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*The evaluation of root canal width by means
of digital radiography*

Ocena szerokości kanałów korzeniowych przy pomocy radiografii cyfrowej

Endodontic treatment is a considerable challenge for dentists. The key factor for successful endodontic therapy is precise determination of the working root canal length, shape and width prior to its enlargement and obturation. There are numerous methods of assessment of root canal length such as tactile method as well as radiographic measurements on conventional radiographs viewed with magnification, xeroradiograms, digital radiographic systems' measuring tools and electronic canal length measuring devices (3, 4, 6). However, the literature concerning measurements of root canal width is scarce.

The aim of the study was to elaborate standard methods of evaluation of root canal width by means of digital radiography before the beginning of endodontic treatment.

MATERIAL AND METHODS

There was used the digital radiography system Digora–Soredex together with Planmeca Intra intraoral X-ray machine. The measurements of root canals were first performed on 12 teeth having single root and 18 teeth having two roots before their extraction due to orthodontic reasons in 28 patients age 14 to 15 years. After the extractions the root canal widths were determined twice: before and after filling of the canal with endomethasone (Fig. 1, 2). The canals were enlarged manually with traditional and flexible hand instruments. In order to obtain standard radiograms the teeth were mounted in wax blocks together with markers of different but known widths. Then buccolingual (Fig. 1, 2) and mesiodistal (Fig. 3, 4) digital radiograms were taken in order to obtain images in different projections. The width of root canals was evaluated by means of Digora–Soredex digital radiography software allowing for line measurements. The width of the original and filled canals was measured at three points: at the levels of 5, 10 and 15mm coronal to the apical foramen. The percentage of distor-

tion of the width of markers was compared with that of root canals. In this way the real width of root canal was calculated.

RESULTS

The difference between linear measurements on digital radiogram and the real root canal width did not exceed 8%. The use of the option of image magnification and linear measurements of individual sections of a root allows for the accuracy of results up to 0.1 mm (Fig. 1–4).

DISCUSSION

Tactile determination of dimensions of a root canal is highly inaccurate [6]. The electronic method can measure the length of the root canal to the end of the apical foramen, not to the radiographic apex, but it is very operator-dependent. Also when strong electrolytes are present in the root canal, the reading is too high thus making the obtained working length too short (4). The measurements of root canal widths on the basis of conventional radiograms is difficult and possible only after introduction of an instrument of a known width into the canal.

The main advantage of digital radiography systems is the real-time image while the conventional film requires proper and time-consuming processing (8). At the same time the dentist taking the X-ray can assess the quality of the image and re-take it, when necessary (8). Digital radiography facilitates measurements and thus shortens the time of endodontic treatment (7). Cederberg et al. (1) found the Digora system measuring tools to be very accurate in assessment of trial file length. They are thought beneficial to the practitioner. In the studies of Leddy et al. (5) no significant differences between RadioVisioGraphy and conventional radiograms were found, but RVG is preferred when both methods are available as the reduction of the radiation dose in digital radiography is considerable (5). On average the dose reduction in comparison with an E-speed film is over 60% (8). Moreover, all the digital radiography systems offer the image enhancement option eliminating the need of more exposures. The edges can be enhanced and the contrast can be improved which leads to higher accuracy of linear measurements.

CONCLUSIONS

Intraoral digital radiograms supply new possibilities of evaluation of root canal width. The results are reliable and can be used in clinical practice.

REFERENCES

1. Cederberg R.A., Tidwell E., Frederiksen N.L., Benson B. W.: Endodontic working length assessment. Comparison of storage phosphor digital imaging and radiographic film. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.*, 85, 325, 1998.

2. De Moor R.J., Hommez G.M., Martens L.C., De Boever J.G.: Accuracy of four electronic apex locators: an *in vitro* evaluation. Endod. Dent. Traumatol., 15, 77, 1999.
3. Griffiths B.M., Brown J.E., Hyatt A.T., Linney A.D.: Comparison of three imaging techniques for assessing endodontic working length. Int. Endod. J., 25, 279, 1992.
4. Kobayashi C.: Electronic canal length measurement. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 79, 226, 1995.
5. Leddy B.J., Miles D.S., Newton C.W., Brown C.E. Jr.: Interpretation of endodontic file lengths using RadioVisioGraphy. J. Endod., 20, 542, 1994.
6. Ounsi H.F., Haddad G.: *In vitro* evaluation of the reliability of the Endex electronic apex locator. J. Endod., 24, 120, 1998.
7. Różyło T.K., Walawska B., Różyło I., Czelej-Górski J.: Zastosowanie radiografii cyfrowej do oceny szerokości kanałów korzeniowych. Przegl. Stomat. Wieku Rozwoj., 20, 22, 1997.
8. Sanderink G., Huiskens R., van der Stelt P.F., Welander U.S., Stheeman S.E.: Image quality of direct digital intraoral X-ray sensors in assessing root canal length. The RadioVisioGraphy, Visualix/VIXA, Sens-a-Ray and Flash Dent systems compared with Ektaspeed films. Oral Surg. Oral Med. Oral Pathol., 78, 125, 1994.

Otrz.: 1999.11.30

STRESZCZENIE

Celem pracy było opracowanie standardowej metody oceny szerokości kanałów korzeniowych przy pomocy radiografii cyfrowej Digora-Soredex przed rozpoczęciem leczenia endodontycznego. Mierzono najpierw szerokość kanałów 12 zębów jednokorzeniowych i 18 zębów dwukorzeniowych przed ich usunięciem z powodów ortodontycznych u 28 pacjentów w wieku 14–15 lat. Po ekstrakcji dwukrotnie określano szerokość kanałów korzeniowych: przed i po wypełnieniu endometazonem. W tym celu zęby zostały zatopione w blokach woskowych wraz ze znacznikami o znanej szerokości. Następnie wykonano zdjęcia wszystkich zębów w dwóch projekcjach: przednio-tylnej i bocznej. Szerokość kanałów korzeniowych określano za pomocą narzędzi do mierzenia odległości w oprogramowaniu systemu radiografii cyfrowej. Procentowe zniekształcenie szerokości znaczników porównywano ze zmierzoną szerokością kanałów korzeniowych i na tej podstawie obliczano rzeczywistą ich szerokość. Różnice pomiędzy pomiarami liniowymi na radiogramie cyfrowym nie przekraczały 8%. Użycie opcji powiększenia obrazu oraz liniowych pomiarów wzdłuż określonego fragmentu korzenia pozwoliło na uzyskanie dokładności 0,1 mm.



Fig. 1. The measurements of root canal width of the second maxillary premolar presented in buccolingual projection



Fig. 2. The measurements of a filled root canal width of the same tooth



Fig. 3. Another second maxillary premolar in the mesiodistal projection with root canal width measured at 5, 10 and 15 mm coronal from the radiological apex

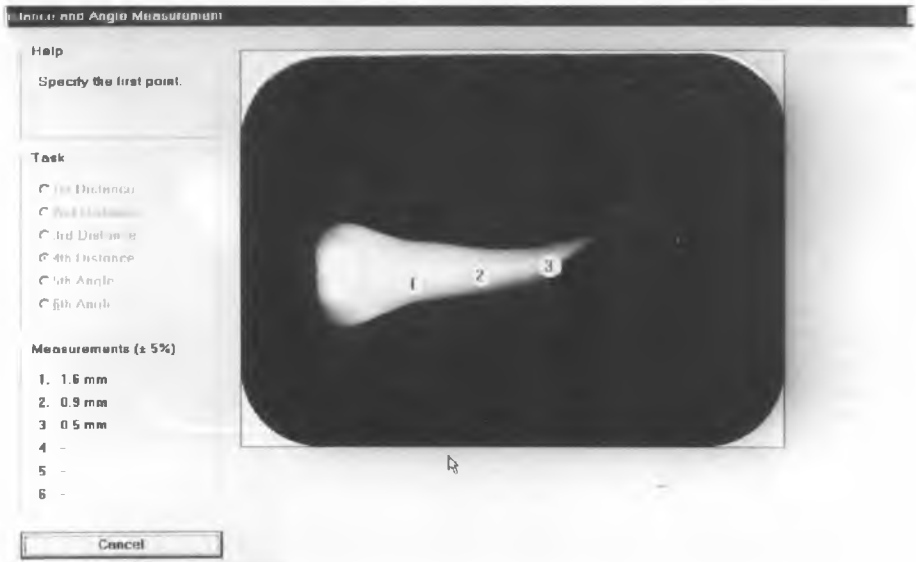


Fig. 4. The measurements carried out in case of filled root canal of the same tooth