Morphometric analysis of hard palate and its clinical importance

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Abstract

Background & aim: The study of hard palate is important because of its role in speech articulation. The aim of the present study was to determine the palatine length, breadth and position of greater palatine foramen [GPF].

Material & Method: 50 dried, unsexed skulls from C U Shah Medical College, Surendranagar were studied. Palatine length, breadth & distance of Greater palatine foramen [GPF] to middle maxillary sutures [MMS] were measured with help of vernier caliper. Result: Mean palatine length and breadth were 47.10±3.34mm & 36.26±2.55mm respectively. The distance of GPF from MMS was 16.55 mm & 16.57 mm on right and left side respectively. The palatine index showed that 68% of the skulls had narrow [Leptostaphyline], 20% intermediate [Mesostaphyline] & 12 % wide [Brachystaphyline] palates. Conclusions: These observations would be helpful for anatomists, anthropologists and also to surgeons for various surgical procedures on hard and soft palates.

Keywords: hard palate, length, breadth, greater palatine foramen

Introduction:

The hard palate lies within the alveolar arch and is slightly arched from before backwards and from side to side. It is formed by the assembly of the palatine processes of maxillae and horizontal parts of palatine bones, separated by a cruciform sutures. Three fourth of the bony palate is contributed by maxillae and one fourth by palatine bones. Posteriorly it ends in a crescentic free margin which presents a middle backward projection, the posterior nasal spine. The greater palatine foramen [GPF] is situated close to the lateral border of hard palate medial to the third molar tooth, and from it a groove runs forward. The foramen transmits greater palatine vessels and nerves. The lesser palatine foramina, usually two on each side lies just behind the greater palatine foramen. The lesser foramina convey corresponding vessels and nerves.

Restricted bony pharynx leads to sleep apnoea syndrome in which there is difficulty in breathing during sleep. The knowledge of normal structure and dimension of the palate region is helpful for various procedures at the level of upper respiratory system like nasopharyngoscopy and nasogastric intubation. It is also useful in the causes of nasopharyngeal carcinoma for understanding the cause of spread of carcinoma. Dentists, anaesthetics and maxillofacial surgeons had to know the location of the foramina in order to carry out accurate nerve block of the maxillary nerve during procedures such as upper tooth extraction, maxillary dental implants, orthognathic surgery and cleft palate surgery.

The aim of the present study was to determine the palatine length, breadth and position of greater palatine foramen.

Material and methods:

The present study was conducted on 50 skulls in the Department of Anatomy at C.U.Shah Medical College, Surendranagar, Gujarat.

Following measurements were taken with the help of vernier caliper.

1. Length was the distance between orale [anterior end of incisive suture located between the sockets of the two medial maxillary incisors] anteriorly and posterior nasal spine posteriorly.
2. Breadth was the distance between inner border of sockets of upper second molar [endomolaria].
3. Distance from middle maxillary suture [MMS] to Greater palatine foramen [GPF] was also measured.
4. The palatine index was calculated by formula: breadth/length X 100.

According the palatine index, the hard palate was classified into 3 types.
### Table 1: Palatine index

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leptostaphyline</td>
<td>&lt;80%</td>
<td>34 [68%]</td>
</tr>
<tr>
<td>Mesostaphyline</td>
<td>80-85%</td>
<td>10 [20%]</td>
</tr>
<tr>
<td>Brachystaphyline</td>
<td>&gt;85%</td>
<td>06 [12%]</td>
</tr>
</tbody>
</table>

### Table 2: Comparison between various studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>Palatine length[mm]</th>
<th>Palatine Breadth[mm]</th>
<th>Palatine index</th>
<th>Distance from GPF to MMS[mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hassanali &amp; Mwaniki</td>
<td>49.2±3.6</td>
<td>40.2±3</td>
<td>L-43.2%, M-23.7%, B-33.1%</td>
<td>-</td>
</tr>
<tr>
<td>Mannoham Patel</td>
<td>49.56±3.95</td>
<td>36.65±3.03</td>
<td>74.2±6.64</td>
<td>-</td>
</tr>
<tr>
<td>Antony Sylvian Dsouza</td>
<td>49.13</td>
<td>40.04</td>
<td>L-42[70%], M-9[15%], B-16[40%]</td>
<td>Rt-14.6±1.47, Lt-14.4±1.40</td>
</tr>
<tr>
<td>Badal Jotania</td>
<td>49.74</td>
<td>37.75</td>
<td>L-42[70%], M-9[15%], B-16[40%]</td>
<td>Rp-14.80±1.20, Lt-14.83±1.52</td>
</tr>
<tr>
<td>Mitesh Dave</td>
<td>43.54±0.28</td>
<td>33.83±0.20</td>
<td>L-83[63%], M-24[24%], B-13[13%]</td>
<td>-</td>
</tr>
<tr>
<td>Erli Sarilta</td>
<td>52.2±3.2</td>
<td>37.97±3.32</td>
<td>L-84.1%, M-7.9%, B-7.9%</td>
<td>Rt-14.0±1.4, Lt-13.5±1.5</td>
</tr>
<tr>
<td>Varalakshmi KL</td>
<td>48.47±4.66</td>
<td>36±4.41</td>
<td>L-43[66%], M-12[18.5%], B-10[15.5%]</td>
<td>-</td>
</tr>
<tr>
<td>Saadia A Shalaby</td>
<td>51.65±4.7</td>
<td>38.68±2.9</td>
<td>L-64[64%], M-24[24%], B-12[12%]</td>
<td>Rt-14.25±1.7, Lt-14.17±1.6</td>
</tr>
<tr>
<td>Vinodini Lakmala</td>
<td>M-54.18, M-34, F-48</td>
<td>M-34, M-48.1, F-32.54</td>
<td>M-62.75, F-67.79</td>
<td>-</td>
</tr>
<tr>
<td>Anil Kumar</td>
<td>M-52.5±0.37, F-48.1±0.36</td>
<td>M-36.51±0.27, F-32.33±0.20</td>
<td>L-50[58%], M-23[27%], B-13[15%]</td>
<td>-</td>
</tr>
<tr>
<td>Vasudha Kulkarni</td>
<td>40.42</td>
<td>44.15</td>
<td>L-179[86.9%], M-3[1.4%], B-24[11.6%]</td>
<td>-</td>
</tr>
<tr>
<td>Present Study</td>
<td>47.10±3.34</td>
<td>36.26±2.55</td>
<td>L-34[68%], M-10[20%], B-06[12%]</td>
<td>Rt-16.55±1.17, Lt-16.57±1.19</td>
</tr>
</tbody>
</table>
Type 1: Leptostaphyline [L] : Narrow palate with index < 80%.
Type 2 : Mesostaphyline [M] : Intermediate palate with index 80%-85%.
Type 3 : Brachystaphyline[B] : Wide palate with index > 85%.

Results:
In the present study, Mean palatine length was 47.10±3.34 mm and Mean palatine breadth was 36.26±2.55 mm. The mean value of the distance of Greater palatine foramina [GPF] from Middle maxillary suture [MMS] was 16.55±1.17 mm on right side and 16.57±1.19 mm on left side.

Discussion:
The study of hard palate is important because of its role in feeding and speech articulation. It is also related with various congenital malformations like cleft palate.
The mean palatine length and breadth were 47.10±3.34 mm and 36.26±2.55 mm in our study which are close to the observations by Varalakshmi KL [48.47 mm & 36 mm]. The palatine length observed by Hassanali & Mwanki [49.2mm], Mannmohan Patel [49.56mm], Antony Sylvan Dsouza [49.13mm], Badal Jotania [49.74mm], Erli Sarilita [52.2mm], Saadia A Shalaby [51.65mm], Anil Kumar [M-52.5mm, F-48.1mm] & Vinodini Lakmala [Male -54.18mm, Female - 48mm] is greater than our findings. Mean
palatine length was 43.54mm in study by Mitesh Dave & 40.42mm in study by Vasudha Kulkarni, is less than our study.

The mean Palatine breadth observed in our study [36.26mm] is close to observation of Mannohnam Patel [36.65 mm], Varalakshmi [36 mm], Badal Jotania [37.75mm] & Erli Sarilita [37.97mm]. While the mean palatine breadth observed by Antony Sylvian D’Souza [40.04mm] and Hassanali & Mwaniki [40.2mm] is higher than our finding. Observation by Mitesh Dave [33.83mm] & Vinodini Lakmala[Male :34mm, Female : 32.54mm] is less than our finding.

We observed 68% leptostaphylone, 20% mesostaphylone and 12% brachystaphylone palates. These results are consistent with study by Mitesh Dave [L-63%,M-24%,B-13%], Varalakshmi KL [L-66%,M-18.5%,B-15.5%]& Saadia A Shalaby[L-64%,M-24%,B-12%]. Badal Jotania and Erli Sarilita observed predominant leptostaphylone palate followed by equal number of mesostaphylone and brachystaphylone. Hassanali and Mwaniki observed 43.2% leptostaphylone, 33.1% brachystaphylone and 23.7% mesostaphylone. While Antony Sylvian D’Souza showed brachystaphylone[40%] more prominent followed by leptostaphylone[37.5%] and mesostaphylone[22.5%].

Distance of GPF from MMS was 16.55mm on right side & 16.57mm on left side, which is higher than the previous study of Antony Sylvian D’Souza [RT-14.6mm, LT-14.4mm], Badal Jotania [RT-14.80mm, LT-14.83mm],Erli Sarilita [RT-14.02mm,LT-13.57mm] & Saadia A Shalaby [RT-14.25mm,LT-14.17mm].

The palate consists of two parts, primitive and permanent. The primitive palate includes a wedge shaped area in front of the incisive fossa and carries the four incisor teeth. The primitive palate is formed by the fusion of the globular swellings of the median nasal process and the maxillary process. The permanent palate is developed from the fusion of the palatine processes of both maxillae across the middle line. The fusion between primitive and permanent palate takes place in a X shaped manner. Ventral three fourth of the permanent palate is ossified to form the hard palate. The fusion between the primitive and permanent palates and between the palatine processes occur before backwards & is completed by the eighth week”.

Conclusions:
Morphometric knowledge of hard palate is important for anatomists, surgeons, anthropologists and forensic experts. Detailed anatomical study of hard palate is helpful for Dentists, anaesthetics & maxillofacial surgery for various procedure and surgeries related to hard & soft palate. Hard palate is used as donor graft in various surgeries of face reconstruction such as of lower lip, lower eyelids, maxilla. Resection of the hard palate is done for management of benign and malignant tumours. Knowledge of location of greater palatine foramen is important when administrating of local anaesthesia in surgeries of palate.

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