ABSTRACT OF

PhD THESIS

Scientific coordinator

UNIV.PROF.PhD. FORNA NORINA CONSUELA

PhD Student

FRĂŢILĂ DRAGOŞ NICOLAE

2014
ELEMENTS OF PREDICTIBILITY ON DIAGNOSTIC IN DENTAL MEDICINE

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2014
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GENERAL CONCLUSIONS

ORIGINALITY

REFERENCES
**Key words:** byte-wing radiography, CBCT, T-SCAN, orofacial dysfunctions, occlusal imbalances, software programme, classic diagnostic, computerized diagnostic

PhD Thesis contains:
- general part - 3 chapters (32 pag.);
- personal researches - 5 chapters (114 pag.);
- 61 tables and 184 figures;
- 246 references.

Note: the abstract show selective references, tables and images in text, respecting content and numbering in PhD Thesis.
CHAPTER V. STUDIES REGARDING POSSIBILITIES TO DETECT OCCLUSAL AND PROXIMAL CARIES USING RADIOGRAPHIC EXAMEN

V.1. AIM OF STUDY. The aim of study was to determine the role of panoramic examen and byte-wing method to assess the prevalence of incipient occlusal and proximal dental caries.

V.2. MATERIALS AND METHOD.

Study group included 40 patients with medium cariogenic risk (age 18-25); the patients were selected from patients treated in Clinical Dental Educational Base care „Mihail Kogălniceanu” of Dental Medicine Faculty, U.M.F. „Grigore T.Popă” Iassy. The researches were performed according to Law 46/2003 regarding patient rights. Written consent was obtained from each patient.

The study group allowed the research of 100 questionable occlusal dental surfaces (incipient dental caries) and 100 proximal surfaces of posterior dental teeth.

The inclusion criteria for occlusal dental surfaces were as follows: colour changes, enamel breakdown, retentive pits and fissures, ICDAS codes 01-03.

The inclusion criteria for proximal dental surfaces were as follows: colour changes, gingival inflammation, enamel breakdown on proximal dental surfaces.

For all investigated dental surfaces, radiographic examination was performed using panoramic and byte-wing methods, by a single examiner trained and calibrated.

For occlusal dental surfaces, it was compared prevalence of dental caries calculated according to visual method (ICDAS codes) and byte-wing radiographic method (Rx indices).

For proximal dental surfaces, it was compared prevalence of dental caries calculated according to visual method (ICDAS codes) after teeth separation and byte-wing/panoramic radiographic method (Rx indices).

Statistical tests were performed using software SPSS 17. The results were expressed as tables and graphs performed in Excel.

V.3. RESULTS

The distribution of radiographic indices (byte-wing) on occlusal surfaces with incipient dental caries and radiographic indices (panoramic, byte-wing) on proximal surfaces with incipient dental caries, are presented in figures 1.a-b.
Fig. 1.a. Incipient occlusal dental caries. Byte-wing 1.7.(D1), 4.7.(radiographic E).

Fig. 1.b. Incipient proximal dental caries. Byte-wing 4.6. (radiographic indice E).

Figures 2.a. and 2.b. is presented distribution of radiographic indices to questionable dental occlusal surfaces. The percentages of radiographic indices are as follows: 48% E0 (demineralization absent); 4% E1 (enamel caries); 24% E2 (enamel caries); 18% D1(superficial dentine demineralisation); 6% D2(advanced dentine demineralisation) (fig.2.a.). The percentages of ICDAS codes are as follows: 4% ICDAS 01 (demineralization absent); 56% ICDAS 02 (enamel caries); 32% ICDAS 03 (demineralization in enamel internal half and dentine external third ); 8% ICDAS 04 (advanced dentine demineralisation).(fig.2.b). For occlusal surfaces with ICDAS 02, 89% have radiographic indices E (E1, E2), 11% radiographic indices D1; for occlusal surfaces with ICDAS 03, 25% have radiographic indices D1, 75% have radiographic indices D2 (75%).

Fig. 2.a. Distribution of radiographic indices on occlusal surfaces with incipient dental caries (byte-wing radiography)
Fig. 2.b. Distribution of ICDAS codes on occlusal dental surfaces

Fig. 2.c. Sensitivity of byte-wing radiography on dentinal occlusal caries

Results regarding prevalence of carious lesions, sensitivity values of byte-wing and panoramic methods, distribution of radiographic indices indicilor radiografici of byte-wing and panoramic methods are presented in table 2 and figures 3.a-b. and 4.

Fig. 3.a. Prevalence of incipient proximal dental caries according to clinical examen (teeth separation) and radiographic examen (panoramic, byte-wing)
Fig. 3.b. Sensitivity values (byte-wing, panoramic)

Fig. 4.a. Distribution of proximal incipient dental caries (byte-wing)

Fig. 4.b. Distribution of proximal incipient dental caries (panoramic)

Test Wilcoxon (non-parametric correspondent of t test) was performed to test null hypothesis.
Tables 3.f-g. Wilcoxon test (radiographic indices/dentine vs. enamel – occlusal dental caries)

<table>
<thead>
<tr>
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</tr>
<tr>
<td>Negative Ranks</td>
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<td>.00</td>
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<tr>
<td>Positive Ranks</td>
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<td>12.50</td>
<td>300.00</td>
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<tr>
<td>Ties</td>
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<td></td>
<td></td>
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<tr>
<td>Total</td>
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</table>

a. dentine < enamel  
b. dentine > enamel

test Statistics^b

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<tr>
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<th>dentine - enamel</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Based on negative ranks.  
b. Wilcoxon Signed Ranks Test  
c. dentine = enamel

Significant statistical differences were found between distributions of radiographic indices on enamel and dentine for investigated dental occlusal surfaces. (table 3.m.).

Table 3.m. Wilcoxon test (byte-wing vs. panoramic – proximal dental caries)

Test Statistics^b

<table>
<thead>
<tr>
<th></th>
<th>panoramic - RX</th>
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<tr>
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<td>-4.793^a</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Based on positive ranks.  
b. Wilcoxon Signed Ranks Test
V.4. DISCUSSIONS

Byte-wing radiography is used to detect incipient occlusal dental caries by 99% of dentists on a percentage of 56% patients, while 14% of dentists use byte-wing radiography as usual complementary diagnostic test on all patients to detect incipient occlusal dental caries (Gordan V. et al.2011) /65/. Ricketts et al. (2002) demonstrate that sensitivity values in the detection of non-cavitary occlusal dental caries with dentine demineralization increase significantly for byte-wing radiography comparing with visual-tactile clinical examen /185/. Conventional and digital radiography (byte-wing or panoramic method) is also most used complementary diagnostic test to detect proximal incipient dental caries. In SUA all dentists use this method on a percentage of 92% patients, to detect and treat proximal non-cavitary or microcavitary dental caries extended in dentine (Gordan V. Et al.2013) /65/. Mialhe FL et al. (2009) prove that radiographic examen increases the diagnostic accuracy of incipient proximal dental caries with 110%, comparing with clinical /134/. Aija-Maria HL et al. (2011) demonstrated that 53% of the investigated teeth has at least one proximal dental caries detected only with byte-wing radiography /2/. Abessi&col. (2012) calculate, regarding prevalence of incipient proximal dental caries, sensitivity 55% and specificity 100% for conventional byte-wing radiography, sensitivity 45%, specificity 100% for digital byte-wing radiography /1/. The review performed by Bloemendal et al. (2004) shows that prevalence of proximal dental caries increases significantly in epidemiological studies if the assessment is performed using an association between clinical examen and panoramic or byte-wing radiography că /22/.

V.5. CONCLUSIONS

1. Byte-wing radiography, performed on occlusal dental surfaces with ICDAS 01-04, indicates the absence of demineralization in percentage 48%, enamel demineralization in percentage 28%, dentine demineralization in percentage 24%.

2. ICDAS system, on occlusal dental surfaces, indicates enamel demineralization (ICDAS 02) in percentage 56%, demineralization localized in enamel internal half and dentine external third in percentage 32% din cazuri and demineralization localized in dentine internal half in percentage 8%.

3. Byte-wing radiography indicates occlusal carious lesions extended in dentine for 24% occlusal surfaces with ICDAS 01-04.

4. The visual examen with teeth separation indicates 59% prevalence of proximal carious lesions. The radiographic examen indicates a prevalence of 32% for panoramic examen 52% for byte-wing method.

5. Byte-wing radiography indicates enamel proximal dental caries in 15% of the investigated proximal surfaces and proximal carious lesions extended in dentine in percentage 37%.

6. Byte-wing radiography (88%) has superior sensitivity values (88%) comparing to panoramic radiography (52,25%), regarding the diagnostic performance of incipient proximal carious lesions. Significant statistical differences were found between panoramic and byte-wing radiographic methods.
CHAPTER VI. STUDY REGARDING THE POSSIBILITIES OF CBCT TO ASSESS ENDODONTIC AND PERIODONTAL STATUS ON PARTIALLY EDENTULOUS PATIENTS

VI.1. AIM OF STUDY
The study aimed to determine the possibilities of CBCT method to assess the endodontic and periodontal status on partially edentulous patients.

VI.2. MATERIALS AND METHODS
Study group included 32 patients with edentation Kennedy class III and class I. selected from patients of Dental Educational Clinical Base “Mihail Kogălniceanu”, Faculty of Dental Medicine, U.M.F.”Grigore T.Popa” Iassy. Patients were programmed for prosthetic treatment with fixed partial prosthesis or removable partial denture. The researches were performed according to Law 46/2003 regarding patient rights. Written consent was obtained from each patient.

All patients presented with panoramic radiographic examen and received recommendation for CBCT method in selected areas with teeth planned to be included in prosthetic treatment. A number of 142 teeth (78 anterior teeth, 38 bicusps, 26 molars) were investigated both on panoramic radiographies and CBCT images, by a single examinator, trained and calibrated. It was compared prevalence of chronic apical periodontitis and alveolar bone lysis, assessed by panoramic radiographies and CBCT method. Special attention was given to prevalence of incipient endodontic and periodontal pathology detected by the investigated complementary diagnostic tests.

The statistical analysis was performed using software SPSS 17. The results were expressed in graphs and tables performed in Excel.

VI.3. RESULTS
Figures 6.a.-b. present radiographic and CBCT images of a clinical case related to endodontic pathology. The prevalence and distribution of endodontic pathology, according to CBCT method was as follows: 66.20% healthy teeth, 11.30% incipient chronic apical periodontitis, 16.90% periapical granuloma, 2.80% radicular chist (fig.7.a.). Prevalence of chronic apical periodontitis was 33.80% according to CBCT method and 33.00% according to panoramic examen (fig.7.b.). Regarding incipient chronic apical periodontitis, CBCT method detected 14.10% affected teeth, panoramic examen detected only 11.30% affected teeth(fig.7.c.).
Fig. 6.c. Panoramic radiograph. U.F., 48 years.

Fig. 7.a. Distribution of CAP on study group (CBCT vs. Rx)

Fig. 7.b. Prevalence of CAP on study group (CBCT vs. Rx)

Fig. 7.c. Prevalence of incipient CAP on study group (CBCT vs. Rx)

The results of statistical analysis are presented in tables 5.a-f. and figures 8.a-b. Test Wilcoxon (non-parametric correspondent of t test) (table 5.f.) tested the existence of significant statistical differences between panoramic examen and CBCT method.

**Null hypothesis**: No significant statistical differences between RX and CBCT.

**Research hypothesis**: Significant statistical differences between RX and CBCT.
Tables 5.f.-g. Spearman test RX, CBCT (periapical status)

<table>
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<tr>
<td>Negative Ranks</td>
<td>0a</td>
<td>.00</td>
<td>.00</td>
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<tr>
<td>Positive Ranks</td>
<td>4b</td>
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<tr>
<td>Ties</td>
<td>138c</td>
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<tr>
<td>Total</td>
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a. CBCT < RX  
b. CBCT > RX  
c. CBCT = RX

Test Statisticsb

<table>
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<tr>
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<tr>
<td>Z</td>
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<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.046</td>
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</table>

a. Based on negative ranks.  
b. Wilcoxon Signed Ranks Test

Table 5.f. indicates test significance level. Between the investigated variables (panoramic examen, CBCT) were found significant statistical differences.

Figures 9.a., 9.b., 9.c., 9.d. present radiographic aspects and CBCT images of teeth with horizontal and vertical alveolar bone lysis for teeth planned to be included in prosthetic treatment. Horizontal alveolar bone lysis was detected on CBCT images on 94.20% teeth; distribution was as follows: 35.20% incipient alveolar bone lysis, 47.80% medium alveolar bone lysis, 11.20% severe bone alveolar lysis (fig.10.a). Related to all investigated teeth, the incipient bone alveolar lysis was detected on 35.20% teeth on CBCT images, and only 26% teeth on panoramic images (fig.10.b.).

Fig.9.a. Panoramic radiography. U.F., 48 years.
Fig. 9.c. Severe alveolar bone lysis 2.4.

Fig. 10.a. Distribution of bone lysis on study group (CBCT vs. Rx)

Fig. 10.b. Prevalence of bone lysis (CBCT vs. Rx)

Fig. 10.c. Prevalence of incipient bone lysis (CBCT vs. Rx)

The results of statistical analysis are presented in tables 7.a-f and figures 11.a-b. Test Wilcoxon (non-parametric correspondent of t test) (table 5.f.) tested the existence of significant statistical differences between panoramic examen and CBCT method.

Null hypothesis: No significant statistical differences between RX and CBCT.

Research hypothesis: Significant statistical differences between RX and CBCT.

Table 7.g. indicates test significance level. Between the investigated variables (panoramic examen, CBCT) were found significant statistical differences.
Tables 7.f.-g. Wilcoxon test. RX vs. CBCT (bone lysis)

### Ranks

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<tr>
<td>CBCT - RX</td>
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<tr>
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<td>Ties</td>
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</table>

a. CBCT < RX  
b. CBCT > RX  
c. CBCT = RX

### Test Statistics\(^b\)

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<td>Z</td>
<td>-3.606(^a)</td>
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<td>Asymp. Sig. (2-tailed)</td>
<td><strong>.000</strong></td>
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</table>

a. Based on negative ranks.  
b. Wilcoxon Signed Ranks Test

### VI.4. DISCUSSIONS

Radiographic examen cannot assess always accurately the real dimension and aspects of chronic apical periodontitis, because of the bidimensional compression of tridimensional structures (Patel S.2009)/159/. To overpass the disadvantages of radiographic examen and to increase the sensitivity values, especially for incipient periapical pathology, new method CBCT begin to spread in dental practice due to images offered in sagital, axial, coronal sections /111, 160,161, 244/. Ee J. et al. (2014) prove that additional use of CBCT method modify the initial treatment plan (adopted according to radiographic examen) 62% cases, due to additional information offered by CBCT in endodontic pathology /42/. The method CBCT is a valuable alternative to the conventional diagnostic methods used actually in dental practice (Hashimoto K.2003)/69/. Vandenberghe et al. (2007) demonstrate significant statistical differences between CBCT and radiographic examen regarding detection of alveolar bone lysis and interradicular lesions and minor differences between gold standard and CBCT regarding measurement accuracy /218/. CBCT can detect the incipient alveolar bone lysis for patients with periodontal diseases /67,137,202,207,218,219/ More, CBCT has the advantage of higher accuracy and lower radiation doses, and is considered a valuable imagistic method for periodontologists.
VI.5. CONCLUSIONS

1. CBCT diagnosed chronic apical periodontitis in 39% of the investigated teeth. Using CBCT, incipient chronic apical periodontitis were detected in percentage 11.2%, while only 8.4% teeth were associated with incipient chronic periapical periodontitis if complementary method was panoramic radiography.

2. CBCT diagnosed bone lysis in 94.5% of the investigated teeth. Using CBCT, incipient bone lysis was detected in percentage 33%, while only 27.5% teeth were associated with incipient bone lysis if complementary method was panoramic radiography.

3. The use of digital filters allows the increase of visibility for horizontal and vertical bone lysis on CBCT images, with role in the increase of diagnostic performance and patient motivation to accept the therapeutical plan.

4. The use of CBCT to assess the prosthetic field is useful and allows the optimization of therapeutical management for partially edentulous patients.
CHAPTER VII. STUDY REGARDING THE ROLE OF T-SCAN IN THE ASSESSMENT OF OCCLUSAL DISORDERS

VII.2. MATERIALS AND METHOD

Study group included 20 patients with orofacial dysfunctions (muscular/ATM pain or discomfort, laterodeviations) due to partially edentations or iatrogenic fixed partial dentures, selected from patients of Dental Educational Clinical Base “Mihail Kogâlniceanu”, Faculty of Dental Medicine, U.M.F.”Grigore T.Popa” Iassy. Patients were programmed for prosthetic treatment with fixed partial prosthesis or removable partial denture. The researches were performed according to Law 46/2003 regarding patient rights. Written consent was obtained from each patient.

T-SCAN was used to record on graphs the distribution of occlusal forces on molars, bicusps and anterior teeth. The system T-SCAN allowed the calculation of occlusal forces intensity and their distribution on all dental groups.

The results are visualized on four windows presenting distribution and intensity of occlusal forces as well as analysis times. In up right window is presented the distribution and intensity of occlusal forces as colour coded tridimensional graphs. In up left is presented the distribution and intensity of occlusal forces as bidimensional image of dental arch; occlusal contacts are escribed with a yellow line. The inferior windows present graphs „Force vs. Time”. The change of occlusal forces percentages in time both to left arch (green line) and right arch (red line). The total force of right and left arches is described as black line in graph Force vs. Time.

The intensity of relative occlusal forces visible in T-SCAN graphs was recorded in Excel tables for each occlusal area. The normal differences were considered as 2-3% for homologous teeth and 4-5% for right and left arches.

The statistical analysis was performed using SPSS 17 to assess the imbalanced occlusal forces between right and left arches as well as between dental groups (molars, bicusps, anterior teeth). The results were expressed as graphs and tables performed in Excel.

VII.3. RESULTS

Figures 11.-13 present recorded data using T-SCAN on patients with orofacial dysfunctions. The results of study are expressed by graphs 14.a-e.

Patient R.E., age 48 (Class II Kennedy). Patient has dental pains, muscular pain and discomfort during mastication and ATM discomfort. Figures 12.a. and 12.b. highlight the imbalanced distribution of occlusal forces in centric relation during recording of occlusal forces for 1.38 seconds. Distribution of occlusal forces in centric relation is imbalanced, with 42.8% from total force on left arch and 57.2% from total force on right arch. Maximal level of occlusal forces is localized on occlusal areas 4.1., with a percentage of 25% from total occlusal forces. Maximal differences between occlusal forces are recorded between 3.5. and 5.5.(9%).
Fig. 12.a. F.G., 58 years. Class II Kennedy. Distribution of occlusal forces in centric relation.

Fig. 12.b. F.G., 58 years. Recording curves of occlusal forces (black - total force; red - right occlusal forces; green - left occlusal forces)

The report between mean value of occlusal forces intensity exerted, on study group patients, on right and left arches is 54%/46% (left/right) (Fig. 14.a.). 95% from patients had a difference over 3% between occlusal forces exerted on left and right arches (Fig. 14.b.).
Fig.14.a. Occlusal forces distribution on study group (right-left archs)

Fig.14.b. Prevalence of imbalanced occlusal forces on patients with orofacial systems disorders

Fig.14.e. Relative occlusal forces (mean differences between homologous teeth)

Test Mann-Whitney (non-parametric correspondent of test t) is performed to check the existence of significant statistical differences between R.A.(right arch anterior teeth) and L.A. (left arch anterior teeth).

Null hypothesis: No significant statistical differences between R.A. and L.A.

Research hypothesis: Significant statistical differences between R.A. și L.A.
Table 7.f. Mann-Whitney test (right-left arch)

<table>
<thead>
<tr>
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<td>25.10</td>
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<td>Total</td>
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</tbody>
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Table 7.g. Mann-Whitney test (right-left arch)

<table>
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<tr>
<th>Test Statistics&lt;sup&gt;b&lt;/sup&gt;</th>
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<td>Mann-Whitney U</td>
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<tr>
<td>Wilcoxon W</td>
<td>318.000</td>
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<tr>
<td>Z</td>
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<tr>
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<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.012&lt;sup&gt;a&lt;/sup&gt;</td>
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<sup>a</sup> Not corrected for ties.

<sup>b</sup> Grouping Variable: arcade

Table 7.g. indicates Mann-Whitney results, with U 108, p = 0.013 < 0.05. The results show significant statistical differences regarding the intensity of occlusal forces between right arch (R.A.) and left arch (L.A.).

Test Mann-Whitney (non-parametric correspondent of test t) is performed to check the existence of significant statistical differences between R.M. (right arch molars) and L.M. (left arch molars).

Null hypothesis: No significant statistical differences between R.M. and L.M.

Research hypothesis: Significant statistical differences between R.M. și L.M.

Table 8.g. indicates Mann-Whitney results, with U 171, p = 0.432 > 0.05. The results show the absence of significant statistical differences regarding the intensity of occlusal forces between right arch molars (R.M.) and left arch molars (L.M.).

Tables 8.f.-g. Mann-Whitney test (right-left molars)

<table>
<thead>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Pearson Correlation Coefficient

The correlation coefficient Pearson between „R BC.” And „L BC.” is 0.372, with significance level 0.106. The results show the absence of significant statistical correlation between scores „R BC.” (right arch bicusp) and „L BC.” (left arch bicusp).

### Test Statistics

<table>
<thead>
<tr>
<th></th>
<th>scor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>171.000</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>381.000</td>
</tr>
<tr>
<td>Z</td>
<td>-.785</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.432</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.445^a</td>
</tr>
</tbody>
</table>

The correlation coefficient Pearson between „R BC.” And „L BC.” is 0.372, with significance level 0.106. The results show the absence of significant statistical correlation between scores „R BC.” (right arch bicusp) and „L BC.” (left arch bicusp).

**Null hypothesis:** No significant statistical differences between R.BC. (right arch bicusps) and L.BC. (left arch bicusps).

**Research hypothesis:** Significant statistical differences between R.BC. and L.BC.

---

<table>
<thead>
<tr>
<th></th>
<th>PMDR</th>
<th>PMST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RIGHT BICUSPS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>.372</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.106</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>LEFT BICUSPS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.372</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.106</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

---

Test t (independent samples) is performed to check the existence of significant statistical differences between R.BC. (right arch bicusps) and L.BC. (left arch bicusps).
Tabel 9.f. Test t. Bicusps dental group (right arch vs. left arch)

<table>
<thead>
<tr>
<th></th>
<th>Bicusps</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RIGHT</td>
<td>20</td>
<td>11.70</td>
<td>5.469</td>
<td>1.223</td>
</tr>
<tr>
<td>LEFT</td>
<td>20</td>
<td>8.15</td>
<td>4.107</td>
<td>.918</td>
<td></td>
</tr>
</tbody>
</table>

Table 9.g. Test Levene. Bicusps (Bicusps left vs. right)

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>scor2</td>
<td>4.478</td>
<td>.041</td>
<td>2.321</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>scor2</td>
<td>2.321</td>
<td>35.262</td>
<td>.026</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The significance of Levene test is <0,05 (p = 0.975). For equal variances, \( t \) is 2,321 (p = 0.026 > 0.05). The test Levene shows **significant statistical differences** between left arch bicusps and right arch bicusps.

- Table 10.e. Pearson test. Anterior teeth (right arch vs. left arch)

**Correlations**

<table>
<thead>
<tr>
<th></th>
<th>F DR</th>
<th>F ST</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIGHT</td>
<td></td>
<td>.900**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>LEFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>.900**</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation coefficient between „F DR” and „F ST” is 0.9; significance level is 0.9, statistically significant.

The statistical analysis shows a strong correlation between scores of study groups „F DR” (right anterior teeth) and „F ST” (left anterior teeth).
The coefficient Pearson is 0.9, with a strong relation between the variables “F DR” and “F ST”.

Test $t$ was performed to check the existence of significant statistical differences. 

**Null hypothesis:** Nu există diferențe semnificative între F DR și F ST. 

**Ipoteza de cercetare:** PM DR și PM ST. diferă semnificativ din punct de vedere statistic.

**Table 10.f. Test $t$. Anterior dental group (right vs. left)**

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>Anterior</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>score</td>
<td>RIGHT</td>
<td>20</td>
<td>14.95</td>
<td>10.821</td>
<td>2.420</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>20</td>
<td>14.20</td>
<td>10.631</td>
<td>2.377</td>
</tr>
</tbody>
</table>

Table 10.f. shows that mean value of study group F DR (right anterior teeth) is 14.95, higher than study group F ST (left anterior teeth).

**Table 10.g. Test Levene. Anterior teeth (right vs. left)**

<table>
<thead>
<tr>
<th>Independent Samples Test</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>scor</td>
<td>Equal variances assumed</td>
<td>.001</td>
<td>.972</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>.221</td>
<td>37.988</td>
</tr>
</tbody>
</table>

The significance of Levene test is >0.05 ($p = 0.975$). For equal variances, $t$ is 0.221 ($p = 0.826 > 0.05$). The test Levene shows the absence of significant statistical differences between left arch anterior teeth and right arch anterior teeth.

**VII.4. DISCUSSIONS**

T-SCAN III (Tekscan, USA) are useful in computerised analysis of static and dynamic occlusion and allow the staged assessment in time of the distribution of occlusal contacts and occlusal forces as well as the loading for each occlusal contact /243/. Our study proved the possibility that T-SCAN III measures, in an objective manner, the forces developed during mastication as the intensity of occlusal forces, moment of occlusal contact, localization.
Kerstein B. is one of the few researchers that studied the possibilities of T-SCAN system to determine distribution and intensity of occlusal forces, the occlusal imbalances between left and right arches (Kerstein B. et al.2006) as well as the occlusion adjustment possibilities using function of measuring occlusion and disocclusion time (Kerstein B. et al.1991) /94,95/. Harvey WL et al.(1992) studied the reproducibility of occlusal measurements using computerized analysis systems and demonstrated the existence of significant statistical differences /70/. Walter M. et al.(1990) tested T-SCAN clinically and in laboratory tests and demonstrate increase variations regarding distribution and intensity of occlusal forces for same occlusal areas /228/. Wieczorek et al.(2011) use T-SCAN III to study the relations between distribution of occlusal forces and muscular activity on maseter and temporal muscles and demonstrate the usefulness of T-SCAN in the assessment of patients with orofacial dysfunctions /237/. The researchers demonstrated that EMG simetry on maseter and temporal muscles is directly related to the balance and simetry of occlusal contacts. In our study we also demonstrated the imbalanced occlusal forces between right and left arches as well as between homologous teeth on patients with orofacial dysfunctions.

VII.5. CONCLUSIONS

1. Patients with orofacial dysfunctions present imbalanced distribution of relative occlusal forces between right and left dental arches (54%/46%), without significant statistical differences.

2. T-SCAN use for patients with orofacial disfunctions proves the existence of different intensity of relative occlusal forces between homologous teeth, significantly statistic only for bicusps dental group.

3. T-SCAN use allows detection of premature occlusal premature contacts and interferences to patients with orofacial disfunctions.
CHAPTER VIII. SOFTWARE WITH ROLE IN DIAGNOSIS OPTIMISATION FOR PATIENTS WITH OROFACIAL SYSTEM DISORDERS

VIII.1. AIM OF STUDY

The aim of study was to demonstrate the possibilities of software application to optimise the data collecting, organisation, interpretation and to facilitate the diagnosis decisions in dentistry.

VIII.2. MATERIALS AND METHOD

Soft DENTAL DIAGNOSTIC was conceived and structured on four domains CARIOLOGY, ENDODONTICS, PERIODONTICS, PROSTHETICS (fig.16).

Each domain is structured in three modules as follows: Data Recording Module, Diagnostic Module, Educational Module.

The software structure respected the organization of clinical papers for homologous disciplines Cariology, Endodontics, Periodontics, Prosthetics of Dental Medicine Faculty, U.M.F.”Grigore T.Popă” Iassy.

VIII.3. RESULTS

CARIOLOGY domain contains a Data Recording Module that facilitates the introduction of diverse indices and codes specific to various carious lesions categories. Data Recording Module allows the recording of cariogenic risk (low, medium, high), ICDAS codes (01-06), localization of the affected dental surfaces, evolution (acute, chronic), depth (superficial, medium, deep), radiographic indices Ekstrand (E, D1, D2, D3), Diagnodent values (according to producer indications: 0-14/ healthy, 15-20/ enamel dental caries, 21-99/ dentine caries) (fig.17.a.). Diagnostic module can deliver a complete diagnostic of the investigated carious lesions related to recorded data and can associate the diagnostic with clinical and radiographic images (fig.17.b-c). Educational Module offers optimal therapeutical strategies related to the data of investigated carious lesion associated with success rate according to the data provided by literature data (fig.17.d-h).

Fig.17.a. Data Recording module(Cariology)
Fig. 17.b. Diagnostic module (Cariology)

Fig. 17.f. Educational module (Cariology)

Fig. 17.h. Educational module (Cariology)
ENDODONTICS domain contains a Data Recording Module that facilitates the introduction of localization, ethiological factors (dental caries, incorrect fillings, trauma), pain features (spontaneous-provoked, localized- irradiated, pulsating-lancinant, continuous-intermittent, low-medium-strong, amelioration to cold stimulus or anti-inflammatory drugs) vitality tests results, radiographic parameters (absent radiotranslucency, 1-5 mm diameter, 5-10 mm diameter, >10 mm diameter) (fig.18.a.).

Diagnostic module can deliver a complete diagnostic of the investigated endodontic pathology related to recorded data and can associate the diagnostic with clinical and radiographic images (fig.18.b-c). Diagnostic module can deliver a diagnostic according to clinical paper of Endodontics Discipline, Dental Medicine Faculty, U.M.F.”Grigore T.Popa” Iassy.

Educational Module offers optimal therapeutical strategies related to the data of investigated carious lesion associated with success rate according to the data provided by literature data (fig.18.h-g).

---

Fig.18.a. Data Recording module (Endodontics)

Fig.18.b. Diagnostic module (Endodontics)
PERIODONTICS domain contains a Data Recording Module that facilitates the introduction of indices and codes specific to periodontal pathology (fig.19.a.). Using Data Recording Module, it can be recorded risk factors (age, smoking, hygiene, malocclusion, systemic factors, genetic factors), hygiene oral indices, PSR indices (Periodontal Screening Recording), CPITN indices (Community Periodontal Index of Treatment Needs), type and alveolar bone lysis degree (incipient, medium, severe; generalized, localized), PBI indices, recession (mm), mobility index, pockets depth (fig.19.a).

Diagnostic module can deliver a complete diagnostic of the investigated periodontal pathology related to recorded data and can associate the diagnostic with clinical and radiographic images (fig.19.b). Diagnostic module delivers a diagnostic according to clinical paper of Endodontics Discipline, Dental Medicine Faculty, U.M.F.”Grigore T.Popa” Iassy.

Educational Module offers optimal therapeutical strategies related to the data of investigated periodontal pathology associated with success rate according to the data provided by literature data (fig.19.c-e). The delivered data cover presentation of therapy strategy regarding ethiological treatment, antibacterial medication, surgery techniques, RTG techniques.
Fig. 19.a. Data Recording module (Periodontics)

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Recording</td>
<td>Periodontics</td>
</tr>
</tbody>
</table>

Fig. 19.b. Diagnostic module (Periodontics)

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>Periodontics</td>
</tr>
</tbody>
</table>

Fig. 19.c. Educational module (Periodontics)

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational</td>
<td>Periodontics</td>
</tr>
</tbody>
</table>
PROSTHETICS domain contains Data Recording Module, Diagnostic Module, and Educational Module.

Data Recording Module allows the collecting and recording of data obtained from anamnesis (fig.20), extraoral and intraoral examen (fig.21.a-g., fig.22.a-k, fig.23.a-j., fig.24.a-e., fig.25.a-d., fig.26.a-b, fig.27, fig.28, fig.29, fig.30.a-d..fig.31.a-c., fig.32, fig.33).

Diagnostic Module is structured according to clinical paper of Prosthetic Discipline of Dental Medicine Faculty, U.M.F. “Gr.T.Popă” Iași. (fig.34.-43). This module deliver diagnostic of clinical-anatomic integrity of teeth, pulp tissues, periodontal tissues, dental arch integrity, occlusion integrity, muscular and bone integrity, ATM integrity, mandibular relations integrity, functional homeostasia integrity.

Educational Module offers optimal therapeutical strategies related to the data of investigated pathology associated with success rate according to the data provided by literature data (fig.44).
Fig. 22.a. Data Recording module

Fig. 22.b. Data Recording module

Fig. 22.g. Data Recording module
Fig. 22. Data Recording module

Fig. 25. Data Recording module

Fig. 26. Data Recording module
Fig. 26.b. Data Recording module

Fig. 37.b. Diagnostic module

Fig. 38.a. Diagnostic module
In fig.44 is presented the interface of Educational module providing therapeutical solutions (fixed partial denture, removable prosthetic solutions) and their success rate related to literature data.

![Educational module interface](image)

Fig.44. Educational module

### VIII.4. DISCUSSIONS

Masic M. (2012) performed a review of software applications used in dentistry to collect and record patients data /127/. Busanello et al. (2014) prove the role of educational software in the efficiency of educational process for students in dental medicine faculties, by comparison between students group assisted by software during learning processes and control students groups /28/. Vuchkova et al. (2012) used an interactive educational instrument for students of dental medicine faculties demonstrating the improvement of control tests results for students assisted by interactive educational software /227/. Farah CS et al.(2009) proves the efficiency of learning software application for students in dental medicine faculties /51/. Langabeer et al.(2008) performed an analysis that proves the economical advantages derived by the use of electronic recording data softwares during clinical examen and complementary diagnostic tests performed by dentists in private offices /106/.

### VIII.5. CONCLUSIONS

1. Software Dental Diagnostic is useful to facilitate and to increase the efficiency of educational process for students in dental medicine faculties.

2. Software Dental Diagnostic sustains the collecting and interpretation of recorded data during clinical examen and paraclinical tests.


4. The association between software Dental Diagnostic and online platform is useful to send updated informations for educational process of students and private dentists, regarding orofacial pathology diagnostic, complementary tests, treatment strategies.
CHAPTER IX. CLASSIC DIAGNOSTIC VERSUS MODERN DIAGNOSTIC IN ORO MAXILLO FACIAL TERRITORY

IX.2. AIM OF STUDY

The aim of study is to analyse comparatively the accuracy of oro maxillo facial diagnostic performed using classic methods and computerized methods, related to the efficiency of practical activity on students from Dental Medicine Faculty, U.M.F. “Grigore T.Popă” Iassy.

IX.3. MATERIALS AND METHOD

Study is based on comparatively analyse regarding the accuracy of oro maxillo facial diagnostic performed using classic methods and computerized methods, on a study group of 300 students, III-year, Dental Medicine Faculty, U.M.F. “Grigore T.Popă” Iassy. The computerized diagnostic was performed using a software programme, a new version of original PRODENT, developed by Univ.Prof. PhD. Forna Norina in collaboration with Neotech, existent in Clinical Educational Base of Dental Medicine Faculty, U.M.F. „Grigore T.Popă” Iassy.

The stages of study protocol were as follows:
1. Introduction of clinical and complementary data in computerized structure of clinical paper;
2. Processing of data and diagnostic performing on each clinical category according to the clinical-biological indices processing;
3. Orientation to the next diagnostic and the complementary examens requested to confirm diagnosis adopted in previous stage;
4. The elaboration of final diagnostic.

Local and regional diagnostic is related to integrity status and/or pathology of orofacial system components, according to the following stages: morphology and clinical aspects, clinical and topographic aspects, ethiology, clinical form, function disorders, evolution, complication, prognostic.

The categories of diagnostic were as follows:
- dental and pulp diagnostic
- periodontal diagnostic (gingivitis, periodontitis)
- oral diagnostic
- edentation diagnostic
- occlusal diagnostic
- ATM diagnostic
- masticatory muscles diagnostic
- intermaxillar relations diagnostic
- bone integrity diagnostic
- surgical diagnostic
- homeostasia integrity diagnostic
- oral hygiene diagnostic (plaque indices, calculus indices)

For each category, diagnostic includes the next components: clinical and morphological elements, functional elements, ethiological elements, evolution, complications, differential diagnostic, prognostic assessment related to treatment.
The parameters integration is characterized by clinical and biological indices of patient on basis of high quantities of informations stored and used on large scale to perform automatic processing for medical domain.

These programmes are frequently named Support Systems for Clinical Decisions (SSCD) or Expert Systems (ES). The data stored with these systems represent not only simple data but a collection of correlations.

Using algorithms “IF-THEN”, prognosis can be performed according to “if these conditions exist, then a certain result can be predicted, with a probability degree x” (Forna N.2011)/55/

IX.4. RESULTS AND DISCUSSIONS

The analysed categories were as follows: teeth integrity (fig.47), pulp integrity (fig.48), periodontal tissues integrity (fig.49), arches integrity (fig.50), occlusion integrity (fig.51), ATM integrity (fig.52), muscular integrity (fig.53), bone integrity (fig.54), intermandibular relations integrity (fig.55), functional homeostasia integrity (fig.56). For each pathology were analysed anatomo-clinical diagnostic, clinical form, topography, ethiology, functional disorders, evolution, complications, prognostic, treatment.

![Integrate arcada](image)

Fig.50. Computerized diagnostic method vs.classic diagnostic method. Arches integrity.

Regarding maxillary and mandibular arches integrity, treatment presented 97.2% accuracy for computerized diagnostic method, and 95.1% for classic diagnostic method; prognostic had 95.7% accuracy for computerized diagnostic method and 94.1% accuracy for classic diagnostic method; for complications, accuracy was 97.8% for computerized diagnostic method, and 97.1% for classic diagnostic method. Functional disorders presented 98.1% accuracy for computerized diagnostic method, and 94.6% for classic diagnostic method. Ethiology had 97.2% accuracy for computerized diagnostic method, and 96.6% for classic diagnostic method. Anatomo-clinical diagnosis had 95.5% for computerized diagnostic method and 93.8% for classic diagnostic method.
Regarding occlusal integrity, treatment presented similar accuracy for both diagnostic methods (94.4%), and prognostic had 98.3% accuracy for computerized diagnostic method and 96% accuracy for classic diagnostic method; for complications, accuracy was 95.6% for computerized diagnostic method, and 95% for classic diagnostic method. Functional disorders presented 98% accuracy for computerized diagnostic method, and 96.6% for classic diagnostic method. Ethiology had 96.4% accuracy for computerized diagnostic method, and 93.1% for classic diagnostic method. Anatomo-clinical diagnosis had 94.5% for computerized diagnostic method and 92.1% for classic diagnostic method.

IX.5. CONCLUSIONS

1. The study highlights the superiority of computerized diagnostic comparing with diagnostic performed by classical means, due to the integrative concept of analysis software.
2. Depending on particularities of clinical case, similar results or minor superiority of classic diagnostic can occur.
3. Computerized diagnostic methods have practical relevance in educational process of students.
GENERAL CONCLUSIONS

1. Byte-wing radiography, performed on occlusal dental surfaces with ICDAS 01-04, indicates the absence of demineralization in percentage 48%, enamel demineralization in percentage 28%, dentine demineralization in percentage 24%.

2. ICDAS system, on occlusal dental surfaces, indicates enamel demineralization (ICDAS 02) in percentage 56%, demineralization localized in enamel internal half and dentine external third in percentage 32% din cazuri and demineralization localized in dentine internal half in percentage 8%.

3. Byte-wing radiography indicates occlusal carious lesions extended in dentine for 24% occlusal surfaces with ICDAS 01-04.

4. The visual examen with teeth separation indicates 59% prevalence of proximal carious lesions. The radiographic examen indicates a prevalence of 32% for panoramic examen 52% for byte-wing method.

5. Byte-wing radiography indicates enamel proximal dental caries in 15% of the investigated proximal surfaces and proximal carious lesions extended in dentine in percentage 37%.

6. Byte-wing radiography (88%) has superior sensitivity values (88%) comparing to panoramic radiography (52.25%), regarding the diagnostic performance of incipient proximal carious lesions. Significant statistical differences were found between panoramic and byte-wing radiographic methods.

7. CBCT diagnosed chronic apical periodontitis in 39% of the investigated teeth. Using CBCT, incipient chronic apical periodontitis were detected in percentage 11.2%, while only 8,4% teeth were associated with incipient chronic periapical periodontitis if complementary method was panoramic radiography.

8. CBCT diagnosed bone lysis in 94.5% of the investigated teeth. Using CBCT, incipient bone lysis was detected in percentage 33%, while only 27.5% teeth were associated with incipient bone lysis if complementary method was panoramic radiography.

9. The use of digital filters allows the increase of visibility for horizontal and vertical bine lysis on CBCT images, with role in the increase of diagnostic performance and patient motivation to accept the therapeutical plan.

10. The use of CBCT to assess the prosthetic field is useful and allows the optimization of therapeutical management for partially edentulous patients.

11. Patients with orofacial dysfunctions present imbalanced distribution of relative occlusal forces between right and left dental arches (54%/46%), without significant statistical differences.

12. T-SCAN use for patients with orofacial disfunctions proves the existence of different intensity of relative occlusal forces between homologous teeth, significantly statistic only for bicuspis dental group.
13. T-SCAN use allows detection of premature occlusal premature contacts and interferences to patients with orofacial disfunctions.

14. Software Dental Diagnostic is useful to facilitate and to increase the efficiency of educational process for students in dental medicine faculties.

15. Software Dental Diagnostic sustains the collecting and interpretation of recorded data during clinical examen and paraclinical tests.


17. The association between software Dental Diagnostic and online platform is useful to send updated informations for educational process of students and private dentists, regarding orofacial pathology diagnostic, complementary tests, treatment strategies.

18. The study highlights the superiority of computerized diagnostic comparing with diagnostic performed by classical means, due to the integrative concept of analysis software.

19. Depending on particularities of clinical case, similar results or minor superiority of classic diagnostic can occur.

20. Computerized diagnostic methods have practical relevance in educational process of students.
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