SEX-RELATED DIFFERENCES IN THE LIPS AND MOUTH AREA OF BUGLARIANS – AN INVESTIGATION BY 3D LASER SCANNING

Tsvetanka Petleshkova¹, Pavel Timonov², Stefan Sivkov¹, Mancho Manev⁴, Miroslava Yordanova⁵, Svetlana Yordanova⁵, Boyan Vladimirov³, Yanitsa Zhecheva⁶, Ivaila Ivanova-Pandurska⁶

¹Department of Anatomy, Histology and Embryology, Medical University of Plovdiv
²Department of Pathologic Anatomy and Forensic Medicine, Medical University of Plovdiv
³Department of Maxillofacial Surgery, Medical University of Plovdiv
⁴Faculty of Mathematics and Informatics, Plovdiv University Paisii Hilendarski
⁵Department of Orthodontics, Medical University of Plovdiv
⁶Institute of Experimental Morphology, Pathologic Anatomy and Anthropology with Museum, Bulgarian Academy of Sciences

ABSTRACT

PURPOSE: The objective of this study was to supply information about normal sex-related dimensions of the mouth area and lips among contemporary Bulgarian population (linear distances, ratios, angles, area, volume) and compare the results with other populations.

MATERIALS AND METHODS: The three-dimensional coordinates of several soft-tissue landmarks on the lips and mouth were obtained by a non-invasive method with FastSCAN in 16 male and 23 female healthy subjects aged 21–35 years. From the landmarks, linear distances (mouth width, width of the philtrum, vermilion heights of the upper, lower and total lips, total lip height), the vermilion height-to-mouth width ratio, areas (vermilion of the upper, lower and total lip) and volumes (upper, lower, and total lip volume) were calculated and averaged for sex.

RESULTS: Comparisons were performed by SPSS 17.0. Data collected in the present investigation could serve as a database for the quantitative description of human lip morphology during normal growth, development and aging. Conclusion. Forensic applications (evaluations of trauma, craniofacial alterations, teratogenic-induced conditions, facial reconstruction, aging of living and dead persons, personal identification) may also benefit from age- and sex-based data banks.

Key words: 3D laser scanning, sex-related dimensions of the mouth

INTRODUCTION

The face comprises probably the most characteristic features of the individual. That is why identification of a person is done mainly by assessment of the face (4,8,16). Mouth and lip morphology play a key role in the evaluation of the craniofacial complex. Determination of the sizes and types of mouth corners, thickness of the lips and their peculiarities form the basis for the so-called
composite drawings in forensic practice. Even after reaching biological maturity facial elements continue to change (1-3,5-7,9-15,17,18,20). Studying the morphological changes associated with gender and age helps to identify a living or dead person. Besides, knowledge of the reference dimensions of the orolabial complex for certain age, gender, population or race is important in orthodontics and maxillofacial surgery with respect to both diagnosis and treatment (3,10,15).

The aim of the present investigation was:
1. To compare the morphology of the mouth and lips in healthy men and women of young age and Bulgarian origin.
2. To search for an association of some cephalometric variables with the height and weight of the studied individuals.

**MATERIAL AND METHODS**

Thirty nine individuals (16 men and 23 women) were included in the study. Their mean age was 26.03±7.3, mean weight was 70.38±17.3, and mean height – 172.28±10.4 /Mean±SD/. The included subjects were all above 20 years because of the considerably lower rate of change of facial structures and the pronounced sex dimorphism after this age which was the aim of the present study. The excluding criteria were as follows: craniomaxillofacial trauma, congenital malformations, surgical or plastic interventions of the mouth and lips, genetic and psychiatric conditions. The facial surface was scanned by means of a laser scanner (FastSCAN) in a standard head position (Frankfort horizontal plane). The following cephalometric points were placed on the thus created three-dimensional model: sn, ls, sto, li, sl, cph and ch (r – right; l - left). Each point is characterized by x, y and z values. /figure 1, 2/. The studied measurements were calculated according to mouth and lip geometric models proposed by Sforza et al. (19).

1. Linear measurements /mm/: L1 – mouth width (chr-chl); L2 – philtrum width (cphr-cphl); L3 – height of upper lip vermilion (ls-sto); L4 – height of lower lip vermilion (sto-li); L5 – total vermilion height (ls-li); L6 – total height of skin lip (sn-sl);
2. Ratios /%/: R – total lip height to mouth width (ls-li/chr-chl) x 100;
3. Area (mm²): upper lip vermilion /S1/ (surface of a quadrangle, defined by the points chr, ls, chl, sto); lower lip vermilion /S2/ (surface of a quadrangle, defined by the points chr, li, chl, sto); total vermilion /S3/ (surface of a quadrangle, defined by the points chr, ls, chl, li);
4. Volume (mm³): upper lip - V3 (calculated as the sum of the volumes of two pyramids: the base of the first pyramid, defined by points chr, ls, chl, sto; the base of the second pyramid, defined by points chr, li, chl, sto); lower lip - V6 (again, the base of the first pyramid was defined by points chr, ls, chl, li) and the apex by sl, while the base of the second pyramid was chr, chl, li and the apex sto); total lip volume - V7 (sum of the volumes of the four pyramids).
RESULTS

The results were analyzed statistically with the help of SPSS 17.0. Kolmogorov – Smirnov test was used to determine the distribution of the variables. The Independent Samples test and Mann – Whithney test were utilized to search for differences between men and women, as well as to find correlations between the studied parameters on one hand and the height and weight of the subjects on the other hand. The level of significance was set at 0.05.

The mean values of the taken measurements (Mean±SD) are shown in Table 1.

DISCUSSION

In general, it was found that male dimensions were greater than female dimensions within a certain age group. This finding found confirmation in other studies too (19).

The Kolmogorov – Smirnov test demonstrated that the studied dimensions were normally distributed /p>0.05/ with the exception of L 2 /p<0.05/.

The Independent Samples test showed significant differences between the two genders for the following normally distributed variables: L1, L5 и L6. Hence, they can be used successfully to discriminate between sexes /Table 2/.

A positive correlation was found between L1 and the subject's height /r = 0.399  p = 0.012/ and weight /r = 0.370  p = 0.02/, between S1 and height /r = 0.383  p = 0.016/ and weight /r = 0.335  p = 0.037/, between S2 and height /r = 0.439  p = 0.005/ and weight /r = 0.351  p = 0.028/, between S3 and height /r = 0.420  p = 0.008/ and weight /r = 0.355  p = 0.026/, between V3 and height /r = 0.400  p = 0.012/ and weight /r = 0.449  p = 0.004/, between V6 and height /r = 0.408  p = 0.01/ and weight /r = 0.368  p = 0.021/, between V7 and height /r = 0.427  p = 0.007/ and weight /r = 0.431  p = 0.007/.

CONCLUSION

The creation of three-dimensional facial models can be used in different clinical and experimental disciplines, in plastic and maxillofacial surgery for the reconstruction of soft and hard tissues after trauma or malformations, for the diagnosis of some genetic and psychiatric diseases. In forensic anthropology they may become important for facial reconstruction, for the creation of composite drawings based on verbal descriptions, as well as in the process and methods of identification.

Tabl. 1.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Male</th>
<th>SD</th>
<th>Female</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, mm</td>
<td>52.29±4.41</td>
<td>46.73±2.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L2, mm</td>
<td>21.48±20.3</td>
<td>12.26±2.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L3, mm</td>
<td>6.40±1.74</td>
<td>5.74±1.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L4, mm</td>
<td>20.06±7.08</td>
<td>17.13±2.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L5, mm</td>
<td>25.06±4.30</td>
<td>22.70±2.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L6, mm</td>
<td>33.95±7.84</td>
<td>29.26±3.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1, mm²</td>
<td>161.9±49.92</td>
<td>142.94±32.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2, mm²</td>
<td>494.68±128.1</td>
<td>433.73±73.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3, mm²</td>
<td>649.62±199.77</td>
<td>580.31±79.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V3, mm³</td>
<td>2343.32±976.44</td>
<td>2077.79±522.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V6, mm³</td>
<td>2474.2±1045.33</td>
<td>2309.07±564.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V7, mm³</td>
<td>4817.52±1947.36</td>
<td>4386.86±972.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R, %</td>
<td>48.12±8.09</td>
<td>48.79±6.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tabl. 2.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>16</td>
<td>23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>52.29±4.41</td>
<td>46.73±2.99</td>
<td>t = 4.682</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>L5</td>
<td>25.06±4.30</td>
<td>22.70±2.83</td>
<td>t = 2.066</td>
<td>p = 0.046</td>
</tr>
<tr>
<td>L6</td>
<td>33.95±7.84</td>
<td>29.26±3.58</td>
<td>t = 2.497</td>
<td>p = 0.017</td>
</tr>
</tbody>
</table>
The present study was based on research project 02/25 from 20.12.2010 financed by the Ministry of Education and Science: “Cephalometric investigation and 3D virtual modelling of the face for the construction and visualization of 3D facial statistics and the establishment of a cephalometric database”.

REFERENCES