

RADIOVISIOGRAPHY VERSUS CONVENTIONAL RADIOGRAPHY FOR ESTIMATION OF CANAL LENGTH: AN IN VITRO STUDY

*DINA AL-SUDANI, BDS, MSED

ABSTRACT

The aim of this study was to compare the accuracy of the Radiovisiography (RVG) with conventional Radiographic in canal length estimation in vitro for root canal treatment. Forty-single-rooted teeth were endodontically assessed and working lengths were determined using both conventional intra-oral dental film and Radiovisiography (RVG) 1R1X 70 intra-oral x-ray system. Measurement assessment was done by two observers. The actual pre-measured lengths of the files and roots were unknown to the observers. Result showed that both conventional radiography and RVG showed a significant greater length than the true length. These differences are statistically significant ($P < 0.05$) but of limited clinical significance. In conclusion RVG is of equal value to conventional radiography in root canal length determination. It was concluded that RVG has the advantage of low radiation dose and rapid image production and recommended to be used during endodontic therapy.

INTRODUCTION

An accurate and reproducible working length is of fundamental importance in determining the success of endodontic therapy.⁽¹⁾ It establishes the apical limit of canal preparation and permits the creation of an apical stop. It also enables thorough debridement of the canal without over-instrumentation as well as trauma to the periapical tissue or destruction of the anatomy of the root apex. The success rate of conventional root canal treatment has been correlated with the length of the final root canal filling.⁽²⁾

Most authors have agreed that ideal apical limit for canal preparation for fully formed permanent teeth lies at the narrowest point of the canal.⁽³⁻⁵⁾ A number of methods to determine working length have been described.⁽⁶⁻⁹⁾ Traditionally the use of a diagnostic file and a conventional radiography has been the basis for the most frequently used method for establishing estimated working length. The major disadvantages of conventional radiography in root canal treatment are the high radiation dose to the patient,⁽¹⁰⁾ film processing interrupts treatment which results in delays and potential for error in image,⁽¹⁰⁻¹¹⁾ and production of a two-dimensional image.⁽¹²⁾

In recent years, new imaging techniques have been developed with aim of improving the clarity of the image whilst reducing radiation dose. These techniques which offer alternative systems for detecting and recording the attenuated x-ray patterns, include the image intensifier, Xeroradiograph and

Radiovisiography (RVG).⁽¹²⁾ Advantage of this digital technique include immediate image display, the ability to improve the clarity of the image whilst reducing the radiation dose and accurate working length estimation even in roots demonstrating severe apical curvature.^(10,13,15)

The purpose of this study was to compare between the accuracy of radiovisiography (RVG) and conventional radiography in determination of the working length in root canal therapy.

MATERIALS AND METHODS

Forty extracted single root teeth with fully formed apices were used in this study. Access cavities were cut in each tooth and sizes 15 K-files with rubber stopper were inserted into the root canals until the apical constriction was identified, or alternatively as far as the file would enter the canal without jamming. The rubber stopper was set at the occlusal reference point, and the file was removed.

True canal length (CL_T) was determined for each tooth using millimeter rulers. Measurements were recorded. The file was then sealed into position by glass ionomer restoration material. Prior to imaging, each tooth was mounted in wooden-plaster block with wax around the apices. Each mounted tooth was imaged by conventional radiographs using D-speed film (Eastman Rodo X company Rocheste, NY). The x-ray set used was 70 kv 8 mA unit (Siemens), and Radiovisiography (RVG) using trophy 1R1X 70 version 4.x. The generator was operated at 70 kv 8 mA in

* Assistant Professor, Department of Restorative Dental Sciences, Division of Endodontics, King Saud University, College of Dentistry, P O Box 5967, Riyadh 11432, [E-Mail: drdina_2000@yahoo.com](mailto:drdina_2000@yahoo.com)

combination with the CCX timer. Using constant relation of x-ray generator to object and constant film to source distance range of exposures was made and developed for both conventional and RVG. The estimated canal length was then measured as the distance from the occlusal reference point to the most apical extent of the file visualized.

Measurement was done by two observers. The actual pre-measured lengths were unknown to the observers. They measured the file length from the RVG image on the screen (CL_{RVG}) using measurement tools and calibration. Examiners were able to adjust the contrast of RVG to achieve best possible image. The other measurement was recorded from radiography film directly using millimeter ruler on a viewer (CL_{CF}). Measurement from examiners were averaged and compared with true canal length (CL_T). A matched-pair t-test was used to statistically evaluate the result.

RESULT

The average measurement for each specimen compared with the true canal length is found in Table I. There was a significant difference between the three group ($p < 0.05$).

Both conventional radiography and RVG showed difference from the actual canal length (Graph I)

The entire three groups showed a very high correlation (Table II).

The difference of CL_{CF} , and CL_{RVG} for CL_T are 0.38 mm and -.60 mm respectively. Further more the difference between CL_{CF} , and CL_{RVG} is 0.22 mm (Table III).

DISCUSSION

Clinical endodontics depends heavily on the radiographs for diagnosis and treatment. The study by Shearer et al.⁽¹⁾ suggested that radiovisiography has a particular value in root canal treatment. The rapid image production and low radiation dose are beneficial in root canal therapy. The radiation reduction as result of using solid - radiation detector which is more sensitive than the conventional silver halide film and the use of rare-earth-x-ray filters which reduces radiation dose to patients without significant loss of image quality.

Major disadvantage of the system can be found in its decrease image resolution and contrast as compared with radiographic film. But the radiographic information can be increased with image treatment capabilities of the system.

One of the uses of the digital system is possibility of quantifying the distance between two points on a given image. The RVG is the on screen measurement utility which allows for rapid additive multiple point

measurement points on screen to a tenth of a millimeter. This is one of the great advantages of the use of this system in endodontics.

This in vitro investigation was undertaken to compare conventional radiography to RVG for the imaging of the root canal. The result of both conventional radiograph and RVG, showed a significant greater length than the true length. However, it should be noted that the mean difference was only 0.3 mm and 0.6 mm respectively. Further more the difference between the conventional radiography and RVG is 0.02 mm. Even though these difference are

TABLE I. AVERAGE MEASUREMENT FOR EACH SPECIMEN

	CL_T -av	CL_{CF} -av	RVG-av
1	21	21	21.2
2	19	19	18.95
3	21	21	21.25
4	20.5	21	21.25
5	19	19	19.3
6	22.5	23	23.3
7	20	21	21.35
8	20	21	21.15
9	24.5	24.25	25.35
10	20.5	21.5	21.55
11	20	25.20	20.2
12	24.5	24	25.3
13	21	22	22
14	21	21	21.35
15	18.5	19	19.3
16	23.5	24	24.3
17	19	19.75	19.5
18	19.5	20	20.7
19	20	21	21
20	20.5	21	20.35
21	19.5	20	20.25
22	23.5	24	24.1
23	20	21.25	21.15
24	23.5	24	24.45
25	17	17.25	17.45
26	15	16.75	16.8
27	19.5	19	18.9
28	22	22	22.55
29	21.5	21.75	21.9
30	21.5	20.75	21.45
31	17	17.5	17.5
32	16	17	17.1
33	21	21.5	21.25
34	25	25	25.4
35	21	21	21.45
36	22.5	22.75	23.6
37	18.5	19	19
38	14.5	15	15
39	21.5	21.5	21.45
40	19	19	19.15

Graph 1 True Canal Length Compared with Conventional Radiograph and RVG

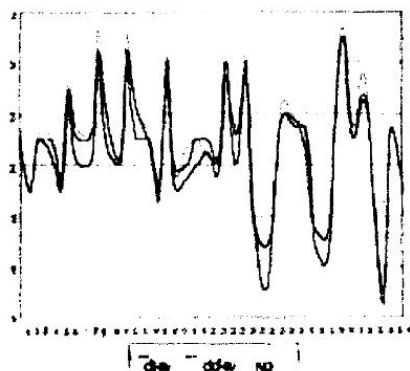


TABLE II. MEASUREMENTS CORRELATION BETWEEN THE GROUPS

GROUP			CORRELATION
CL _T	α	CL _{CF}	98
CL _T	α	CL _{RG}	98
CL _{CF}	α	CL _{RG}	99

TABLE III. TRUE CANAL LENGTH MEANS (MM) SD COMPARED TO CONVENTIONAL RADIOGRAPH AND RVG

GROUP	N	Mean ± SD	SE
CL _T	40	20.36 ± 2.40	0.38
CL _{CF}	40	20.74 ± 2.24	0.35
CL _{RG}	40	20.96 ± 2.41	0.38

statistically significant ($p < 0.05$) due to the small standard of deviation, but of limited clinical significance. These differences were considered within the normal limit of measurement errors. This result supported and agreed with the study of Shearer et al. 1991) which showed statistical significance difference between conventional radiography and RVG ($p < 0.05$). Furthermore, they noted that the difference was 2% of the file length (about 0.4 mm for a typical root length of 20 mm). These differences were considered of a limited clinical significance and within the limited measurement error and x-ray distortion.

The result of this study indicated that both techniques are of equal value. This was similar to in vitro study reported by Shearer et al.⁽¹⁾ who found no significant difference in working length made in digital radiography and conventional radiograph.

Our finding are parallel to those stated by other authors.^(1,11,17) That digital radiography is of equal value to conventional radiograph for imaging root canal system. However, the radiovisiography has the advantage of being rapid, low dose imaging technique, besides the image can be stored. Clinically, the difference in subject contrast among patients and the variation in quality and quantity of trabecular bone

will affect image quality. Consequently, these are limitation in an in vitro study of the type carried out and, therefore clinical evaluations of RVG are indicated to confirm in vitro finding.

CONCLUSION

This in vitro study suggests the radiovisiography is in a high correlation with conventional radiograph in root length determination. This finding together with the lower radiation dose and rapid image production revealed that radiovisiograph is of particular value in root canal treatment and recommended to be used during endodontic therapy.

ACKNOWLEDGEMENT

The author would like to express her gratitude to her students, Hind Al-Ibrahim & Hind Abu-Hulaibah for their participation in the practical part of the study.

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