ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN — POLONIA
VOL. LVII, N 1, 14 SECTIO D 2002

2nd Department of Medical Radiology, Medical University of Lublin
Private Dental Practice, Düsseldorf
Department of Dental and Maxillofacial Radiology, Medical University of Lublin

INGRID RÓŻYŁO-KALINOWSKA, JOLANTA CZELEJ-GÓRSKI,
T. KATARZYNA RÓŻYŁO

Radiodensitometric measurements in cases of chronic periapical changes of endodontically treated teeth

One of the most frequently encountered dental pathologies are periapical changes. Periapical inflammations are divided into acute and chronic processes. According to literature, acute changes cannot be detected by means of conventional radiography (7). However, it is possible to detect local resorption in radiodensitometric measurements (4). Chronic periapical inflammations are divided into fibrous, granulomatous and purulent. In fibrous changes there dominate productive processes that lead to appearance of deposits of mineralised structures. They can be called protective mechanisms as there develop layers of bone trabeculae around the affected roots. On the other hand, the main symptom in purulent inflammations is the destruction of alveolar bone.

The differences in radioopacity or radiolucency of hard tissues of teeth and alveolar bone can be detected on conventional X-ray images only when the change of mineralisation is large enough to produce hypermineralisation or demineralisation (9, 10). So if these differences are not prominent, it becomes difficult to determine the extent of pathological process on the basis of traditional radiography. However, using digital radiography allows more precise diagnosis of pathological changes of teeth (3, 4, 12). At the same time it offers the benefit of reduction of the dose of harmful ionising radiation that leads to decrease in diagnostic risk (5, 8, 11, 13).

The purpose of the paper is radiodensitometric evaluation of hard tissues of roots and alveolar bone of endodontically treated teeth with clinically detected periapical inflammatory changes.

MATERIAL AND METHOD

The material consisted of 139 digital intraoral radiograms of endodontically treated teeth with clinically found chronic periapical changes: 54 teeth with granulomatous inflammation, 62 with fibrous changes and 23 teeth with purulent lesions.

All the radiograms were taken using the bisected angle technique by means of Prostyle Intra X-ray Unit (Planmeca) and Heliodent MD 8458 747x1744 (Siemens) X-ray generators, suitable for cooperation with digital radiography systems. The Digora Soredex and Dexa-CDR Schick digital radiography systems were used as image detectors. As it was mandatory to evaluate the entire material by means of the same image analysis tools, digital radiograms from the Dexa-CDR system were transferred to the Digora system owing to the compatibility of software. The used software was Digora Version 1.51 Rev. 2.

The applied image enhancement tools were: grey-scale imaging with contrast and brightness adjustment as well as full colour option. The so-called tomosynthesis function allowed precise determination of the extent of periapical lesions (11). The radiodensitometric measurements of affected roots were carried out along a line drawn at the distance of 1 mm from the radiological apex (Fig. 1). Then the density of alveolar

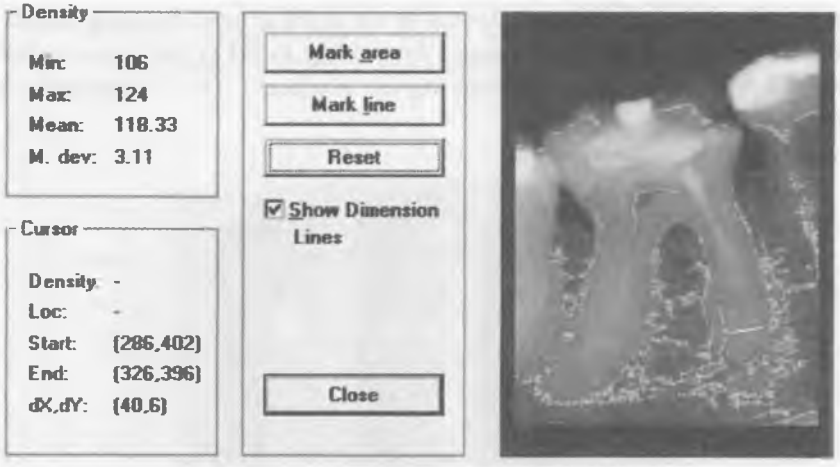

Fig. 1. An example of density measurements of root in case of chronic fibrous periapical inflammation of an endodontically treated tooth

bone was measured along a line marked in 2 mm distance from tooth apex (Fig. 2). In all cases there were registered the minimum, maximum and mean values of densities along the line of measurement. Twenty-five teeth with no evident dental pathologies served as a control group.

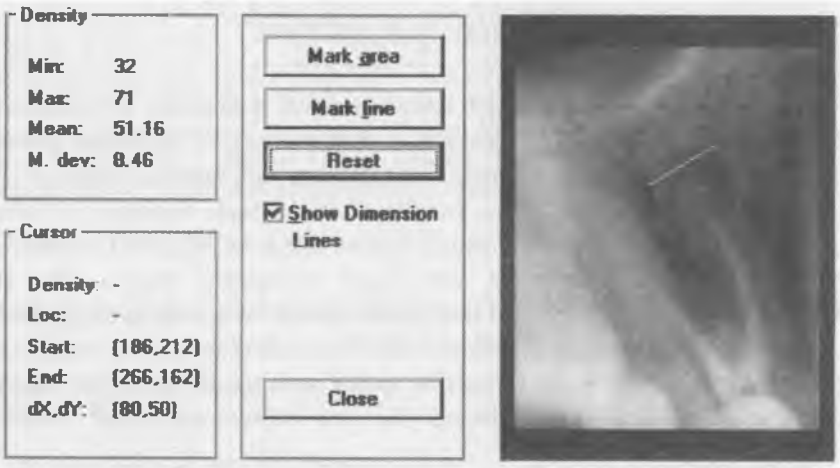

Fig. 2. An example of density measurements of alveolar bone in case of chronic granulomatous inflammation at an apex of an endodontically treated tooth

RESULTS

In the group of chronic fibrous changes at the apices of endodontically treated teeth the measurements of alveolar bone ranged from 109.21 to 124.39 with the mean value of 114.07. The values of root densities were higher: minimum – 119.07, maximum – 132.86 and mean – 125.61 (Fig. 3).

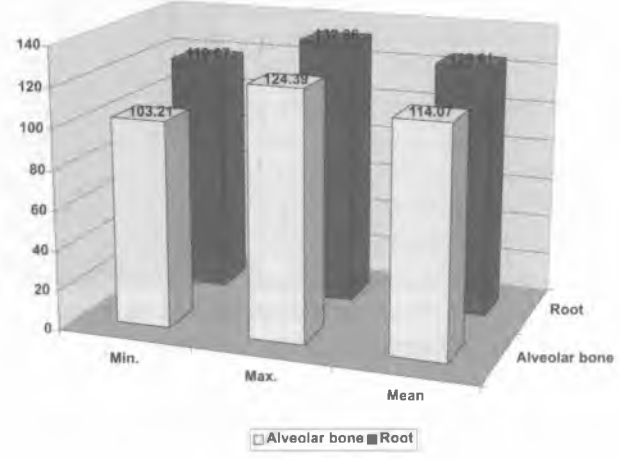

Fig. 3. Averages of minimum, maximum and mean values of density measurements in cases of chronic fibrous periapical changes of endodontically treated teeth

Chronic granulomatous periapical inflammation of endodontically treated teeth was characterized by lower values than in cases of fibrous changes, both in the alveolar bone (minimum – 65.32, maximum – 84.13 and mean – 72.48) and in hard tissues of the affected roots (minimum – 9.2, maximum – 107.83 and mean – 98.35) – Fig. 4.

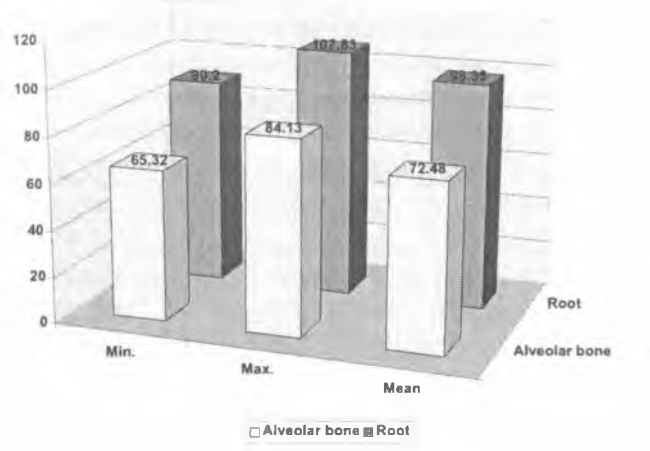

Fig. 4. Averages of minimum, maximum and mean values of density measurements in cases of chronic granulomatous periapical changes of endodontically treated teeth

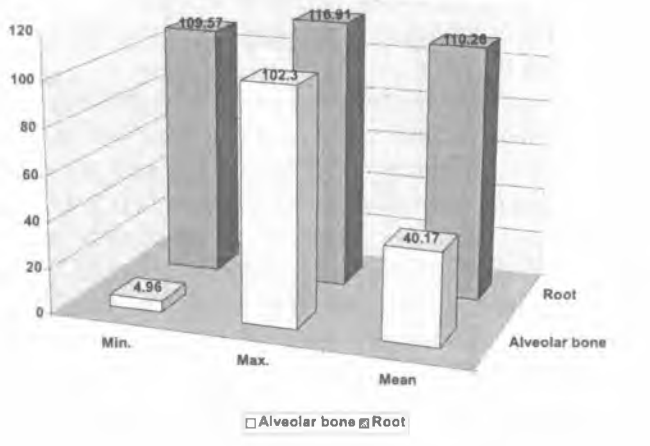

Fig. 5. Averages of minimum, maximum and mean values of density measurements in cases of chronic purulent periapical changes of endodontically treated teeth

As far as chronic purulent lesions of apices of endodontically treated teeth are concerned, the values of radiodensitometric measurements of alveolar bone were even lower than in chronic granulomatous changes – the minimum registered values were as low as 4.96, maximum – 102.3 but the mean value was generally low – 40.17. The measurements of roots showed higher results with minimum values of 109.57, maximum of 116.91 and mean – 110.26 (Fig. 5).

DISCUSSION

There are two methods of treatment of periapical inflammations. One of them is a long-term method using temporary, non-hardening filling materials on the basis of calcium hydroxide. Such materials are introduced into root canals for 3 months and during that period the regression of periapical changes is controlled radiologically. If a radiogram shows that healing processes are slow, the temporary filling is applied for next 3 months. Such procedure leads to significant diminution of inflammatory processes or to complete healing of periapical changes. In such case permanent filling material can be applied (7).

The other method of treatment is based on the necessity of prompt treatment filling of root canals as every change of temporary filling is considered an act leading to secondary infection. After a short-term treatment with antibiotic-steroid preparation, the root canals are finally filled. When the treatment is over, long-term radiological follow-up is carried out (7).

It is evident that in both methods of endodontic treatment of periapical changes, radiological examinations are indispensable. They become crucial in the first method when the detection of advances in healing processes determines the course of treatment and influences the decision on the onset of final permanent filling.

Detection of lesions on a conventional radiogram is feasible only in regions, where the changes in mineralisation of tooth and surrounding bone were large enough to produce a defect (a lucency) or an opacity (11). Digital radiography is a more sensitive tool than conventional radiography and it is wider and wider used (1, 3, 4, 11, 15, 18). Among many advantages of digital radiography there are: the reduction of the dose of ionising radiation necessary for exposure, constant high quality of radiograms as well as the possibility of digital image enhancement and processing (11, 14–17). Radiodensitometric measurements are superior to conventional radiography in detection of early stages of inflammations that produce little demineralisation of hard tissues (2, 3, 4, 6, 12). Such changes in hard structures in cases of chronic periapical inflammation result for the most part from the spreading of odontogenic inflammatory processes to alveolar tissues surrounding an affected tooth (3, 12). The symptoms of chronic periapical inflammations can be analysed by means of digital radiography tools (15, 16). Thun-Szretter et al. (15, 16), used contrast enhancement as well as performed density measurements along a

chosen line and in a given area in patients with clinically confirmed chronic periapical inflammation just before resection of roots. It was concluded that the density measurements were more objective and more reliable than subjective human evaluation. Density measurements can be useful in the diagnostics and assessment of treatment results in cases of chronic periapical changes that is consistent with own results (3, 12).

The radiodensitometric values were the highest in cases of chronic fibrous inflammatory changes at the apices of endodontically treated teeth. It is a result of formation of layers of bone trabeculae around filled roots, which can be considered mechanisms protecting the organism against further spread of inflammatory process. The values obtained for endodontically treated teeth with granulomatous changes were intermediate: lower than in the group of fibrous lesions and higher than in case of purulent inflammations. On the other hand, the difference between the values of measurements of roots and alveolar bone was more significant than in case of fibrous inflammations. However, the most striking discrepancy was found in the group of purulent changes, where the radiodensitometric values of alveolar bone were very low. It is the consequence of destruction of bone tissue in the area of formation of pus.

CONCLUSIONS

It was concluded that radiodensitometric measurements allowed detailed examinations of inflammatory changes at the apices of endodontically treated teeth. Digital radiography is a valuable and objective tool in diagnosis of periapical changes, monitoring of the course of endodontic treatment as well as in follow-up after such treatment. At the same time it allows reduction of ionising radiation dose, thus decreasing diagnostic risks to a patient.

REFERENCES

1. Benz C., Mouyen F.: Evaluation of the new RadioVisioGraphy system image quality. Oral Surg. Oral Med. Oral Pathol., 72, 627, 1991.
2. Chen S. K., Hollender L., Omnell A. A.: Detection of small differences in mass using a direct digital dental X-ray system. Dentomaxillafac Radiol., 26, 63, 1997.
3. Czelej-Górski J., Różyło-Kalinowska I., Różyło T. K.: Ocena przydatności radiografii cyfrowej we wczesnym wykrywaniu i różnicowaniu zmian przewlekłych ropnych okołowierzchołkowych. Mag. Stomat., 116, 28, 2001.

4. Czelej-Górski J., Różyło T. K., Różyło-Kalinowska I.: Zastosowanie radiografii cyfrowej i radiodensytometrii do wykrywania resorpcji w przebiegu ostrych zmian okołowierzchołkowych. Mag. Stomat., 115, 40, 2001.
5. Hedrick R. T., Dove S. B., Peters D. D., McDavid W. D.: Radiographic determination for canal length: direct digital radiography versus conventional radiography. J. Endod., 20, 320, 1994.
6. Hildebolt C. F., Bartlett T. Q., Brunsden B. S.: Bitewing-based alveolar bone densitometry: digital imaging resolution requirements. Dentomaxillofacial Radiol., 23, 129, 1994.
7. Jańczuk Z.: Stomatologia zachowawcza. PZWL, 1995.
8. Miles D. A.: Absorbed X-ray doses to critical organs of the head and neck. Dentomaxillofac. Radiol., 16, 17, 1987.
9. Moreno E. C.: Rola Ca-P-F w zapobieganiu próchnicy – aspekty chemiczne. Mag. Stomat., 7, 51, 1994.
10. Napiontek-Kubanek H.: Badanie kliniczne nad możliwością remineralizacji początkowych uszkodzeń szkliwa pochodzenia próchniczego. Czas. Stomat., 47, 681, 1994.
11. Różyło T. K.: Zastosowanie metod radiodensytometrycznych do rozpoznawania i interpretacji stanów patologicznych zębów oraz niektóre problemy ich metabolizmu. Rozprawa habilitacyjna. AM Lublin, 1996.
12. Różyło T. K., Czelej-Górski J., Różyło-Kalinowska I.: Zastosowanie radiografii cyfrowej i radiodensytometrii do oceny przewlekłych ziarninowych zmian przy wierzchołkach zębów nie leczonych endodontycznie. Przegl. Stomat. Wieku Rozw., 33, 26, 2001.
13. Russell M., Pitts N. B.: Radiovisiographic diagnosis of dental caries: initial comparison of basic mode videoprints with bite-wing radiography. Caries Res, 27, 65, 1993.
14. Sanderink G.C.H., Huiskens R.: RadioVisioGraphy for caries detection: an *in vitro* comparison with conventional radiography. J. Dent. Res., 71, 705, 1992.
15. Thun-Szretter K., Markiewicz H., Czerwiński K. et al.: Systemy cyfrowego obrazowania rentgenowskiego w radiologii stomatologicznej – alternatywa konwencjonalnych zdjęć wewnątrzustnych zębowych. Czas. Stomat., 49, 579, 1996.
16. Thun-Szretter K., Tuderek-Sobocińska G., Ciechowicz K.: Zastosowanie radiografii cyfrowej w diagnostyce przewlekłego zapalenia okołowierzchołkowego. Czas. Stomat., 53, 65, 2000.
17. Wenzel A., Larsen M. J., Fajerskov O.: Detection of occlusal caries without cavitation by visual inspection, film-, xero- and digitized radiographs. Caries Res., 25, 379, 1991.
18. White S. C., Yoon D. C.: Comparative performance of digital and conventional images for detecting proximal surface caries. Dentomaxillofacial Radiol., 26, 32, 1997.

2001.05.30

SUMMARY

The purpose of the paper was radiodensitometric evaluation of hard tissues of roots and alveolar bone of endodontically treated teeth with clinically detected chronic periapical inflammatory changes. The material consisted of 139 digital intraoral radiograms of endodontically treated teeth with chronic periapical changes: 54 teeth with granulomatous inflammation, 62 with fibrous changes and 23 teeth with purulent lesions. There was discussed the value of digital radiography and radiodensitometric measurements in cases of periapical inflammations of endodontically treated teeth. It was concluded that radiodensitometric measurements allowed detailed examinations of inflammatory changes at the apices of endodontically treated teeth. Digital radiography is a valuable and objective tool in diagnosis of periapical changes, monitoring of the course of endodontic treatment as well as in follow-up after such treatment. At the same time it allows reduction of ionising radiation dose, thus decreasing diagnostic risks to a patient.

Pomiary radiodensytometryczne w przypadkach przewlekłych zmian okołowierzchołkowych zębów leczonych endodontycznie

Celem pracy była ocena radiodensytometryczna tkanek twardych korzeni i wyrostka zębodołowego zębów leczonych endodontycznie z klinicznie stwierdzanymi objawami zmian okołowierzchołkowych. Materiał stanowiło 139 cyfrowych rentgenowskich zdjęć wewnątrzustnych zębów leczonych endodontycznie z przewlekłymi zmianami okołowierzchołkowymi. Były to radiogramy 54 zębów ze zmianami ziarninowymi, 62 ze zmianami włóknistymi i 23 ze zmianami o charakterze ropnym. Omówiono wartość radiografii cyfrowej i radiodensytometrii w przypadkach zmian zapalnych okołowierzchołkowych zębów leczonych endodontycznie. Stwierdzono, że pomiary radiodensytometryczne pozwalają na dokładną ocenę zmian zapalnych przy wierzchołkach zębów leczonych endodontycznie. Radiografia cyfrowa jest wartościowym i obiektywnym narzędziem w diagnostyce takich zmian oraz monitorowaniu postępów leczenia endodontycznego. Jednocześnie pozwala na zredukowanie dawki promieniowania rentgenowskiego, co zmniejsza ryzyko diagnostyczne dla pacjenta.