Co-relation between face form and edentulous mandibular ridge form: a clinical study

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Abstract

Purpose: The purpose of the study was to evaluate the correlation between face form and edentulous mandibular ridge form.

Material and Methods: Sixty edentulous patients were selected, 20 of each facial type i.e. square, ovoid and tapered. Casts of the mandibular arch of these patients were made. Frontal facial photographs of the patient and cast was taken. Five anatomic points on each cast and five facial landmarks on photographs were identified. The landmarks on the cast were joined by straight lines using computer software and angles formed were digitally measured. Similar procedure was repeated for the facial photographs. The results were then statistically analyzed.

Results: A definite correlation existed between the face form and the corresponding arch form. (p<0.007, highly significant through ANOVA and Tukey HSD test of Pair wise comparisons except b'<bo'. According to Karl Pearson's coefficient of correlation, maximum correlation was found between square face form (0.731 @ p<0.001) and minimum correlation between taper face form (0.456 @ p=0.043).

Conclusion: A square facial type had a square shaped dentulous arch form however a similar correlation could not be established for tapered and ovoid facial forms.

Key words: Face form, mandibular ridge form, facial photograph

Introduction

In the management of completely edentulous patient, artificial teeth arrangement must harmonize with the natural anterior arch form which relates with the face form. Correct teeth arrangement, however, has been a longstanding dilemma due to uneven resorption of the maxillary residual ridge. Maxillary ridge form, which is often considered as convenient landmark for teeth placement, can undergo resorption of labial and buccal alveolar processes consequent to tooth loss, resulting in change of its original form. On the other hand, even with resorption occurring in a downward and inward direction, the mandible still tends to preserve its original outline form. Face form has been classified as square, tapered, ovoid and more recently square taper type of faces. It has been suggested that teeth arrangement must correspond with the facial type i.e. a square face must be given a square shaped teeth arrangement. This indirectly would imply that a relation may exist between the face form and the edentulous arch form, although no study has been done to validate this relationship. This clinical study was performed to establish correlation between face form and mandibular ridge form in different facial types.

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Materials and methods

Sixty edentulous patients between the age of 50 to 70 years were selected for this non-probability convenience sampling. Patients were selected with well demarcated anatomic landmarks i.e. retro-molar pad and canine eminence. Patients with gross facial asymmetry, i.e. palsy, maxillary/mandibular/facial defect etc were excluded from the study. Standardized photographic procedure was adopted to shoot frontal photograph of each subject. The camera (Sony Cybershot DCS-W55; 7.2 Mp 3X optical zoom, which was mounted on a tripod (SIMPEX333) at a fixed height of 135 cm was used. The natural head position of patient was taken as the reference plane and was stabilized by using a water bulb gauge. Mandibular impressions were made using Impression Compound (DPI Pinnacle) and casts were poured (Gypstone dental stone type-III). Standardized procedure was employed to take the photograph of the mandibular cast of subjects. Five key orthognathic anatomic landmarks were marked on each photograph using software (adobe Photoshop). The landmarks were zygomatic prominence - left and right(Zn), gonion angle of mandible(G) - left and right, symphysis menti(S). Each of these landmarks was joined with straight lines and the angles formed were measured using software. (Digital Screen Protractor) Five key orthognathic anatomic landmarks were marked on each cast viz the anterior tip of the retromolar pads - left and right, canine eminence - left and right, crestal point (that point on the crest formed by dropping perpendicular from midpoint of inter canine eminence line). (Fig 1) The angles between these landmarks were again measured using the same software. (Fig 2).

The null hypothesis was that there is no correlation between the face form and the edentulous arch form. The alternate hypothesis was that a correlation exists between the face form and the edentulous arch form. The angles on the face should relate in following order, based on simple geometry $\angle a > \angle a' > \angle b$ and $\angle b < \angle b'$, where $t$ = tapered face form, $o$ = ovoid face form, $s$ = square face form.

Angle $a$ is the angle formed between $Zn-G-S$ while angle $b$ is angle formed between right $G-S$-left $G$ on the photograph of a particular patient and angle $a'$ and

<table>
<thead>
<tr>
<th>TYPE</th>
<th>face $&lt;a$</th>
<th>face $&lt;b$</th>
<th>cast $&lt;a'$</th>
<th>cast $&lt;b'$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>126.80</td>
<td>146.50</td>
<td>130.55</td>
<td>142.55</td>
</tr>
<tr>
<td>Taper</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>141.50</td>
<td>118.90</td>
<td>139.55</td>
<td>134.85</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>5.296</td>
<td>4.518</td>
<td>6.151</td>
<td>6.293</td>
</tr>
<tr>
<td>Ovoid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Mean</td>
<td>132.35</td>
<td>129.20</td>
<td>134.60</td>
<td>135.65</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>7.548</td>
<td>11.759</td>
<td>6.082</td>
<td>10.449</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Mean</td>
<td>133.55</td>
<td>131.53</td>
<td>134.90</td>
<td>137.68</td>
</tr>
</tbody>
</table>
are corresponding angles measured on the casts of the same patients. If the alternate hypothesis holds true, then the same relation should be found between $\alpha^t > \alpha^o > \alpha^s$ and $\beta^t < \beta^o < \beta^s$.

The patients were divided into three groups according to face form as square shaped, ovoid and tapered face forms. The angles on the face and their corresponding casts were measured. Table I One way ANOVA test was used to compare the angles of the three groups. To find correlation between the sequences, Mann-Whitney U test was employed and Pearsons correlation coefficient was used to compute comparison between individual values.

Results

Using oneway analysis of Variance for comparing three groups (square, taper and ovoid groups) and using Tukey HSD Tests for multiple comparisons, results shows mean of at > ao > as ($p < 0.001$) & bt < bo < bs ($p < 0.001$) highly significant through ANOVA and Tukey HSD test of Pairwise comparisons except bt’<bo’.

The Mann Whitney U test shows that the two sequences at > a$^o > a^s$ and a$^t > a'^o > a'^s$ matched exactly ($p=0.830$) ; the two sequences b$^t < b^o < b^s$ and b$^t' < b'^o < b'^s$ matched exactly ($p=0.520$). According to Karl Pearsons coefficient of correlation for square type, $r$ (between a & a$^t$) = 0.731 ($p<0.001$), $r$ (between b & b$^t$) = 0.654 ($p=0.002$), taper type, $r$ (between a & a$^t$) = 0.456 ($p=0.034$), $r$ (between b & b$^t$) = 0.540 ($p=0.014$) and ovoid type, $r$ (between a & a$^t$) = 0.601 ($p=0.005$), $r$ (between b & b$^t$) = 0.460 ($p=0.041$) (Fig 5).

Discussion

Esthetics is a fundamental requirement of modern denture prosthesis, unfortunately, the ability to establish a harmonious relationship between the artificial teeth and alveolar ridge in their proper relation to facial harmony is not readily acquired. However, it has been well documented that the teeth arrangement must correspond with the face form to attain maximum esthetic harmony. A mismatch between the two factors leads to loss of facial details and natural expressions. In the edentulous mouth, the loss of teeth results in loss of facial harmony. Replacement by artificial teeth in the correct relation becomes difficult because the maxillary ridge form which is often considered as convenient landmark for teeth placement can undergo resorption of labial and buccal alveolar processes consequent to tooth loss resulting in change of its original form. Literature suggests that the mandibular ridge, however, tends to preserve its outline form even though resorption occurs in a downward and inward direction.
In this study, facial soft tissue landmarks were taken as guide for categorizing face forms and standard anatomic landmarks were taken as guide for categorizing mandibular ridge form. The landmarks were joined and angles were measured to assess the pattern of similarity between angles formed on the face and the angles formed on the corresponding casts.

The sequence matching through Mann Whitney U Test showed an exact correlation between at > ao > as and at’ > ao’ > as’ (p=0.83); and between bt < bo < bs and bt’ < bo’ < bs’ (p=0.520). There is a definite correlation between face form and ridge form in the 3 groups. For the population assessed, the mean “a (retromolar pad to canine eminence) for a square face ranged from 123.93 to 137.17. For taper face Da ranged from 133.40 to 145.70 and for ovoid face it ranged from 128.52 to 140.68. The mean Db’ (canine eminence to crestal point) for square face ranged from 135.62 to 149.48, for ovoid from 125.16 and 146.14 and tapered from 128.56 and 141.14. With respect to the anterior mandibular ridge, it was widest for the square face and progressively most acute for the tapered face. This shows that the posterior mandibular ridge was most acute for a square face and progressively became obtuse for tapered faces.

The coefficient of relation between Da and Da’ for square face is 0.731 (p<0.001), for tapered is 0.456 (p=0.043) while for ovoid is 0.601 (p=0.005). The coefficient between Db and Db’ for square face is 0.654 (p=0.002), taper =0.540 (p=0.014) and ovoid = 0.460 (p=0.041). These values show that for a square shaped face there was a strong correlation between the angles on face and cast. Ovoid face had strong correlation with respect to Da and taper face with Db. The difference in correlation between the groups may be attributed to the fact that there was an overlapping of the taper and ovoid facial forms. The reasons for correlation between the face form and mandibular arch form could be genetic predisposition, esthetics, personality, endocrinal/hormonal factors or factors related to muscle function.

Conclusions
A strong correlation exists between angular measurements of the face form and mandibular ridge form between the different groups (square, facial and ovoid). Within the groups, square form had the highest correlation between the face form and mandibular ridge form. The mandibular ridge form, as a stable guide for artificial teeth setting is valid in case of a square face, while for other facial types, slight overlapping is observed. Future studies with bigger sample size and a derived mathematical formula of each arch could be used to attain specific results.

References
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