Interobserver variability of the diagnosis of apical periodontitis on panoramic radiography assessment

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Panoramic radiography is one of the most frequently used radiodiagnostic techniques in the dental office, although it has a limited value for the diagnosis of caries lesions or periapical inflammations compared to retroalveolar radiography (1).

There are different opinions in the literature regarding the most adequate radiological method for the assessment of patients at the first visit in the dental office. Some authors consider inadequate the indication of panoramic radiography as the only examination for the diagnosis of caries, root abnormalities or periapical changes, and recommend the performing of a full-mouth radiograph series (2). Others recommend the performing of an initial panoramic radiograph, along with bite-wing and retroalveolar radiographs in the tooth groups in which the presence of caries or periodontal lesions is clinically suspected. Molander B et al. (3) show that the combined use of panoramic and retroalveolarradiographs results in a 42-96% sensitivity for the diagnosis of caries and a 80-96% sensitivity for the diagnosis of periapical lesions, with a 97% and 95% specificity, respectively. A disadvantage of the use of the two radiographic methods is the increased radiation of the patient. However, Jenkins et al. (4) show that radiation in this case is lower than that found after the performance of periapical radiographs in all teeth with clinically suspected lesions.

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The use of panoramic radiography alone, as a unique diagnostic method for apical periodontitis, is not recommended because the absence of details on the radiological image produced by the movement between the source and the film may generate interpretation errors.

A number of previous studies show the high benefit of the use of panoramic radiograph associated with selective retroalveolar radiographs for the diagnosis of dento-periodontal and jaw bone lesions (5,6). The association of panoramic radiograph with periapical or bitewing radiographs leads to an increased accuracy in the detection of periapical lesions (7,8).

We consider that it is important to determine if there is an interobserver variability for the diagnosis of apical periodontitis based on panoramic radiography, since the decision of recommending another selective radiograph belongs to the dentist, after the examination of the panoramic radiograph and the clinical examination of the patient. As far as we know, the interobserver variability of panoramic radiography was only explored for the assessment of its reliability in the determination of some measurements, but not for panoramic radiographic diagnosis (9).

This study **aims** to determine the interobserver variability of the diagnosis of apical periodontitis based on panoramic radiography which is a measure of the reliability of this radiological technique. ❏

MATERIAL AND METHOD

This paper is based on the retrospective study of 30 panoramic radiographs, performed with the INSTRUMENTARIUM OP 100 Orthopantomograph (Finland). All radiographs were interpreted by 3 examiners with different degrees of experience, as follows: examiner 1 – specialist dentist; examiner 2 – specialist radiologist; examiner 3 – student. Each of the three examiners studied the radiographs independently, under the same light conditions, using the same negatoscope type.

For the 30 studied cases, a total number of 631 teeth present on the dental arch were identified and studied for a diagnosis of apical periodontitis. The radiological signs considered significant for the diagnosis of apical periodontitis were: periapical radiotransparency with the interruption or thinning of the lamina dura; widening of the periapical space or diffuse periapical demineralization in a tooth with extensive crown caries or endodontic obturation. For each tooth present on the dental arch, the degree of probability of a periapical lesion was recorded. For this, the following score was established: 0 – absence of radiological signs of apical periodontitis; 1 – uncertain radiological signs of apical periodontitis; 2 – certain radiological signs of apical periodontitis.

The results of the interpretation of each examiner were centralized and statistically analyzed, using Pearson's correlation coefficient and the Kappa index. Pearson's correlation coefficient was calculated for each case and for each examiner and it expressed the agreement between the scores given by the three examiners for each case.

Of the 631 teeth present on the dental arch, 3 teeth with apical resection were excluded from the study.

The next objective of this study was to determine the interobserver variability of a certainty radiological diagnosis of apical periodontitis. After the exclusion from the study of teeth with score 1, the statistical Kappa index (K) was calculated for examiners 1 and 2 (K_{1-2}, n=601 teeth) and for examiners 2 and 3 (K_{2-3}, n= 426 teeth). The interobserver variability depending on the examiner's degree of experience was calculated by the comparison of K_{1-2} and K_{2-3} indices.

Subsequently, it was evaluated whether interobserver variability was influenced by the radiologicaly assessed anatomical region, by calculating the K_{1-2} coefficient for the group of upper and lower front teeth, premolars and molars. ❏

RESULTS

The mean age of the patients included in the study was 43 years.

Both experienced examiners excluded the diagnosis of apical periodontitis (score) in 84.23% of the radiologicaly assessed teeth, while examiner 3 excluded this diagnosis only in 59.55% of the teeth (**Figure 1**). Examiner 3 made a probability diagnosis for periapical lesions (score 1) in a considerable percentage of cases (32.01%), with a statistically significant difference compared to the frequency of this score in the experienced examiners (p=0.00025). The percentage difference between the number

of teeth with suspected apical periodontitis was statistically insignificant between the experienced examiners (p=0.131).

The certain diagnosis of a periapical lesion (score 2) was made by the three examiners in 13.69%, 12.42%, and 8.44% of the teeth, respectively, with an insignificant difference between the first two examiners (p=0.308) and a significant difference compared to the third examiner (p=0.033 between ex. 1 and 3 and p=0.0126 between ex. 2 and 3).
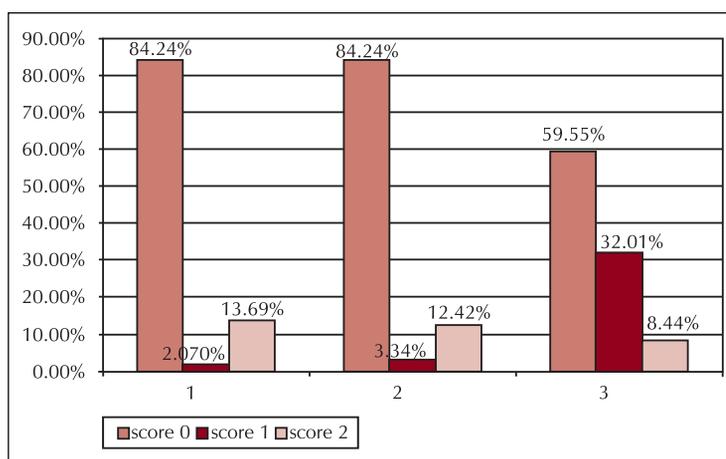
The dispersion diagram of Pearson's correlation coefficient between the scores given by examiners 1 and 2 and examiners 2 and 3, respectively, is shown in **Figures 2** and **3**.

The degree of correlation between the diagnoses made by the three examiners is shown in **Table 1**. For 70% of the examined radiographs it was found a very good correlation between the scores given by the two experienced examiners, while between examiners 2 and 3, the very good correlation was present only in 20% of cases and a moderate correlation in 40% of cases.

The Kappa coefficient for the teeth with a certain positive or negative radiological diagnosis of periapical inflammation was 0.815 for examiners 1 and 2, and 0.733 for examiners 2 and 3 (**Table 2**). The interobserver variability was higher at the upper teeth (Kappa coefficient between 0.695 and 0.645) compared to the lower teeth (Kappa coefficient between 0.950 and 0.816) (**Table 3**). ❑

DISCUSSION

The assessment of the interobserver variability of the diagnosis of apical periodontitis on panoramic radiography has a special practical importance because a significant number of dentists use this method (10), combined with clinical examination and periapical radiography. However, the decision of additional examinations in the case of the suspicion of apical

FIGURE 1. Total number of teeth with score 0, 1, and 2, respectively
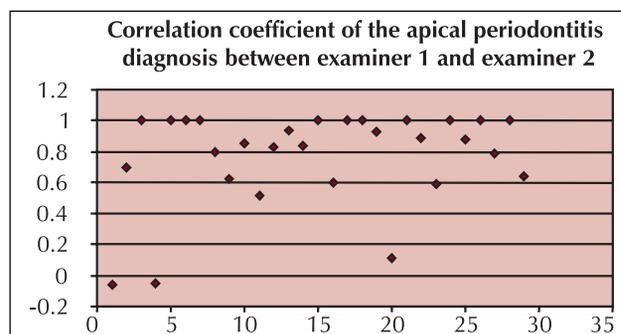
FIGURE 2. Dispersion diagram of the correlation coefficient values of the 1st and 2nd examiner
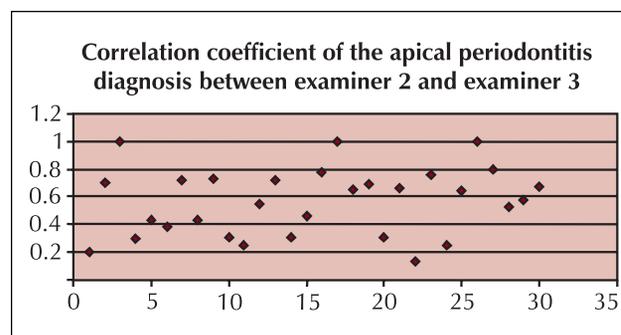
FIGURE 3. Dispersion diagram of the correlation coefficient values of the 2nd and 3rd examiner

	Weak correlation (Pearson <0.25) (% of all cases)	Acceptable correlation (Pearson 0.25-0.5) (% of all cases)	Moderate correlation (Pearson 0.5-0.75) (% of all cases)	Very good correlation (Pearson > 0.75) (% of all cases)
Ex1-ex2	10	0	20	70
Ex 2-ex3	13.33	26.66	40	20

TABLE 1. Cases distribution on Pearson's correlation coefficient in the diagnosis of periapical periodontitis

Number of examined teeth	Kappa coefficient	95% confidence interval
n=601	K_{1-2}=0.815	[0.735-0.872]
n=426	K_{2-3}=0.733	[0.623-0.802]

TABLE 2. Interobserver variability of the certain diagnosis of periapical inflammation in the studied cases

Tooth group	Number of examined teeth	Kappa coefficient (K_{1-2})	95% confidence interval
Upper front teeth	149	0.695	[0.546-0.734]
Upper premolars	57	0.686	[0.390-0.788]
Upper molars	94	0.645	[0.303-0.788]
Lower front teeth	175	0.828	[0.509-0.828]
Lower premolars	94	0.950	[0.752-0.950]
Lower molars	61	0.816	[0.478-0.816]

TABLE 3. The Kappa coefficient for the certain diagnosis of periapical inflammation by tooth groups

periodontitis is subjective and depends on the examiner.

The mean age of the patients included in the study was 43 years. We consider that this group is representative for the evaluation of periapical inflammation, as the prevalence of this lesion decreases with age proportionally to the number of tooth extractions.

The comparative analysis of the score given by the three examiners (Diagram 2) shows a highly statistically significant difference in the percentage of teeth with a probable diagnosis of apical periodontitis (score 1) between examiners 2 and 3 (p<0.005), but an insignificant difference between the experienced examiners (p=0.131). These teeth represent in practice **indications** for selective radiographs given by examiners.

Consequently, the number of periapical radiographs indicated by the dentist after the evaluation of a panoramic radiograph depends on the examiner's experience. An inexperienced dentist will tend to make probability diagnoses, having difficulties in making a certainty diagnosis in the absence of another radiograph or clinical data. This may result in the performance of an unjustified number of radiographs and the increase of patient radiation.

Although there was a very good correlation between the scores given by the two experienced examiners in 70% of cases, a weak correlation between these was found in 10% of cases, a percentage similar to that found between examiners 2 and 3, which was 13.33%. Consequently, the presence of this weak correlation between the scores given by the examiners is not dependent on their experience, but can be explained by the lack of clinical data in the radiologicaly examined patients.

In a study performed in 40 patients for the diagnosis of apical periodontitis it was recommended the panoramic radiography. To establish the diagnosis it was required to perform a mean of 5.1 additional periapical radiographs. From all these only 3.1 provided additional information and 2.0 had no diagnostic benefit (3).

The analysis of the Kappa coefficient in the examined cases shows an almost perfect agreement between the results of examiners 1 and 2 (K_{1-2} >0.8) and a substantial agreement between examiners 2 and 3 (K_{1-3} between 0.6-0.8). These values correlated with the confidence intervals of the Kappa coefficient show that regardless of the examiners' experience, the agreement of the certainty radiological diagnosis of apical periodontitis is substantial (Kappa >0.6).

At the same time, the results show that the Kappa coefficient value is different depending on the examined dental region. Although the Kappa coefficient indicates the presence of an almost perfect agreement in the lower dental arch (Kappa=0.828; 0.950; 0.816) and of a substantial agreement in the upper dental arch (Kappa=0.695; 0.686; 0.645), the analysis of 95% confidence intervals demonstrate a high interobserver variability, which depends on the examined dental region.

The better reliability of panoramic radiograph for the diagnosis of apical periodontitis in lower teeth compared to upper teeth can be explained by the absence of overlappings at the level of the mandible teeth apexes.

The 95% confidence interval at the level of upper premolars and molars is wide and shows that only good or moderate interobserver agreement is possible at this level (Kappa between 0.2-0.6). This could be explained by the overlapping of sinus radiotransparency in the tooth apex region. At the same time, in the upper front teeth, by the overlapping of bone radiopacity and air in the oral cavity, interobserver agreement can be moderate or substantial (Kappa between 0.4-0.8).

A high interobserver variability of the diagnosis of apical periodontitis would result in a lower reliability of panoramic radiography. This would mean that some teeth with periapical lesions might be considered false negative cases on the panoramic radiograph and would not be further investigated by other radiological techniques. Interpretation errors may also appear, as well as false positive cases, especially caused by different radiotransparent overlappings at the level of tooth apexes. In this case, clinical examination is extremely important for the making of an accurate differential diagnosis.

The reliability of panoramic radiography can be influenced by the quality of radiological images and the correct positioning of the patient. Radiological technique errors result in a lower quality of the radiograph and reduce the information required for diagnosis. In a study, Petrikowski CG, Eibadrawy HE, Boehlau EE et al. – Interobserver variability in pediatric radiography quality assessment, *J Can Dent Assoc* 1998, Jan; 64(1):36-41, estimated the interobserver variability of the assessment of technical errors on radiographs performed in 200 children. The authors showed that in spite of a small number of technical errors in the panoramic radiograph, there was an interobserver variability in the decision of repeating the radiograph and this decision was based on subjective criteria, in particular the absence of clinical information. ❑

Conclusion

Panoramic radiography is a reliable method for the diagnosis of apical periodontitis, especially for the lower dental arch, but it depends on the examiner's experience. The interobserver agreement was excellent for experienced examiners and moderate when the examiners had a different degree of experience.

The results show that the diagnosis of apical periodontitis based on panoramic radiography may lead to an unjustified number of additional selective radiographs, particularly when the examiner has a reduced experience. This is why we consider that panoramic radiographs should be interpreted with caution and they should be correlated with the clinical examination of the patient. ❑

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