Abstract

Introduction: Research about root curvature is very important since it can affect procedural accidents during root canal treatment and its prognosis. So the present study aimed to evaluate the error rate between manual and digital methods in root canal curvature measurement.

Materials and methods: The printed and LCD periapical radiographs of 260 patients who need root canal treatment for their maxillary first molar and referred to a private endodontic clinic in Babol from January 2011 to February 2012, were studied. The radiographs were taken using periapical parallel technique. A maxillofacial radiologist and an endodontist measured the degree of root canal curvature separately. In the manual method, the curvature angle of mesiobuccal root of maxillary first molar was measured by Schneider technique using a conveyor. In the digital method, the measurement was conducted by Scanora 4.3.1 software (Soredex, Finland) on LCD monitor. Then data were analyzed by SPSS17 statistical software, paired t-test and Pearson correlation coefficient.

Results: The agreement between observers was assessed using Pearson Correlation Test. There were no significant differences between observers. (P> 0.05) The curvature angle of mesiobuccal root of maxillary first molar in digital method was 17/11 ± 7/79 and in manual method was 12/68 ± 7/73 and a statistically significant difference was found between them. (P<0.001) Error rate in the digital method was 0.08 ± 0.79 and 0.37 ± 0.16 in the manual method with no significant difference. (P>0.05)

Conclusions: In the present study, there was no significant difference in the error rate between digital and manual methods.

Key words: Root canal curvature, digital measurement, manual measurement.

Introduction

Morphologic and anatomic evaluation of the teeth has been a subject of great attention by many researchers over the last few years. Study on root curvature is very precise because it can affect procedural accidents during root canal treatment, determination of working length, instrumentation difficulties, and penetration depth.

There are various methods for this evaluation, among which tooth preparation, dye injection and clearing, taking radiographs of the extracted teeth, and taking radiographs during treatment can be enumerated. In the measurement of root canal curvature, Schneider, Wein, and longitudinal axis techniques are worth to be pointed out. In the measurement of root canal curvature, Schneider, Wein, and longitudinal axis techniques are worth to be pointed out. With new progressing and use of digital system in the measurement of root canal curvature, there is always one question about the rate of error of this measurement technique. Till now there is no study about the agreement between digital and manual methods or the rate of error between them.

So, the aim of this study was to determine the error rate between manual and digital methods in root canal curvature measurement.

Materials and methods

From a total of 486 patients who need maxillary first molar root canal treatment and referred to a private endodontic clinic in Babol from January 2011 to February 2012, 260 patients were included in the study. Inclusion criteria consisted
of the maxillary first molar teeth that required root canal treatment with complete apical foramen and contour. Teeth with extensive caries or large restorations or patients with gag reflex or having anatomic limitations for taking radiographs with paralleling techniques were excluded from the study.

Firstly, each patient was given information about the study, and a consent form was completed afterward. Then, the radiographs were taken using the periapical parallel technique with XCP film holder (Dentsply, United Kingdom) and PSP receptor (Digora Optime, Soredex, Finland) with pixel size of 40μ and spatial resolution of 12.5 LP/mm. Digital images were saved in JPEG format and size of 24.3 KB. This investigation was performed in two steps; at first, mesiobuccal canal curvature was measured on the printed film (manual method); then, after 2 weeks the measurement was carried out on the LCD monitor (digital method). In the end, for evaluating the error rate intra observers, 10% of radiographs were measured again one month later (In both methods).

**Radiographic evaluation**

Each of the printed and LCD images were assigned a specific code. A maxillofacial radiologist and an endodontist measured the degree of root canal curvature separately.

In the manual method, root curvature angle was measured by Schneider technique on the printed images using a conveyor (Rotting, Germany) in a semi dark room on the view box. In the digital method, measurement was conducted by Scanora 4.3.1 software (Soredex, Finland) on a 19 inch LG monitor (Flatron W2053 S) with high resolution in quiet dark room.

Then, the data were analyzed by SPSS statistical software, paired t-test and Pearson correlation coefficient.

**Results**

This cross-sectional study was conducted on 260 patients (45% male and 55% female) with the mean age of 32.52 ± 11.60 years. The inter- and intra-observer relationship was assessed by the Pearson correlation test and no significant difference was found (P> 0.05) (Table 1).

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<th>Intra observer</th>
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<tr>
<td>Digital</td>
<td>0.999</td>
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<td>Manual</td>
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Then the mean measurements by two observers were evaluated. The degree of mesiobuccal maxillary first molar root curvature angle was 17.11 ± 7.79 and 12.68 ± 7.73 in digital and manual methods respectively, between which a statistically significant difference was found (P <0.001)

The error rate was 0.08 ± 0.79 in digital method and 0.16 ± 0.37 in manual method, and no significant difference was observed.

**Discussion**

In the present study, the error rate between manual and digital methods in root canal curvature were investigated and we found no significant difference between them.

Ilguy et al. stated in caries detection the quality of images on both computer and medical LCD monitors was comparable with D-speed film images. Tofangchiha et al. also concluded there was no different significant between monitor and film (E-speed) in detection of vertical root fracture. They also suggested that the type of monitor (conventional or medical) had not influence on diagnosis of vertical root fracture but, medical monitor was more sensitive and specific than conventional monitors.

There are many studies related to comparing printed film and monitor display in dentistry. All of them emphasized on methods facilitation and advantages of the technologies. Several studies proposed the use of periapical radiography for the detection of canal curvature. The method used in this study was based on the Schneider technique on periapical radiograph and its measurement was carried out on the monitor screen and manually on the printed film.

Huang et al. also used on-screen measurement for determining measurement accuracy in mandibular incisor. They found that curved canal length should be estimated with 3-click measurement for increasing precision, but he didn’t compare the root canal curvature on-screen and on printed film images. Our results showed there was a statistically
significant difference between digital and manual methods (p<0.001). In this study for approaching to clinical situation, we performed it invivo but this situation impose special problems such as absence of gold standard and sometimes patient poor cooperation for taking parallel radiographs.

In relation to error rate, there was no significant difference between the digital and the manual methods, but its amount was lower for the digital method. Maybe less involvement of clinician in reading the amount of angle causes this lowering; however, this difference was not significant.

This finding is in accordance with Schulze et al.’s study\textsuperscript{17}. They mentioned there were no significant differences between printed images and monitor viewing for caries detection. Tofangchiha\textsuperscript{13} also didn’t find differences between printed images and monitor viewing in vertical root fracture detection.

Until now we didn’t find any article similar to our study about root canal curvature. As radiograph presents a two-dimensional image of a three-dimensional object \textsuperscript{18}, it can cause doubt in identifying the actual direction and degree of root canal curvature\textsuperscript{19}. So, we suggest to conduct this study with advanced technique such as CBCT and in vitro with more samples.

Conclusions

In the present study, there was no significant difference in error rate between the digital and the manual methods in root canal curvature measurement.

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References


15. Kühl S, Krummenauer F, Dogassan-Berndt D, Lambrecht TJ, d Hoedt B, Schulze RK. Ink-jet printout


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