Dental Arch Shape and Dimensions Influence Maxillary and Mandibular Third Molar Impaction

Introduction

Third molar impaction is a common pathology worldwide, with prevalence estimated at 24.4%. Third molar extraction is therefore among the most common oral-maxillofacial surgeries performed, and there is ongoing debate over the risks and benefits of prophylactic third molar extraction. The frequency of third molar impaction has been hypothesized to result from evolutionary reduction of the human face that has occurred in tandem with expansion of the neurocranium and reduction of the masticatory apparatus. To test our hypothesis that certain dental arch dimensions could contribute to obstruction of an erupting third molar on both the human mandible and maxilla, we collected landmark coordinates from 3D scans of dental casts collected from 61 individuals living in India in the 1980s.

Research Questions:

- Which dental arch dimensions differ in those with and without third molar impaction?
- Are there differences in the relationships between dental arch dimensions and third molar impaction between sexes and caste populations?

Caste

<table>
<thead>
<tr>
<th>Caste (tribe)</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meda (tribe)</td>
<td>Impacted = 4</td>
<td>Non-impacted = 13</td>
</tr>
<tr>
<td>非-impacted = 2</td>
<td>Non-impacted = 3</td>
<td></td>
</tr>
<tr>
<td>Mahar (caste)</td>
<td>Impacted = 10</td>
<td>Non-impacted = 8</td>
</tr>
<tr>
<td>非-impacted = 1</td>
<td>Non-impacted = 1</td>
<td></td>
</tr>
<tr>
<td>Maratha (caste)</td>
<td>Impacted = 5</td>
<td>Non-impacted = 14</td>
</tr>
<tr>
<td>非-impacted = 0</td>
<td>Non-impacted = 0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Impacted = 19</td>
<td>Non-impacted = 35</td>
</tr>
<tr>
<td>非-impacted = 3</td>
<td>Non-impacted = 4</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Sample sizes by sex, caste, and impaction used in these analyses.

Materials and Methods

- Dental casts were made in India in 1983-1984 under the direction of Dr. John Lukacs with support from the Smithsonian Institution in collaboration with the Government Dental Hospital and Clinic (Ahmedabad), Deccan College, Post-Grad Research Institute (Pune), and Sri Venkateswara University, Department of Anthropology (Tirupati).
- Each dental cast has associated records including date of birth, birthplace, age, sex, and anthropometric measurements including stature and weight.
- All three populations inhabit Maharashtra: the Meda are a Gond tribe and among the most socio-economically disadvantaged groups in India, the Mahar are of low stature and weight, and the Maratha of high socio-economic status.
- Dental casts from 61 individuals between 18-30 years of age (the time frame for third molar eruption) were scanned using the Trios intraoral scanner.
- Third molar impactions were determined visually following published visual standards.
- LA collected landmarks from the maxillary and mandibular dentition and bone of all individuals.
- General Procrustes Alignment and principal component analysis were performed on each digitized sample, and linear models and ANOVA were used to identify individual and population-level differences.

Results

- Maxillary, but not mandibular, PC1 scores differ significantly by caste.
- Maxillary and mandibular PC1 scores do not differ significantly by sex.
- Maxillary and mandibular arch lengths do not differ significantly by caste or sex.
- Maxillary and mandibular PC1 scores significantly differ with M3 impaction (Figure 2).
- There is a stronger positive relationship between maxillary and mandibular arch length in the sample without M3 impaction (Figure 4).

Discussion

These data suggest dental arch shape may influence third molar impaction, both maxillary and mandibular, or vice versa. The difference between maxillary and mandibular relationships between those with and without impaction also suggest a lack of developmental integration between the maxilla and mandible in those with M3 impaction. Though whether this is due to some innate biological difference or an environmental interruption of growth is unclear. Additionally, the significant difference in maxillary PC1 scores between casts suggests population-level environmental or genetic differences that will require further study. Further research will also be needed to evaluate the application of these statistical findings to other human populations.

Acknowledgements

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References