JOURNAL OF APPLIED ORAL SCIENCE
www.fob.usp.br/revista or www.scielo.br/jaos
J Appl Oral Sci *2005; 13(1): 20-3*

COMPARATIVE ANALYSIS OF THE VISUALIZATION OF SMALL FILES USING DIGITAL AND CONVENTIONAL RADIOGRAPHY

ANÁLISE COMPARATIVA DA VISUALIZAÇÃO DE LIMAS DE FINO CALIBRE, USANDO A RADIOGRAFIA DIGITAL E A CONVENCIONAL

Sandra Regina Boarin PACE[1], Sandra Márcia HABITANTE[2]

1- Master in Endodontics at UNITAU (SP).
2- PhD, Assistant Professor, Discipline of Endodontics of UNITAU (SP).

Corresponding address: Sandra Regina Boarin PACE - Rua Bartira, 87 apto.42 - Perdizes - São Paulo - SP - Cep.: 05009-000
Phone: 3872.3321 / 223.7956 / cel. 9617.2040 / 9916.0852 - E-mail: pace@usp.br

Received: December 9, 2003 - Modification: April 14, 2004 - Accepted: July 16, 2004

ABSTRACT

The present work was designed to carry out a comparative analysis of the visualization of small files using digital and conventional radiographs. Forty maxillary molars inserted in human skulls were used; Maillefer K-files #06, #08, #10 and #15 were inserted in the mesiobuccal canals and measured at 0.5mm beyond and 1.5mm before the tip with 0.5-mm intervals, in order to allow five professionals to observe whether the files were at the limit, before or beyond the foramen when visualized on conventional radiographs taken on Insight Kodak film (Eastman Kodak, Rochester, NY, USA) and with the RVG digital system (Trophy). Based on the results obtained, the conclusions were: with the two systems it was possible to visualize #06 K-files in nearly 60% of the evaluated cases; for the others, #08, #10 and #15 K-files, visualization was higher with both radiographic systems, achieving 82% of correct visualization for #15 K-files with the conventional system. The differences between the results of the two systems studied – conventional (Insight film, Kodak F-speed) and last generation digital (RVG - Trophy) radiographs – were not statistically significant according to the Student's t test.
Uniterms: Radiograph, dental; Direct digital radiography; Measurements; Canal length.

RESUMO

Objetivo: O objetivo deste trabalho foi comparar a visualização de limas de fino calibre usando as radiografias digital e convencional. *Material-método:* Para tal, foram utilizados quarenta dentes molares superiores inseridos em alvéolos de crânio seco, com limas Maillefer tipo K de calibre #06, #08, #10 e #15, em canais mésio-vestibulares, mensurados de 0,5 mm além ápice a 1,5 mm aquém do ápice com intervalos de 0,5 mm, de forma que cinco avaliadores pudessem observar se as limas estavam no limite, aquém ou além do forame em radiografias convencionais com filme Insight Kodak (Eastman Kodak, Rochester, NY, USA) e sistema digital RVG (Trophy). *Conclusão:* Diante dos resultados obtidos concluiu-se que nos dois sistemas foi possível visualizar as limas #06 em cerca de 60% dos casos avaliados, para as demais limas - #08, #10 e #15-, a visualização foi superior em ambos os sistemas radiográficos, chegando a 82% de acertos para as limas #15 no sistema convencional. As diferenças entre os resultados dos dois sistemas estudados – radiográfico convencional (filme Insight, F speed) e digital (RVG – Trophy) de última geração – não foram estatisticamente significativas, segundo o teste t-Student.
Unitermos: Radiografia dentária; Radiografia digitalizada; Medição de condutos radiculares.

INTRODUCTION

Considering the standardization of endodontic instruments, the progress of knowledge on microbiology and immunology, the evolution of modern autoclaves, and biosecurity standards, the dental surgeon cannot anymore comply with a procedure that allows only partial vision of the internal tooth anatomy (Paiva, et al.[14]), which may cause

diagnosis errors in cases of vertical fractures, curvatures and apical delta.

The advent of new technology led to replacement of conventional radiography, used up to now with considerable propriety, by digital radiography, which provides a good quality image with less exposure of the patient to radiation and easier operation, since it reduces the working time by eliminating the need to develop the radiographic film chemically.

It should be remembered that, when releasing the Directive # 453, from June 1st 1998 on the regulatory standards for "Radiographic Protection on Dental and Medical Radiodiagnosis", the Secretary of Sanitary Surveillance, Brazil[4], has included, among its basic principles, the justification – mentioning that "the existing types of practice must be revised anytime new significant data are acquired, regarding their efficacy or consequences". This has encouraged researches for achievement of more secure radiographic means for the patients, mainly regarding a lower incidence of radiation.

As emphasized by Khademi[10], the study of new means to allow the best visualization of the internal anatomy of the tooth is distinguished by its great importance. With no doubts, molars are the teeth showing greater difficulties for work, mainly with regard to the ,maxillary molars, whose localization involves other structures – as the maxillary sinus, tuber and zygomatic arch, besides the frequent presence of a flat mesiobuccal canal in mesiodistal direction. Furthermore, these teeth can present two canals, distal inclination, curves and atresia, which make the endodontic treatment even more difficult.

Previous studies have shown the inefficiency of digital radiography when small files are used. Because of the evolution of the new resolution of twenty pairs of lines, which may allow better visualization, besides reducing the need to submit the patient to unnecessary exposition to radiation, this technique must be revised, since it may become a valuable instrument for endodontic treatment.

MATERIAL AND METHODS

Human skulls with the alveolar region of maxillary molar in excellent condition were coated on the maxilla with 4-mm thick silicone, simulating the soft tissue, as recommended by Bóscolo, et al.[3].

The teeth were removed from the maxillary sockets and internal bony trabeculae; this way, 40 teeth were adapted, these being first and second right and left maxillary molars.

To minimize the radiolucent areas, saline solution and lyophilized organic bone matrix of lyophilized bone OSSEOBOND, of medium granulation, were prepared and inserted in the area in which the bone trabeculae between the roots were removed, for better adaptation of molars.

The teeth were submitted to coronal opening, which allowed exploration of the mesiobuccal duct of the referred teeth.

To standardize the measurement of the root canal, the mesiobuccal cusp was leveled and afterwards a small metallic device was bonded to allow a stable reference point for odontometry of the mesiobuccal canal.

Then, endodontic files were introduced in the canal until outreaching the foramen, and drawn back until there was coincidence of the end of the instrument with the foramen. Data were recorded to determine the real length of the mesiobuccal canal of each tooth, besides the respective file and its number.

The teeth were submitted to two radiographic methods: conventional and digital, following a table that was prepared distributing the forty molars into five groups with eight teeth each. Group 1: real length of the tooth – control group – the instrument was placed so as its end was at the limit of the foramen. Group 2: real length of the tooth at 0.5mm short of the foramen. Group 3: real length of the tooth at 1.0mm short of the foramen. Group 4: real length of the tooth at 1.5mm short of the foramen. Group 5: real length of the tooth at 0.5mm beyond the foramen.

The radiographs were taken with Maillefer K-files #06, #08, #10 and #15.

Conventional radiographs were taken with the Insight (Kodak F-speed) film, which presents better results than the others, as revealed by Farman, et al.[7] and Price[16], at 70kV and 7mA for 0.3s, and developed in an automatic developer.

The digital radiography was performed with the direct system of digital radiography TROPHY, model RVG-UI, with twenty line pairs, including an electronic sensor with active area of 30.0 x 20.0mm and width of 6.0mm, wrapped by a plastic cover with external size of 40.0 x 24.0mm and Software - Trophy Windows version 4.2K (2000) - Trophy Radiologie (Vincennes – France) - RVG (Trophy) system, at 70kV and 7mA for 0.15s, using the same film holders with a slight adaptation from those used in the conventional system.

Five endodontists unaware of the real length of the files and canals observed each image. These professionals verified the position of the file as beyond, at the limit, or beneath the radiographic apex, on the conventional radiographies, with a 10x magnifying glass and a light box in a dark environment with a black Bristol board mask.

The test was repeated with the images obtained with the

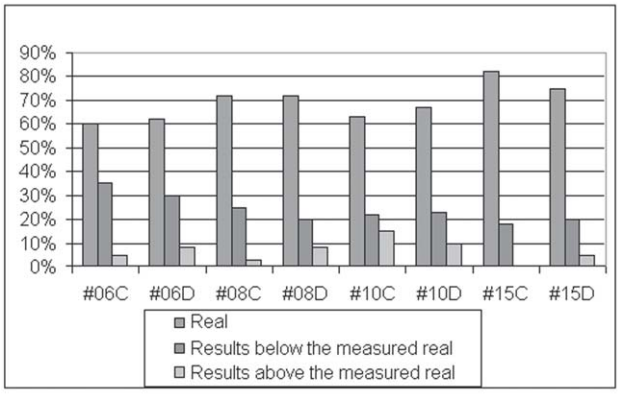

FIGURE 1- Values of the method obtained from conventional (C) and digital (D) radiographs and files #06, #08, #10 and #15

digital radiography system, that is, reading on a monitor with aid of a computer program supplied with the digital machine, which offers resources as: zoom, high definition filter, negative, negative with zoom, relief and relief with zoom, with the aim of improving visualization of the files.

The resources for evaluation of the digital images were available according to the preference of the professionals, who could choose the images that allowed them the best visualization. The radiographic images were always observed from the largest to the smallest file. The data achieved were recorded in tables especially designed for this purpose and submitted to statistical analysis by the Student t test.

RESULTS

The data obtained from the answers of the five professionals corresponded to a total of 320; in order to facilitate handling of the data, a mean was calculated for each file and for each radiographic system.

Satisfactory results could be obtained, with approximately 60% correct for #06 K-files in the conventional system and 62% in the digital system; the difference was related to only one tooth. Most errors happened for measurements short of the real foramen.

With #08 K-files, the results were similar for both radiographic systems, with better outcomes , i.e. 72% matching the table.

As to the #10 K-files, the conventional radiographic system was slightly better than the digital, matching the table in 67% and 63% of cases, respectively. Only four teeth showed visual positions beyond the real.

The #15 K-files showed the best visualization, with correct indexes of 82% for the conventional system and 75% for the digital system. Only for the #15 K-files in the conventional system were all results coincident or beneath the length established by the files. There were no data beyond the real position.

The results were submitted to the Student t test, which revealed that the differences were not statistically significant at the 5% level.

DISCUSSION

The need to verify the level of efficiency of the digital and conventional radiographic systems, combined to the objective to avoid submitting the patients to unnecessary radiation doses, led to accomplishment of the present study in vitro. Such option is supported by literature, which has a great number of works on the issue, also in vitro, such as those of Cederberg, et al.[5]; Sarmento, et al.[18]; Piepenbring, et al.[15]; Melius, et al.[13].

Authors as Langland, et al.[11] and Aun, et al.[2] have cautioned on the occurrence of superposition of images; thus, the parallelism technique was adopted in the present study, as Vande Voorde, et al.[21], with utilization of film holders. This procedure was used to avoid the possibility of distortions on the radiographic image, which was in fact verified, since the results were satisfactory even though the region selected allows several distortions.

As observed by Goldman, et al.[8,9], the memory is not capable of assimilating the radiographic image, and the same radiograph may cause different responses from a same professional when observed at different moments; this was also confirmed in this investigation.

Therefore, several factors should be considered, such as the fact that professionals are not used to the digital system, finding it difficult to observe, and also spending more time when compared to the conventional system, which is widely used.

The small files required greater attention, and their observation led the professionals to use more resources than those used for the large files, even though Shearer, et al.[19] have verified that the increase in contrast does not significantly alter the results, besides causing loss of image structure and reduced resolution, as also observed in the present study.

The results obtained on the digital system with #06 K-files were slightly superior than those on the conventional system as was observed by Wenzel[23], who points out that the digital image allows alterations, thereby improving the definition of the structure's limits, different from the conventional system, which is immutable after being developed – although the Student t test did not reveal a significant statistical difference between them at 5%. Such findings differ from the observations of Vale,[20] who reports that the conventional system is more efficient than the digital system for visualization of #06 and #08 K-files. Some considerations should be presented on this aspect: the thickness of the end of #06 K-files is 0.6mm, which is already difficult to visualize; such situation is aggravated when this file is inserted in a small canal inside a tooth that has various dense bony structures, also of difficult visualization. Therefore, and considering that the visual acuity of human eye has limitations, it would be interesting for the system to have resources – either electrical, sonorous, or others – to define the real position of the file at the apical region of mesiobuccal canals of maxillary molars.

With larger files, #10 and #15, the results were superior to the conventional system – as reported by Shearer, et al.[19]; Sanderink, et al.[17], yet with no statistical significance. These data have corroborated the findings of Matheus, et al.[12], whose results with #06 K-files were inferior than those for #10 K-files.

In both digital and conventional systems, the mean of the results was decreased from the largest #15 file to the smallest #06 file, that is, the matching in relation to the real length was decreased, in agreement with the findings of Shearer, et al.[19] and Sanderink, et al.[17].

Different from this investigation, Versteeg, et al.[22] obtained better results with #15 file with the digital system compared to the conventional system; this was also observed by Melius, et al.[13], mainly with the negative resource, due to the use of an old digital source.

The total number of errors in the evaluations occurred primarily for positions short of the length of the instruments, which agrees with the results obtained by Eikenberg, et al.[6], who observed that the real measurements were superior to the radiographic measurements. Therefore, if the endodontic treatment was performed on the basis of these values, there would be no damage to the periapical region. This is demonstrated by the results of professionals who attempt to avoid the painful and traumatic process of overinstrumentation as much as possible. However, these measurements with possibilities of difference of up to 2mm would lead, in case of necrotic pulp, to underinstrumentation, i.e. not enough instrumentation, which would impair the success of the treatment. Thus, in case of doubts, the measurements should be confirmed by utilization of the conventional radiographic system, as reported by Araújo Filho, et al.[1]

Considering the reduction in time of exposure to radiation, fast achievement of the image on the computer screen and easy filing of the material, the digital system has shown to be capable of substituting the conventional system, although it has a higher cost and presents similar results to the former. In all cases, to minimize possible errors in the dental clinic, both digital and conventional radiographic systems should be used in combination.

CONCLUSION

Analysis of the results allowed that the following conclusions:

1. With the two systems, it was possible to visualize #06 K-files in nearly 60% of the cases evaluated.

2. For the other files, #08, #10 and #15, visualization was very good in both radiographic systems, achieving 82% of correct visualization for #15 K-files on the conventional system.

3. The differences between the results of the two systems studied – conventional radiography (Insight film) and last generation digital radiography (RVG-Trophy) – were not statistically significant according to the Student t test.

REFERENCES

1- Araújo WRF, Clasen NF, Silva CS, Aun CE. Radiografia digital direta x radiografia convencional na obtenção da odontometria: uma comparação "in vivo". Rev Bras Odontol 1999;56:323-6.

2- Aun CE, Bernabé PFE. Adaptação da técnica do paralelismo para tomadas radiográficas durante o tratamento endodôntico. Rev Ass Paul Cirurg Dent 1978;32:118-27.

3- Bóscolo FN, Oliveira AEF, Almeida SM, Haiter CFS, Haiter Neto F. Estudo clínico comparativo da qualidade de imagem de três sistemas radiográficos digitais, filme E-Speed e filme digitalizado. Pesq Odont Bras 2001;15:327-33.

4- Brasil. Ministério da Saúde. Secretaria de Vigilância Sanitária. Portaria n 453 de 1 de junho de 1998. Proteção radiológica.

5- Cederberg RA, Tidwell E, Frederiksen NL, Benson B. Endodontic working length assessment. Oral Surg Oral Med oral Pathol 1998;85:325-8.

6- Eikenberg S, Vandre R. Comparison of digital dental x-ray systems with self-developing film and manual processing for endodontic file length determination. J Endod 2000;26:65-7.

7- Farman T, Farman AG. Evaluation of a new F-speed dental x-ray film. The effect of processing solutions and a comparison with D and E speed films. Dent Radiol 2000;29:41-5.

8- Goldman M, Pearson AH, Darzenta N. Endodontic success – who's reading the radiograph? Oral Surg Oral Med Oral Pathol 1972;33:432-7.

9- Goldman M, Pearson AH, Darzenta N. Reability of radiographic interpretations. Oral Surg Oral Med Oral Pathol 1974;38:287-93.

10- Khademi JA. Digital images & sound. J Dent Educ 1996;60:41-6.

11- Langland OE, Sippy FH. A study of radiographic longitudinal distortion of anterior teeth using the paralleling technique. Oral Surg Oral Med Oral Pathol 1966;22:737-49.

12- Matheus RA, Oliveira AEF, Almeida SM, Haiter C, Bóscolo FN. Estudo comparativo de diferentes sistemas e recursos radiográficos digitais em mensurações endodônticas. Rev Paul Odont 2000;6:34-7.

13- Melius B, Jiang J, Zhu Q. Measurement of the distance between the minor forâmen and the anatomic apex by digital and conventional radiography. J Endod 2002;28:125-6.

14- Paiva JG, Antoniazzi JH. Endodontia, bases para a prática clínica. 2nd ed. São Paulo: Artes Médicas; 1988.

15- Piepenbring ME, Potter BJ, Weller RN, Loushine RJ. Measurement of endodontic file lengths: a density profile plot analysis. J Endod 2000;26:15-8.

16- Price C. Sensitometric evaluation of a new F-speed dental radiographic film. Dent Rad 2001;30:29-34.

17- Sanderink GCH, Huiskens R, Stelt PFVD, Welander US, Stheeman SE. Image quality of direct digital intraoral x-ray sensors in assessing root canal length. Oral Surg Oral Med Oral Pathol 1994;78:125-32.

18- Sarmento VA, Pretto SM, Costa NP. Entendendo a imagem digitalizada. Rev Odontol Ciênc 1999; 27:171-8.

19- Shearer AC, Horner K, Wilson NHF. Radiovisiography for length estimation in root canal treatment: an in-vitro comparison with conventional radiography. Int End J 1991;24:233-9.

20- Vale I. Visibilidade de algumas limas endodônticas por meio do sistema de imagem digital Digora e de três filmes radiográficos periapicais. Rev Fac Odontol Bauru 2002;10:29-33.

21- Vande Voorde HE, Björndahe AM. Estimating endodontic working length with paralleling radiographs. Oral Sur Med Oral Med Pathol 1969;27:106-10.

22- Versteeg KH, Sanderink GCH, Ginkel FCV, Stelt PFV. Estimating distances on direct digital images and conventional radiographs. JADA 1997; 128:439-43.

23- Wenzel A. Computer-aided image manipulation of intraoral radiographs to enhance diagnosis in dental practice: a review. Int Dental J 1993;43:99-100.