RELIABILITY OF SEX ESTIMATION BY LATERAL ANGLE METHOD AND METRIC ANALYSIS OF REGION OF THE FORAMEN MAGNUM

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Introduction
Estimation of sex, age, ethnicity and stature forms basic pillars of forensic anthropology. Even if it is necessary to gain as much relevant information as it is possible; it has to be bear in mind that even if complete skeleton remains are available, biological profile is possible to be estimated and not determined.

In the field of forensic investigation, fragmentary skeletal human remains demand special approach to be handled. Incompleteness of material induced subsequent osteological studies dealing with sexual dimorphism of different parts of bones, especially those, which usually survive also bad condition of burial or taphonomical process in relatively good state. It is necessary to test already published methods because a set of variables, which are discriminant in one population, may not be as discriminating when applied to a different population due to the interpopulation variation in sexual dimorphism.

Test of accuracy of sex estimation by Lateral angle method

In terms of preservation, the petrous part of temporal bone is one of the densest structures in the human skeleton. Petrous portion may be usually found also in mechanically damaged or even cremated remains. This resistance induced several studies to consider significance of exhibited sexual dimorphism in petrous portion (Wahl 1981; Norén et al. 2005; Graw et al. 2005. Akamal et al. 2008). For testing the sexual dimorphism the lateral angle (LA) of meatus acusticus internus was selected, which denotes the angle of internal acoustic canal in relation to the medial surface of the petrous bone (Figure 2).

Sample and methods
Data were obtained by using CT scanner Siemens – Somatome Volume Zoom on Radiodiagnostic ward FNpP Ružinov in Bratislava.

The sample comprises 125 patients who underwent CT scanning of paranasal sinuses for diagnostic purposes. There were sixty-four females (age range: 15-85 years) and sixty-one males (age range: 19-61 years).

The LA was measured on axial images of head using method modified from cadaveric studies (Norén et al. 2005).

Results

<table>
<thead>
<tr>
<th>LDs</th>
<th>mean</th>
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<tbody>
<tr>
<td>x</td>
<td>-0,153</td>
</tr>
<tr>
<td>y</td>
<td>0,024</td>
</tr>
<tr>
<td>Sectioning point</td>
<td>0</td>
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<td>&gt; 0</td>
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Probability of correct sex classification 0,568

The formula for linear discriminant function analysis follows:

\[ \text{sex} = \left[ x\text{-mean (x)}\right] \times \text{LD(x)} + \left[ y\text{-mean (y)}\right] \times \text{LD(y)} \]

The resultant formula for linear discriminant function analysis follows:

\[ \text{sex} = \left[ x\text{-mean (x)}\right] \times \text{LD(a)} + \left[ y\text{-mean (y)}\right] \times \text{LD(b)} \]

Discussion
Using linear discriminant analysis the probability of correct classification of sex by using Lateral angle method is only 0.688. The blind trials of previously published studies revealed varying percentage (66% to 83.2%) of correctly assigned sex (Norén et al. 2005; Graw et al. 2005; Akamal et al. 2008) pointed out that using extreme value characteristic for one sex will exclude the majority of opposite. Nevertheless the practical applicability of this principle is difficult, because the selected extreme point was common neither for females nor for males. The higher probability of correctly classified sex of fragmentary remains is when the foramen magnum is considered. 0.8. In previously published studies percentage of correctly assigned sex varieded from 69.2 and 81% (Holland 1986; Upasal et al. 2008; Gappert et al. 2009). Our results are in concordance with them.

Another skeletal part which is usually well preserved is foramen magnum region. The basis of cranium is protected by large soft tissue masses comprises muscle, tendon and ligaments. As such, the occipital region may prove useful of sex estimation in cases of significantly fragmented remains.

Sample and methods
The parameters of foramen magnum region were measured in a total of 75 patients. Sample comprises 38 females (age range: 15-80 years) and 37 males (age range: 19-86 years).

The parameters of foramen magnum were measured as follows: length (LC; LRC - right; LLC - left) and width (WC; WRC - right; WLC - left) of occipital condyle, minimum intercondylar distance (MnID), maximum bicondylar distance (MBD), length (LFM) and width (WFM) of foramen magnum.

Results

<table>
<thead>
<tr>
<th>LDs</th>
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<tbody>
<tr>
<td>a</td>
<td>LFM</td>
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<td>b</td>
<td>WFM</td>
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<td>g</td>
<td>MBD</td>
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<td>h</td>
<td>MnID</td>
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The result of sex estimation using foramen magnum region

Graph 1: Boxplots of LA values in degrees for females and males showing wide overlapping of values

Table 1: Linear discriminants for sex estimation by LA

Table 2: Linear discriminants for sex estimation using foramen magnum region

References