SUMMARY

It is a well known fact that gonial angles of the edentulous patients are wider than those of the dentate ones. However, the causative factor for this widening is unclear. It has been proposed that after extraction of all teeth the progressive resorption of alveolar ridge may have an effect on the widening of this angle. The purpose of this study was to investigate the relationship between mandibular ridge resorption and the size of the gonial angle. A total of 158 panoramic radiographs were analyzed retrospectively for mandibular ridge resorption and gonial angle size.

The results of the present study suggest that females have wider gonial angles and more alveolar ridge resorption compared to males. However, there was no statistically significant correlation between the gonial angle size and mandibular ridge resorption level. As a conclusion, the widening of the gonial angle in edentulous subjects appears to be independent of the alveolar ridge resorption.

Keywords: Alveolar Ridge; Resorption; Gonial Angle; Panoramic Radiographs; Age; Gender

Introduction

The gonial angle is formed by the line tangent to the lower border of the mandible and the line tangent to the distal border of the ascending ramus and condyle[4,15]. The effect of the individual age and gender on the size of the gonial angle is controversial in the literature. Although some studies have shown a widening of the gonial angle with the increasing age[6,15], a lot of articles have reported differing results[3,17,19]. Moreover, most of the studies have indicated a wider angle in female subjects[3,8,19], while this finding has not been confirmed in some other studies[15,17].

Numerous articles have shown a statistically significant widening in the gonial angle of the edentulous subjects compared to the dentate ones[2,3,11,13,15]. The justification of this difference shows a discrepancy in the literature. While some authors have suggested that the decrease in masticatory force after extraction of all teeth may have an effect on the widening of the gonial angle[9,17], others have proposed that changes in mandibular bone after tooth extraction include a progressive resorption of the residual ridge that may cause the widening of this angle[3,18].

The design of the earlier studies, in which a difference in the gonial angle was determined between dentate and edentulous stages, was cross sectional[5,11,13,15,17,19,20]. However, a number of longitudinal studies indicate that the gonial angle size doesn’t differ during the edentulous period[2,6,7]. Thus, the effect of the reduced muscle activity seems more relevant to justify this phenomenon. Ingervall and Thilander[9] have shown that dentate subjects with strong masseter and anterior temporal muscles have small gonial angles. It has also been found that the EMG activity and muscle density were lower in edentulous subjects than the dentate ones[16]. Additionally, in a study of Raustia and Salonen[17], it has been revealed that there is a correlation between increased EMG activity in the masseter muscle and small gonial angle size in a complete denture wearing population.

There are only a few studies wherein the correlation between the amount of the residual ridge resorption and gonial angle size was investigated[5,14,17,19]. Xie and Ainamo[19] have reported a negative correlation between the size of the gonial angle and the average height of the mandibular residual body of the edentulous subjects. On the other hand, Raustia and Salonen[17], Nissan et al[14] and
Engström et al have pointed out that residual resorption of the mandible appears to be independent of the gonial angle. The purpose of the present study was to investigate the relationship between the size of the gonial angle and the amount of the alveolar residual ridge resorption on the panoramic radiographs of edentulous subjects.

Materials and Methods

A total of 170 panoramic radiographs (Panoura 10 CSU, Yoshica Dental Co. Ltd. Tokyo Japan) from the collection of the Removable Prosthetic Department of Istanbul University were investigated retrospectively. These radiographs were obtained from the patients who referred to the university clinic for renewal of their complete dentures.

In 12 radiographs, it was not possible to detect the mental foramen bilaterally. Thus these images were excluded from the study. In 8 images from the remaining 158 radiographs, the mental foramen was detectible only in one side. These images were analyzed unilaterally. So a total of 156 right and 152 left side measurements were prepared.

The resorption of mandibular ridge was measured by the method of Wical and Swoope 21, in which the original height of the mandible is assumed to be 3 times the distance between the inferior border of the mandible to the lower border of the mental foramen. The amount of resorption from the original alveolar level to the measured level of the residual ridge was expressed as a percentage of the original height of the mandible (Fig. 1). All measurements were made with a digital caliper (Mitutoyo Corporation, Kanagawa, Japan).

Gonial angles were measured by tracing a line on the panoramic radiographs tangent to the most inferior points at the gonial angle and the lower border of the image of the mandible, and another line tangent to the posterior borders of the ascending ramus and condyle on each side. The intersection of these lines formed the gonial angle.

15 panoramic radiographs were randomly selected and re-measured at an interval of 10 days to test inter- and intra-observer reliability.

Statistical analyses of the results were conducted on a personal computer with SPSS 10.0 for Windows (SPSS Inc., Chicago, Ill). A Spearman’s Rho Test was used to analyze the correlation between the mandibular ridge resorption and the gonial angle values. To investigate the side differences of the above mentioned values a Wilcoxon matched pair test was applied. Additionally, a Mann-Whitney U test was used to analyze the gender differences.

Results

Inter- and intra-observer reliability results of the measurements of the mandibular ridge resorption and gonial angle are illustrated in table 1. Since there was no statistically significant difference between right (33.79% ridge resorption; 122.75° gonial angle) and left (34.34% ridge resorption; 122.99° gonial angle) side measurements, the data of both sides were put together.

The Mann-Whitney U test has shown that the female subjects had statistically significant larger gonial angles (p<0.01) and more resorption on the mandibular ridge compared to the male subjects (Tab. 2).

The difference of the mean ages of the male (62.15 ± 9.12) and female (63.23 ± 9.21) subjects was not statistically significant. There was also no correlation between age and gonial angle size, both in male and female subjects. However, in male subjects, a positive correlation between age and the amount of the mandibular ridge resorption was detected (r = 0.528 and p = 0.000). According to the resorption levels, the subjects were divided into 2 groups: minimal resorption (<33%) and severe resorption (>33%). The mean ages of the subjects for the minimal and severe resorption groups were shown in table 3. No statistically significant difference was detected in gonial angles of the subjects with minimal and severe alveolar ridge resorption. The Spearman’s Rho Test showed also lack of correlation (r = 0.037, p = 0.519) between gonial angle and mandibular ridge resorption (Figs. 2 and 3).

Table 1. Inter- and intra-observer reliability of the measurements

<table>
<thead>
<tr>
<th></th>
<th>Mandibular ridge resorption</th>
<th>Gonial angle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inter-observer</td>
<td>Intra-observer</td>
</tr>
<tr>
<td>Correlation coefficient (r)</td>
<td>0.833*</td>
<td>0.891*</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.01 level (2-tailed)
Table 2. The alveolar ridge resorption and gonial angles in males and females

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resorption (%)</td>
<td>36.86 ± 14.16</td>
<td>30.00 ± 15.94</td>
<td>.000</td>
</tr>
<tr>
<td>Gonial Angle (in degree)</td>
<td>123.95 ± 6.96</td>
<td>121.28 ± 7.40</td>
<td>.004</td>
</tr>
</tbody>
</table>

**Mann-Whitney U Test

Table 3. The relationship between age and alveolar ridge resorption in males and females

<table>
<thead>
<tr>
<th>Age</th>
<th>Resorption</th>
<th>n*</th>
<th>Mean</th>
<th>SD</th>
<th>P**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>Minimal</td>
<td>73</td>
<td>60.42</td>
<td>8.60</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>53</td>
<td>72.29</td>
<td>6.15</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>Minimal</td>
<td>61</td>
<td>57.95</td>
<td>10.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Severe</td>
<td>121</td>
<td>62.40</td>
<td>8.36</td>
<td>.139</td>
</tr>
</tbody>
</table>

*Right and left sides were computed together

**Mann-Whitney U Test

Discussion

Several studies have reported that panoramic radiographs are reproducible and accurate for the linear and angular measurements on mandibles. Larheim and Svanaes have found that the gonial angle assessed from a panoramic film was almost identical that measured on the dried mandible. It has been shown that reliability of the panoramic radiography technique for imaging of the mandible is highly dependent on head position. The panoramic radiographs in the present study were made by 2 experienced radiographers using the same panoramic unit.

Resorption of the residual alveolar ridge has been measured using various radiographic techniques. Although the panoramic radiographs have several limitations to monitor the resorption of the alveolar ridges, like difficulties in standardization of the head position and controlling the distortion and magnification of the images, there is an important advantage of this technique. Panoramic radiographs are often a part of the routine examination of patients, thus their use for research purpose does not involve the patient in any additional exposure or cost, and they are a very good source for the retrospective studies. The technique for the measurement of the alveolar ridge resorption used in the present study was described by Wical and Swoope. In a study of Wilding et al., in which the reliability of this technique was tested, it has been concluded that the use of this technique is sufficient to provide information about resorption of the residual mandibular alveolar bone compared to a more complicated method.

Xie et al. have found that females have more alveolar ridge resorption than males, while Atwood and Coy have presented a slightly higher rate in males. The results of the present study have suggested that alveolar ridge resorption is more noticeable in females. This phenomenon could be explained with the effect of the menopausal activity in women on the alveolar ridge resorption. The results of this study have also shown statistically significant larger gonial angles in female subjects compared to the males. This result is in accordance with several studies. Raustia and Salonen have shown a negative correlation between masseteric activity and the gonial angle size, and it is well known that females have lower muscular activity than males. Otherwise, Xie et al. have found a negative correlation between gonial angle size and alveolar ridge height. The results of the present study haven’t suggested a correlation between alveolar ridge resorption and the gonial angle size. This result is in accordance with some other studies. Thus, within the limitation of this study, it could be speculated that the larger gonial angle in female subject is a result of the lowered masseteric activity - the widening of the gonial angle appears to be
more dependent of the increased muscular activity than the alveolar ridge resorption.

Conclusion

The results of this study showed that the female subjects have statistically significant larger gonial angles and more resorption on the mandibular ridge compared to the male subjects, and there was no correlation between size of the gonial angle and amount of the mandibular resorption.

References


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