Changes in Mandibular Ridge Height in Relation to Aging and Length of Edentulism Period

This study investigated the mandibular height reduction in relationship to aging and the length of edentulism period. Data were collected from 120 edentulous male subjects (complete denture wearers) who were divided into two resorptive age groups. The edentulism period of the subjects was classified as 1 to 5, 5 to 10, and over 10 years. Ridge resorption was estimated on the panoramic radiograph by estimating the original height of the alveolar process as being three times the distance from the inferior border of the mandible to the inferior edge of the mental foramen. According to statistical analysis, the amount of mandibular height reduction increased in the older age group. The mandibular resorption rate was greatest in the earlier stages of edentulism and slowed with longevity of edentulism.


One of the perplexing problems associated with complete denture patients is change or loss of supporting bone. This is a chronic, progressive, irreversible, and disabling disease, and it is probably of multifactorial origin. Bone loss varies from patient to patient, but the most dramatic changes occur in the mandibular arch.

In microscopic pathology of this disease, there is an osteoclastic activity, especially on the external surface of the crest of residual ridges. In gross pathology, on dry specimens the external cortical surfaces of the mandible are uniformly smooth, while the crestal area of the residual ridge is much more porous. Mandibles having severe resorption may display gross porosity of the medullary bone on the crest of the ridge and may eventually display the uncovering of the inferior alveolar canal.

Resorption of the residual ridge has been measured using a variety of radiographic techniques. Lateral cephalometric radiographs provide a possibility for determining the amount of residual ridge and the rate of its reduction over a period of time.

The panoramic radiographic technique described by Wical and Swoope is a simple, useful method for arriving at a gross estimate of the amount of residual ridge resorption in a given patient and has been used in many studies.

The purpose of this study was to investigate the amount of mandibular ridge resorption in relationship to aging and edentulism period.

Materials and Methods

One hundred and twenty male edentulous subjects participated in this study. The study was limited to men to overcome variables associated with osteoporosis and menopause. All were complete denture wearers and were divided into two resorptive age groups: those 40 to 60 years of age and those over 60 years of age. Age groups and periods of edentulism of the subjects are shown in Table 1. The resorption of mandibular ridge was measured by the method of Wical and Swoope. A standard panoramic radiograph (Siemens orthopantomograph 10, Bensheim, Germany) of each subject was made. All radiographs used in this study were made with the same machine and by the same individual. On this radiograph, the right mental
foramen was identified. Alveolar resorption was estimated by taking the original height of the alveolar process as being three times the distance from the inferior border of the mandible to the lower border of the mental foramen. The amount of bone loss 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 ruler and caliper to the nearest 0.5 mm by the same individual (Figs 2 and 3).

The analysis of variance (ANOVA) was used to test measurement significance.

**Results**

The means and standard errors of percentage ridge reduction in relationship to edentulism period in the 40 to 60 years age group can be seen in Table 2. Table 3 shows the means and standard errors of percentage ridge reduction for the subjects over 60 years.

The minimum mandibular height reduction expressed as a percentage of the estimated original height of mandible was 9% and the greatest was 49%. Nearly 66% of the subjects had mandibular height reductions of less than 30%.

### Table 1 Age Groups and Edentulism Period of Subjects

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age groups (y)</th>
<th>Edentulism period (y)</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>20</td>
<td>40-59</td>
<td>1-5</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>40-59</td>
<td>5-10</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>40-59</td>
<td>over 10</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td>over 60</td>
<td>1-5</td>
</tr>
<tr>
<td>E</td>
<td>20</td>
<td>over 60</td>
<td>5-10</td>
</tr>
<tr>
<td>F</td>
<td>20</td>
<td>over 60</td>
<td>over 10</td>
</tr>
</tbody>
</table>

### Table 2 Comparison of Percentage Ridge Reduction in Mandibular Height With Edentulism Period in 40-59 Years Age Group

| Group | Edentulism period (y) | n | Mandibular height reduction Mean (%) | Standard error of mean (\%)
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>A</td>
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<td>21.88</td>
<td>1.87</td>
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<td>B</td>
<td>5-10</td>
<td>20</td>
<td>23.20</td>
<td>2.11</td>
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<tr>
<td>C</td>
<td>over 10</td>
<td>20</td>
<td>24.91</td>
<td>1.97</td>
</tr>
</tbody>
</table>

### Table 3 Comparison of Percentage Ridge Reduction in Mandibular Height With Edentulism Period in Subjects Over 60 Years

| Group | Edentulism period (y) | n | Mandibular height reduction Mean (%) | Standard error of mean (\%)
<table>
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<tr>
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<th></th>
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</thead>
<tbody>
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<td>24.30</td>
<td>1.90</td>
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<tr>
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<tr>
<td>F</td>
<td>over 10</td>
<td>20</td>
<td>32.50</td>
<td>2.01</td>
</tr>
</tbody>
</table>

Fig 1 Diagram of method of estimating original height of atrophied mandible.

Fig 2 Panoramic radiograph showing limited residual ridge reduction.

Fig 3 Panoramic radiograph of patient who is estimated to have lost more than two thirds of the original mandibular height.
The means of percentage ridge reduction within the 40 to 60 years age group increased from 21.88% to 24.91% with edentulous age. Within the group over 60 years, these means increased from 24.30% to 32.50%. It can be concluded that mandibular ridge resorption continued with time. Early mean reduction in mandibular height was followed by slower mean resorption as the period of edentulism increased. This reduction was significant between groups D and F (P < .01).

The rate of resorption increased with age. A significant relationship between mandibular height reduction and age was found between groups B and E (P < .05) and groups C and F (P < .01).

Discussion

Gross resorption of the edentulous mandibular alveolar process resulting in excessive loss of the denture bearing ridge is one of the most difficult restorative problems facing the prosthodontist. Tallgren stated that a clinically significant amount of mandibular osteopenia occurs in edentulous patients, especially in postmenopausal women among whom the reduction of residual ridges is accelerated. According to Nordin, osteoporosis develops at different rates in men and women. But Atwood and Coy found low correlation between alveolar ridge reduction and sex. Because of these conflicting findings, the present investigation was conducted on male subjects. Further investigations on female subjects are in the scope of an intended investigation.

In growing individuals, bone formation is greater than bone resorption. The two processes are in equilibrium in the adult. However, in the aged, the resorption may not be compensated by production of bone resulting in senile osteoporosis. Thus, it can be argued that bone resorption is a part of normal aging and is balanced between the anabolic and catabolic metabolism of the body. Several studies have evaluated age-related changes in mandibular bone. According to these studies, it can be summarized that bone loss appears to be physiologic and the reduction in mandibular bone volume has a linear relationship with age. However, a low correlation between the rate of reduction of residual ridges and age was established by Atwood and Coy. Newton-John and Morgan stated that the bone loss begins at about 45 to 65 years in men. In the present study, the age groups were planned in two categories as the younger resorptive age group (40 to 60 years) and the older resorptive age group (over 60 years). According to the findings of this study, mandibular resorption was present in both groups, but in the older age group the height of mandibular ridge decreased significantly. It was apparent that mandibular resorption and age were correlated.

Ward et al found 30.73% mandibular height reduction in men with an average edentulism period of 13 years. In the study of Karaağaçlıoğlu and Aydın this reduction was 26.50% in subjects between 44 to 72 years of age and having an edentulism period of 5 to 10 years. Parkinson compared the percentage reduction in mandibular height with edentulous age and found the reduction to be 21.00% in 1 to 10 years, 27.42% in 11 to 20 years, and 32.54% in 21 to 30 years of edentulousness in men without considering the age factor. The results obtained in this study concerning mandibular height reduction in relationship to age and edentulism period supports the findings of the above-cited authors. In a 25-year study of complete denture wearers, Tallgren reported that there is a rapid reduction of the height of the alveolar ridge during the first year of denture wearing and there is a continued reduction in mandibular height during extended denture wearing. According to Smith and Applegate, edentulous areas in the mandible usually do not undergo severe diffuse atrophy during a period of less than 5 years. In the present study, mandibular resorption rate was greatest in the earlier stages of edentulism and slowed as the edentulism period elapsed. A mean loss of 21.08% of the mandibular height was evident during the first 5-year period of edentulism; in the next 10 years and over, the mean reduction of ridges increased an additional 3.03%, for a total loss of 24.91% in the younger age group. In the group over 60 years of age, early mean reduction of mandibular height was 24.30%, and in an edentulism period of 10 years and over, it increased with an additional 8.02%, for a total loss of 32.50%.

Parkinson carried out a similar investigation of the relationship of the length of edentulism period and mandibular height reduction and found also a deceleration of resorptive rate and attributed this finding to the inhibitory influences of the muscle fibers attached to the lateral walls of the mandible.

Although, in both age groups, mandibular resorption percentage was found greatest in earlier edentulism period, the progression of this reduction was smaller in the younger age group (from 21.88% to 24.91%) than in the older age group (from 24.30% to 32.50%, P < .01). This may be attributed to the lack of neuromuscular control in elderly people that makes the masticatory activity detrimental to bone.
Summary and Conclusions

This study investigated whether or not a relationship exists between mandibular resorption and the length of edentulism period and/or age. Within the limitations of the study and with the understanding that only male subjects were evaluated, the following conclusions can be made:

1. The reduction in mandibular height has a linear relationship to age.
2. Early mean reduction in mandibular height was followed by slower mean resorption as the period of edentulism increased in both age groups.
3. In the older age group, the progression of mandibular resorption in relationship to edentulism period was faster than in the younger age group.

References