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RESEARCH ARTICLE

DIAGNOSIS OF INCIPIENT PERIODONTAL DISEASE IN ADOLESCENTS: SEARCH OF ACCURACY.

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Abstract

Background:-Increased distance between the alveolar bone crest and the cementoenamel junction (ABC/CEJ) is indicative of periodontal disease.So, more adequate diagnosis methods are crucial in the detection of this disease.Moreover, softwares may automate this mensuration process and eliminate the influence of the examiner's judgment.

Objective:- To evaluate the effectiveness of the Digora computerized method to determine distance between alveolar bone crest and cementoenamel junction (ABC/CEJ), comparing this method to the caliper traditional analysis in the early detection of the periodontal disease.

Methods:- The sample was comprised of 380 sites (mesial/distal surfaces of molars and premolars) of standardized bitewing radiographs. An experienced examiner measured the ABC/CEJ distances using caliper and4X increase lens (Standard Gold) and a calibrated examiner measured using the Digora program. ABC/CEJ distances longer than 2mm were considered periodontal disease. Positive and negative sites for the disease were selected (25/each), with the same variation based on the cut point. Double-blind mesurations of the ABC/CEJ distances were made by two examiners: one inexperienced and another calibrated, using caliper and Digora program. It was made a comparative analysis of the data gotten by the method of instrument validation. **Results:** The inexperienced examiner showed inefficiency in both the analysis methods and the calibrated examiner using the Digora system presented more efficiency.

Conclusion:- The use of Digora system to detect bone loss in early stages proved as efficient as the caliper.

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Introduction:-

Increased distance between the alveolar bone crest and the cementoenamel junction (ABC/CEJ) is indicative of periodontal disease.[1] Radiographic diagnostic methods are often used in the complementary diagnosis of this disease,[2-6] in determining the prognosis and evaluation of treatment outcome. In radiographic images, changes in calcified tissue are detected, as well as the effects of past experience on bone and tooth roots.[7]

Variations in the radiographic technique produces devices that limit the diagnostic value of radiographs. The bone level, the pattern of bone destruction, the extent of the periodontal ligament space and radiodensity are modified by changing the exposure time, film type and X-rays angulation. Standardized and reproducible techniques are required for obtaining secure radiographs for comparison before and after treatment,[7] otherwise underestimation of bone loss can occur.[8,9]

The most accurate radiographic projection of the alveolar bone level is achieved when the film is placed parallel to tooth and the X-ray central beam impinges at a right angle to tooth and film.[10] The interproximal technique is the one that best fulfills these requirements.[11] When used properly, the positioners assist the acquisition of images that enable the detection of reduced bone loss, less than 1 mm.[12] An alternative for better detection of bone loss is to use software tools to improve visualization of interest structures.[6]

Since the incipient diagnosis of periodontal disease is very important to disease treatment and control, an accurate measurement of the distance between cementoenamel junction and alveolar bone becomes fundamental. Therefore, the aim of this study was to determine which method of radiographic analysis (visual or computerized) is the most appropriate to identify periodontal disease in its early stages and to evaluate the effectiveness of a computerized method (Digora) to measure the ABC/JCE distance, comparing this method to the traditional analysis using caliper.

Material and Methods:-

Initially a pilot study comprised of 47 radiographs was carried out. The sample consisted of 380 sites (mesial and distal surfaces of molars and premolars) in 23 patients of the Primary Care Integrated Clinic, Faculty of Dentistry, Federal University of Minas Gerais (FO-UFMG), aged 12 to 20 years (Research Ethics Committee: protocol #059/06).Standard interproximal radiographic examinations with positioners for molars and premolars (4 radiographs per patient) were performed.

The distance between the alveolar bone crest and the cementoenamel junction was measured subsequently in bitewing radiographs. One experienced investigator measured the distance ABC/CJE with the aid of a caliper and a 4X magnifying glass and was considered gold standard (Fig. 1A). A properly calibrated examiner (kappa = 0.88) measured the ABC/CEJ distance with Digora system in order to make the comparison (Fig. 1B). For this, the radiographs were previously scanned with the Epson Expression scanner 1680. The correction of the decline in X-rays using the scanning process was carried out multiplying the values by 1.17.

A set of rules[13] were followed for the measurement data, which takes into account the anatomical variations found in X-rays:

1. Ideal cementoenamel junction - the most apical extent of the enamel portion interface with the root surface. This interface must be indicated by a change in density and a definite change of boundary between crown and root.
2. Not ideal cementoenamel junction - (a) if the most apical location of the density change interface differs from the change location of boundary, the density change is marked; (b) if the contour change is well defined, but the density is not, the contour change is marked; (c) if the density change is well defined, but the boundary is not, the density change is marked and (d) if neither the density change nor the boundary are well defined, we must reject this site for the analysis.
3. Ideal bone crest - the most interproximal coronal point of density change, clearly defined, immediately adjacent to the root surface.
4. Not ideal bone crest - (a) in sites with vertical defect, the spot immediately adjacent where the vertical defect ramp starts in the tooth must be marked; (b) when the density change is coronal to the cementoenamel junction this site must be rejected.

The sites with ABC/CEJ distances longer than 2 mm were considered to this disease and the sites below this value were considered as absence of disease.

We selected 50 cases (25 with disease and 25 without disease), with the same variation, based on cutting point (E.g. 2.5mm/1.5mm). The calibrated and inexperienced examiners performed double-blind measurement of distance ABC/CEJ with the use of caliper and Digora system. A comparative analysis of the obtained data by the instrument validation method was made.

A database was performed with the SPSS software for analysis of statistical data providing error estimates and false-positive/negative.

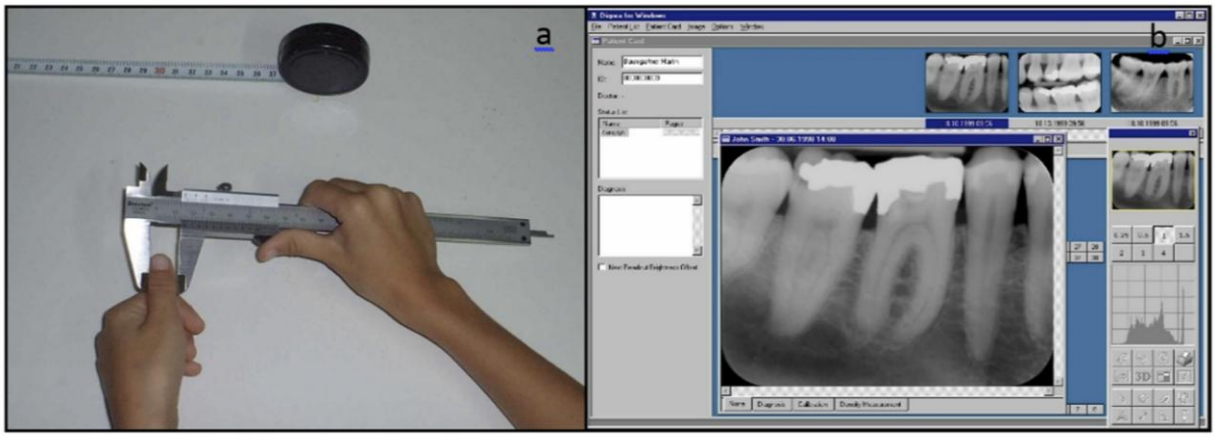
Results:-

From the comparison between the results of the diagnostic test (Digora) and the gold standard (Caliper), few false-positives and false-negatives were obtained, showing that the test is useful for diagnosing and predicting incipient periodontal disease in adolescents (Table 1). The digitized radiography (Digora) showed high sensitivity indicators, accuracy/validity and specificity. Since the prevalence of the disease is low, the positive predictive value (percentage of people with the disease) was also low, while the negative predictive value (percentage of people without the disease) was high (Table 2).

In the instrument validation method, analyzing only the inexperienced examiner, the caliper showed higher sensitivity (S), however, to identify incipient bone loss the inexperienced examiner was ineffective with both analytical methods. The Digora program proved to be the most sensitive when used by experienced examiner. Regarding the predictive value (equal to the prevalence of the disease), the inexperienced examiner in both tests showed a Negative Predictive Value (NPV) less than that showed by the calibrated examiner. The calibrated examiner showed a Positive Predictive Value in both tests (PPV) less than that of the inexperienced examiner. Even though all the tests showed approximate Accuracy (A), the calibrated examiner using Digora was more accurate in identifying the incipient bone loss in its early stages (Figure 2 and 3).

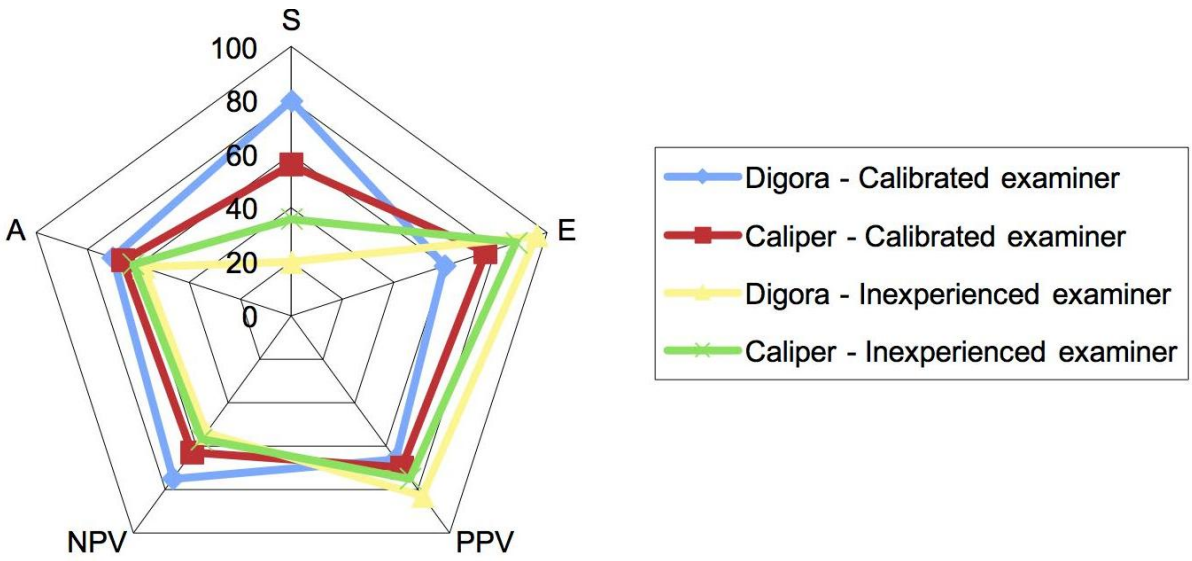
Legends

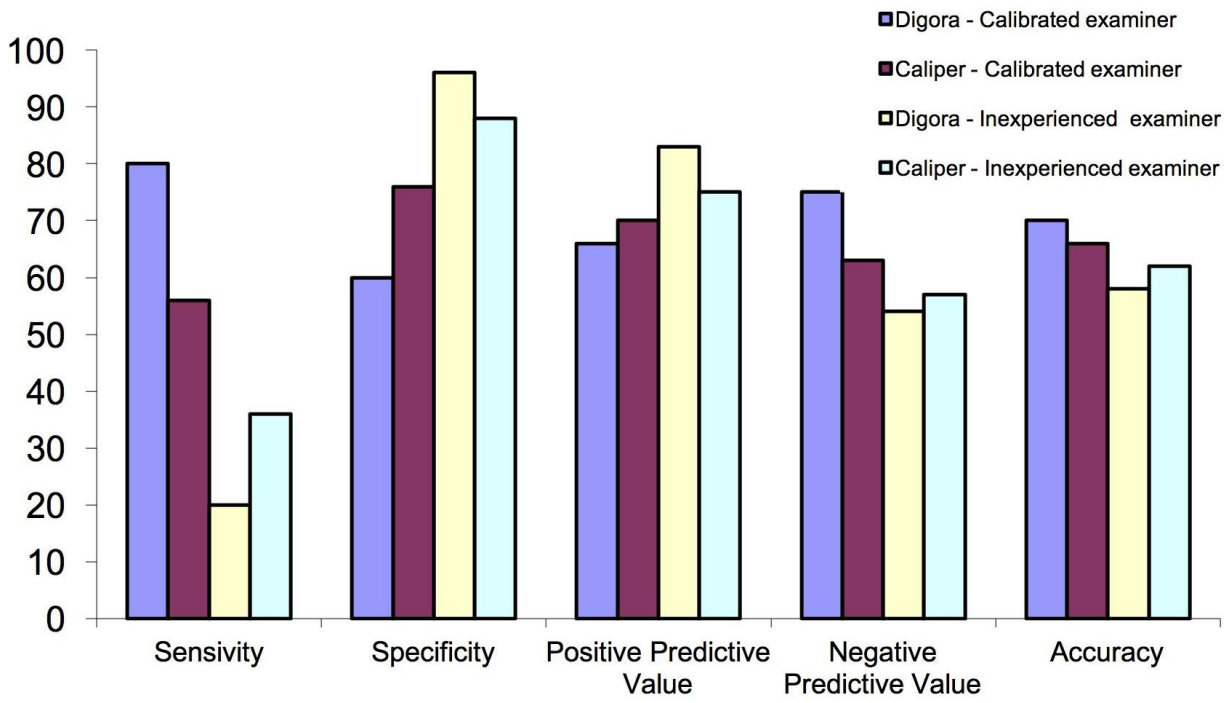
Figure 1. Mensuration of the ABC/CEJ distances using:a) Caliper and b) Digora.
Table 1. Relation between the test result and the gold stand result.
Table 2 - Digitized radiography validation (Digora) as a diagnostic instrument of incipient bone loss.
Figure 2. Comparison by instrument validation method.
Figure 3. Comparison by instrument validation method.



Test Disease	Present	Absence	Total
Positive	True positive (T+) 20	False positive (F+) 70	90
Negative	False negative (F-) 5	True negative (T-) 285	290
Total	25	355	380

Factors	Values
Sensitivity	s = 0,80
Specificity	e = 0,80
+ Predictive value	PPV = 0,22
- Predictive value	NPV = 0,98
Accuracy	ac = 0,80
Prevalence	ac = 0,80





Discussion:-

The prevalence of periodontal disease reported in the literature shows significant variation, probably due to the applied methods and criteria for the diagnosis of this disease. Different methods have been proposed, among them the measurement of the distance ABC/JCE. Therefore, analysis of radiographs with caliper can be considered the gold standard.

The measurement method using the caliper compared with a computerized system (Digora) showed consistency of results between the methods in relation to the quantitative validity in the distance measuring, that is, in the accuracy of the periodontal disease diagnosis and prediction, as well as in other studies.[8,14,15] Thus, the method carried out with Digora program enabled the identification of the disease, without affecting the sensitivity of the diagnosis and specificity in detecting incipient bone loss.

Another important factor when considering the validation of an instrument is the reproducibility of the method by comparing intra and inter examiners. In this study, the greatest differences were found when we compared the calibrated examiner measurements with those of the inexperienced examiner. This fact suggests, as reported by others researchs,[16] that studies on evaluation of alveolar bone loss on radiographs should use a single examiner to avoid incompatibility between the examiners. Future advances in software may fully automate the process and eliminate the influence of the examiner's judgment. In addition, the examiner's experience interfered in the results of the methods, therefore their prior training for the reproducibility of both methods proves to be necessary, as reported in epidemiological studies.[17]

Since the method using Digora was effective in detecting periodontal disease, the development of software in order to improve the diagnosis is a key factor, for it will be able to provide greater accuracy of this method and thus enable proper planning, along with clinical examination for the early treatment of incipient bone loss.

Conclusion:-

Digora system to detect bone loss in early stages proved to be as effective as the traditional method using caliper.

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