GENDER RELATED PATTERNS IN THE SHAPE AND DIMENSIONS OF THE FORAMEN MAGNUM IN AN ADULT KENYAN POPULATION

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ABSTRACT
Foramen magnum is a useful landmark in the base of the skull. Its shape and dimensions show ethnic and gender differences. This data is useful in forensic medicine and anthropology but are unknown among Kenyans. Two hundred and two dry adult skulls from the Osteology Department at the National Museums of Kenya, were studied. The shape of the foramen magnum was oval, circular and polygonal in 13%, 24% and 63% of the cases respectively. The foramen magnum does not show sexual dimorphism in shape among Africans. The shape of foramen magnum cannot be used in solitude to ascertain the gender of skulls.

Key words: Foramen magnum, variations

INTRODUCTION
The foramen magnum is an important structure of the skull base and is of particular interest for anthropology, anatomy, forensic medicine, and other medical fields (Grubber et al., 2009). Foramen magnum shows ethnic and gender dimorphism in its dimensions and shapes (Catalina-Herrera, 1987; Murshed et al., 2003). Achondroplasia and other bone disorders distort the size of the foramen magnum (Hecht et al., 1985). Shapes of the foramen magnum have been described to be oval, round, tetragonal, pentagonal, hexagonal and irregular (Murshed et al., 2003). The shape of the foramen magnum is of radiological, forensic and clinical value (Harvati and Weaver, 2006). The size and shape of the foramen magnum in the Kenyan population is largely unknown. The aim of the present study is to document the gender dimorphism in the morphometry and shape of the foramen magnum in the Kenyan population.

MATERIALS AND METHODS
Two hundred and two skulls were acquired from the Osteology Department of the National Museums of Kenya. This is a labeled collection, obtained in Kenya between 1956 and 1971. The anteroposterior (AP) and transverse diameters of the foramen magnum were determined using a sliding caliper [Figure 1] (Precision 0.001) and taken as a mean measurement of two different observers. The AP dimensions were between the AP diameter was between the basion and opisthion. Tranverse diameters were measured from the margins of the foramen at its junction with the posterior ends of the occipital condyles. The shape of the foramen was observed, compared to pretested shape models and recorded as circular, oval or polygonal. Data obtained were analyzed using Statistical Package for Social Sciences (SPSS) for windows version 17.00 Chicago Illinois 2010.
RESULTS

One hundred and thirty eight (68%) male and 64 (32%) female foramen magnum were assessed. The shape of the foramen magnum was oval, circular and polygonal in 13%, 24% and 63% of the cases respectively. There were no significant gender differences in the shapes of the foramen magnum. The mean AP and transverse diameters were 3.85±0.65cm (4.00cm for males and 3.4cm for females, p=0.191) and 3.50±0.7cm (3.8cm for males and 2.80cm for females, p= 0.220) respectively (p=0.267).

DISCUSSION

The foramen magnum is wider in the AP dimensions than lateral dimensions. In addition, it is wider in males than females, similar to observations made in previous reports (Catalina-Herrera, 1987; Günay and Altinkök, 2000). Similar to observations made in other studies, the gender difference in AP and lateral dimensions were however not significant (Grubber et al., 2009).
Table 1: Ethnic variations in the dimensions of the foramen magnum

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Populations</th>
<th>Sample size</th>
<th>AP (mm)</th>
<th>Transverse (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Sendemir et al., 1994</td>
<td>Turkish</td>
<td>27</td>
<td>35.1 +/- 2.8</td>
<td>28.7 +/- 2.2</td>
</tr>
<tr>
<td>Present study</td>
<td>Kenyan</td>
<td>138</td>
<td>40</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Since this gender difference in AP and lateral dimensions were not statistically significant it implies that more reliable markers that display distinct sexual differences should instead be utilized in forensic identification of skulls (Claudio et al., 2009; Raghavendra Babu et al., 2012). The dimensions of the foramen magnum show ethnic variations. It is wider in Africans compared to Caucasians (Table 1).

The shape of the foramen magnum was often polygonal, without significant gender disparities different from observations made in previous studies (Table 2). The shape of the foramen magnum is determined by the spinal cord and the hind brain (Rosing et al., 2007). This shape can guide surgeons in instrumentation and manipulation around this region.

Table 2: Comparison of the shapes of foramen magnum in different populations

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Sample size</th>
<th>Oval (%)</th>
<th>Round (%)</th>
<th>Polygonal (%)</th>
<th>Other (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zaidi and Dayal, 1988</td>
<td>Indian</td>
<td>200</td>
<td>64</td>
<td>0.5</td>
<td>32</td>
<td>35</td>
</tr>
<tr>
<td>Present study</td>
<td>Kenyan</td>
<td>138</td>
<td>13</td>
<td>24</td>
<td>63</td>
<td>-</td>
</tr>
</tbody>
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