that is an extrapolation or marriage of step-back filing and crown-down methodology. The technique incorporates the use of hand instrumentation and rotary instruments. The combination of these techniques can provide continuously tapering shapes safely and efficiently. This technique will be described in greater detail, following a discussion of the requirements for an ideal root canal preparation.

REQUIREMENTS

In a previous discussion,⁵² it was established that endodontic success is dependent on two fundamental criteria, the complete removal of the contents of the root canal system and the complete elimination or obturation of that system.

To fulfill these criteria, a set of requirements for an ideal root canal preparation must be delineated. These requirements should not be dissimilar to tho-