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Research Article

Accuracy of Digital Radiography in Detecting Root Canal Type in Mandibular Premolars in South Indian Population

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Abstract: The success of endodontic therapy relies on adequate mechanical and chemical debridement of the root canal system which optimally requires elaborate knowledge of the complex root canal anatomy. The anatomical variation of the root canal system is often a complicating factor during root canal treatment. Failure in assessing the root canal morphology can lead to misdiagnosis, missed canals, improper debridement and eventually failure of treatment. Conventional radiography has been used for many years for evaluating root canal morphology. Digital radiography was developed to overcome the shortcomings of conventional radiography which provided the major advantage for image manipulation. The aim of the present study was to evaluate the accuracy digital radiography for assessing the root canal morphology in teeth indicated for endodontic therapy.

Keywords: Endodontic therapy, mandibular premolars, root canal, morphology.

INTRODUCTION

The intricacy of the root canal system desires cautious vigilance from an endodontist in the morphological analysis when treating a tooth. Internal complexities of the root canal require the identification of methods that precisely determine the root canal morphology. This requires information about the number and shape of roots and canals in order to plan and perform a satisfactory endodontic treatment¹⁻³. From the early work of HESS (1925) to the present studies demonstrating pulp space anatomy, it has been established that pulp space with a graceful taper and single apical foramen is an exception rather than a rule⁴. In order to master the anatomic concept, the operator must develop a rational, three dimensional image of the internal anatomy of the tooth from the pulp horn to the apical constriction. Slowey has documented the probable cause of failure being variations in canal anatomy and mandibular premolars being the most complex and a challenge to endodontically treat them. Thus endodontic flare-ups, re-treatment and failures were most likely seen due to variants in root canal morphology^{5,6}. No single scientific advancement has contributed as greatly to improved dental health as the finding of the amazing properties of cathode rays by Professor Wilhelm Konrad Roentgen in November 1895. The first dental radiographs to aid in the diagnosis of hard tissue alterations of the teeth, to determine the location, shape, size and direction of root and root canals^{7,8}.

Advancements in digital radiographic imaging systems have introduced many potential benefits to endodontic practice. Instantaneous generation of high-resolution digital images; manipulation or processing of the captured image for enhanced diagnostic performance; lack of need to re-expose patients for potential retakes; lower dose compared with D-speed film with round collimation; ease of archiving, transmission, and long-distance consultation; lower turnaround times; reduction in time between exposure and image interpretation; and digital documentation of patient records are some of the advantages of digital radiography^{9,10}. The quality of the image is probably of the utmost significance in endodontics, as it facilitates accurate interpretation of root and canal morphology, and particularly the determination of radiographic canal length, as well as the postoperative and long-term evaluation of the outcome of endodontic treatment¹¹. The aim of the present study was to evaluate the accuracy of digital radiography for assessing the root canal morphology in teeth indicated for endodontic therapy.

EXPERIMENTAL

This diagnostic study was performed on 578 patients requiring endodontic therapy. It was approved by the Institutional Ethical Committee and the patients consent was taken. The inclusion criteria for permanent mandibular first and second premolars were single rooted fully erupted teeth with closed apices and teeth with multiple roots, root canal fillings, post and core restorations were excluded from the study. Digital radiographs were taken by SKANRAY TECHNOLOGIES. Exposure parameters were set at 65 kvp, 7.5 ma and an exposure time of 0.40 seconds. The distance between the buccal surface and the focal spot was 20 inches. The images were taken by direct system using CCD receptor of 23×14×4mm size and displayed in a LG 14-inch monitor with 1600×1200 resolution. The images were prepared with IntraskanDiGi software and saved in JPEG format. Two independent endodontists assessed the canal configuration using One Data Viewer software (Morita Manufacturing Corp) to reach consensus in the interpretation of radiographic findings. In cases where consensus was not reached, a third professional oral radiologist was asked to perform a decisive evaluation.

RESULTS AND DISCUSSION

The following results were obtained after digital radiographic analysis:

Table 1: Number and Percentage of Canal Types in 1068 Mandibular first Pre-Molars

No of canals	1	2	3
Number	1009	56	3
Percentage	94.47	5.24	0.28

Table 2: Number and Percentage of Canal Types in 1056 Mandibular second Pre-Molars

No of canals	1	2	3
Number	1012	41	4
Percentage	95.83	3.88	2.84

Two dimensional imaging modalities have been used in dentistry since the first intra-oral radiograph. Mandibular premolars are known to be a 'single-rooted' tooth with a 'single' canal⁷⁻¹⁰. The root canal dimension is wider bucco-lingually than mesio-distally, usually having two pulp horns; a large pointed buccal pulp horn and small rounded lingual pulp horn. In the cervical area, the canal is oval shaped; and it assumes a round shape when approaching the middle third. However a few variations with regard to mandibular premolars have been reported. A variation is reported wherein a lingual canal emerges at a sharp angle from the main canal, making it arduous to negotiate. Also, the lingual inclination of the crown makes access opening and further endodontic treatment challenging for the clinician⁶. Vertucci's class 1 was found to be most prevalent in both mandibular first and second premolars, 94.47 % and 95.83 percent. The incidence of type 2 (5.24% and 3.88%) and type 8 (0.28% and 2.84%) of Vertucci's classification was found to be low.

In a study done on extracted permanent first molars from a Chinese population taken from a buccolingual and mesiodistal angulation wherein the digital radiographs were compared with the clearing technique showed the limited value of digital imaging when studying the root canal type¹¹. Due to genetic pre-disposability and evolutionary patterns, an intricate internal anatomy and an elevated frequency of congenital absence in mandibular first premolars can be observed. According to Pink and Hoen, missed canal contributes to 42% of the teeth that have been re-accessed for treatment¹². Thus magnification aids like loupes or microscope for endodontics, along with digital imaging are recommended for enhancing the quality of endodontic treatment.

The major advantage of digital imaging in studying root canal anatomy is image manipulation. It involves selecting the information of greatest diagnostic value and suppressing the rest¹³. Manufacturers provide software programs with many different processing tools, however some are more useful than others and these include features like contrast enhancement which can effectively compensate for over or under exposure of the digital image¹⁴. It has been shown that contrast enhancement of CCD devices were more accurate than E-speed film for detecting simulated caries under orthodontic bands. Also, digital calipers, rulers and protractors are some of the many tools available for image analysis. The

images can also be superimposed onto each other and onto digital photographs. It also allows for 3-D reconstruction which can be theoretically used to reconstruct intra-and extra-oral images. The uses range from filling root canals to visualizing facial fractures in all three dimensions¹⁵.

CONCLUSION

Digital radiography has several advantages and has become an indispensable diagnostic tool for many dentists in daily practice. However, inappropriate use of enhancement has been shown to adversely affect diagnosis. If digital radiographs are exported using various software packages created for graphic design and image manipulation, digital information can be altered, added, or removed. According to the results obtained in our study, Vertucci's class 1 was found to be most prevalent in both mandibular first and second premolars with the incidence of type 2 and type 8 being low. However, the limitations of this technique are mainly the investment costs, the infection control measures as the detectors cannot be autoclaved and also the time which will take in mastering the software.

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