Abstract

Introduction of teleradiography represented a turning point for orthodontic diagnosis and treatment, offering the possibility to quantify the deviations/alterations of the structures forming the dental-maxillary apparatus. The aim of the paper is to establish the orthodontic diagonal characteristics in a group of 60 patients, by applying the computer-based interpretation of profile teleradiography, assessed comparatively with the classical interpretation methods in use.

The group of patients under investigation showed a general tendency towards the presence of class II Angle anomalies with compensating dental modifications. The accuracy of the computer-based cephalometric measurements is comparable to that obtained by the classical ones, leading to a rapid and correct orthodontic diagnosis.

Keywords: orthodontic diagnosis, dental-maxillary anomaly, computer-based cephalometry

Introduction

Cephalometric radiography (teleradiography) represents a paraclinical means for establishing essential diagnosis in orthodontics. The data provided by the profile teleradiographies offer valuable information, permitting to evaluate the growth and development of the facial skeleton, to establish a treatment strategy and to interpret the results thus obtained.

The rapid progress of the techniques of informatics now creates the conditions for computer-based cephalometric analyses in a considerably shorter time, with fewer calculation errors, and a rapid archivation of the radiological images.

Up to now, several studies have comparatively analyzed the accuracy of the data obtained through computerized interpretation of digitized, scanned or directly-digital radiographies, versus the data provided by classical, manual interpretations.\textsuperscript{1,6}

The present study establishes the orthodontic diagnosis pattern of the group under investigation, along with a comparative analysis of the accuracy of the results of linear and angular cephalometric measurements, obtained by manual and computer-based techniques for the interpretation of teleradiographies. Digital images have been obtained by scanning the analogical films, while computerized processing made use of the Orthalis cephalometric program.

The initial comparative studies were mainly devoted to a precise identification of the cranio-metric points position. The present outlook considers that the accuracy in the identification of the cephalometric points is not sufficient to test a new diagnosis system, such as computerized cephalometry.

Recent approaches are focused on linear and angular cephalometric measurements, which actually represent the final target in devising and interpreting teleradiographies, providing the necessary data for a correct treatment strategy.\textsuperscript{7,8}

Materials and method

The study group included the initial teleradiographies of 60 subjects (38 girls and 22 boys), made with the same radiological device. The teleradiographies were randomly selected from the group of patients who came for treatment.

The exclusion criteria of the teleradiographies were: obvious malpositions of the head in cephalostate, the presence of included incisors
or the absence of incisors, the presence of included teeth in the apex area of the incisors.

The teleradiographies were drawn on a negatoscope, in a dark room, with a 0.5 mm mechanic pencil, on 0.003 inch mat paper. The outlines of the soft tissues and the skeletal and dental contours were drawn, and the cephalometric points were established. The measurements, made with a cephalometric protractor and a millimetric ruler, followed the parameters of Steiner cephalometric analysis.

For their computerized processing, the radiographies were digitized through scanning (on an UMAX Powerlook 1000 scanner), at a 300 DPI resolution, being converted into JPEG (Joint Photographic Experts Group) type digital images, format 2548x3510 pixels. Computerized interpretation made use of the Orthalis cephalometric program (Fig 1).

In a first stage, the images were calibrated to diminish the errors induced by magnification and scanning, by setting two points on the scale of each radiography, and by following the cranio-metric points and the soft tissues points involved in contour delineation and also in automatic calculations. The obtained data were introduced in Excell tables subsequently processed with the SPSS statistical program.

Analysis of the main variables of interest was based on graphical and numerical methods:
- the descriptive indices (arithmetic mean, the mediant, average quadratic deviation, asymmetry, vaulting, quartile, variation coefficient) were calculated;
- the confidence intervals for the arithmetic mean were determined;
- graphical representations of variables’ distributions were plotted (histograms and box-plots);
- the differences between the average values were tested by the t Student test;
- the average values of the variables were compared with the standard (reference) values, both numerically and graphically.

The statistical descriptive indices calculated for analyzing the variables were the mediant, the mean quadratic deviation (standard deviation), asymmetry, vaulting, quartiles. Further on, a graphical comparison (involving histograms and box-plot diagrams), as well as a numerical comparison (with the t Student) of the results were performed, for the sake of precision, using the classical and computerized Steiner method.

Results

A comparison between the average variables and the reference values will provide specific variation values for each parameter under analysis (Table 1).

The graphical comparison of the mean values with the standard ones showed that the most important differences are recorded for ANB and AoBo, the lowest ones appearing for 1/NA mm and 1s/1i.
Table I. Average variables and reference values – A comparative presentation

<table>
<thead>
<tr>
<th>Index</th>
<th>Std. Steiner</th>
<th>Classical Steiner</th>
<th>Modification (%) versus std. value</th>
<th>Modern Steiner</th>
<th>Modification (%) versus std. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNA</td>
<td>82</td>
<td>80.07</td>
<td>2.35</td>
<td>81.77</td>
<td>0.28</td>
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<tr>
<td>SNB</td>
<td>80</td>
<td>76.02</td>
<td>4.98</td>
<td>76.87</td>
<td>3.91</td>
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<tr>
<td>ANB</td>
<td>2</td>
<td>4.05</td>
<td>-102.50</td>
<td>5.46</td>
<td>-173.00</td>
</tr>
<tr>
<td>SND</td>
<td>76</td>
<td>73.65</td>
<td>3.09</td>
<td>74.53</td>
<td>1.93</td>
</tr>
<tr>
<td>1/NA mm</td>
<td>4</td>
<td>3.33</td>
<td>16.75</td>
<td>3.45</td>
<td>13.75</td>
</tr>
<tr>
<td>1/NB mm</td>
<td>4</td>
<td>4.67</td>
<td>-16.75</td>
<td>4.63</td>
<td>-15.75</td>
</tr>
<tr>
<td>1/NA grade</td>
<td>22</td>
<td>22.08</td>
<td>-0.36</td>
<td>21.57</td>
<td>1.95</td>
</tr>
<tr>
<td>1/NB grade</td>
<td>25</td>
<td>22.83</td>
<td>8.68</td>
<td>23.78</td>
<td>4.88</td>
</tr>
<tr>
<td>1s/1i</td>
<td>131</td>
<td>131.93</td>
<td>-0.71</td>
<td>-</td>
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<td>SNOcl</td>
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<td>15.35</td>
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<td>17.88</td>
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<tr>
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<td>32.82</td>
<td>-2.56</td>
<td>32.17</td>
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<tr>
<td>1/Sna-Snp</td>
<td>110</td>
<td>110.78</td>
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<tr>
<td>AoBo</td>
<td>2</td>
<td>3.22</td>
<td>-61.00</td>
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<td>FMA</td>
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<td>-</td>
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</tbody>
</table>

Figura 2. Comparison between average and standard values using the classical Steiner method
Results of a comparative evaluation of the cephalometric parameters under analysis. The correlation coefficient varied between 0.000 and 0.914 (Table 2).

Discussion

Table I and Figure 2 show that a comparison between the reference values with the values obtained by measurements performed either classically or by modern techniques indicates a slight tendency towards class II in patients from the experimental group (ANB classical - 4.05, ANB modern - 5.46), as a result of the presence of an important number of cases of mandibular retrognatism, while the development of the jaw bone remains within normal limits. In this case, too, the values of the digitally drawn angles are higher than their corresponding ones, obtained by manual measurements. At dental level, a tendency towards natural compensation may be noticed, proclination of the low incisors (1/NB – 4.67 mm) being accompanied by a slight retroclination of the superior ones (1/NA – 3.33 mm). An encouraging factor is the general pattern of a vertically normal facial development (SNGoGn – 32.82°).

Table II shows the presence of variables for which the average values obtained by the two methods are significantly different, as value Sig. is below 5%.

These variables are: SNA, SNB, ANB, SND and SNOcl. Out of the ten measured parameters (7 angular, 3 linear), significant differences have been registered for the 5 angular ones, between manual and computerized drawing. The highest average difference occurs for angle SNOcl – 2.5°, followed by angles SNA – 1.7°, ANB - 1°, SNB and SND – 0.8°. Mention should be made of the fact that, for all five angles, higher values were recorded for computerized drawing, the differences being probably caused by the magnification errors induced by conversion of the analogical film into digital image.

Another possible explanation for the existence of these errors might be the difficult identification of points A, Na (Na is present in all five measurements showing statistical differences), as also evidenced by other researchers.

With the exception of the SNOcl angle, the values of the average differences for the other 4 measurements occur within the ± 2° interval of clinical confidence established by Gregston.

Conclusions

1. Diagnosis of the dental-maxillary anomalies established by computerized cephalometric measurements is quite close to the accuracy achieved with classical methods, being, therefore, clinically acceptable.
2. The experimental group of patients showed a general tendency towards a class II Angle dental-maxillary anomaly, with mandibular retrognatism, maxillary retroclination and mandibular proclination.

3. The amplitude of the differences recorded between the initially measured and the control values is quite low, being statistically significant, yet clinically acceptable. Both the classical, manual and the modern, computerized techniques provide results leading to a correct diagnosis.

References