ABSTRACT

Aim: The aim of the present research is to characterize the morphological features of the upper and lower jaws in cases of completely edentulous patients.

Materials and methods: For the purpose of this study, 96 patients aged 49-88 were examined between 2016-2019. The research was conducted during the practical classes in prosthetic dental medicine and oral and maxillofacial surgery at the Faculty of Dental Medicine, Medical University - Sofia. The study methods included an individual interview, observation, palpation, and clinical and laboratory measurements. The results were collected in pre-made patient cards. The investigated variables were age, gender, stage of atrophy, the morphological features of the alveolar ridge, and the total period of edentulism and denture usage.

Results: The results of the research showed that the second degree of atrophy is the most prevalent condition for both jaws. The third degree of atrophy was associated with the lower jaw but rarely occurred in the upper. The vestibular inclination was typical for the maxillary, frontal alveolar ridge, whereas, in the distal areas, the edentulous ridge was predominantly vertical. The vertical slope of the ridge was prevalent in the three examined areas on the lower jaw. Unequal and asymmetric alveolar ridges were more frequent in the mandible. An association between the time being edentulous and the degree of atrophy was observed in both jaws.

Keywords: complete edentulism, bone atrophy, alveolar ridge,

INTRODUCTION

It is well established that tooth extraction is followed by vertical and horizontal resorption of the alveolar ridge at the edentulous site, often complicating the retention and stability of subsequent removable dentures [1, 2, 3, 4]. In their study, Araujo et al. found that the resorption of the buccal/lingual walls occurs in two overlapping phases. In the first phase, the blood clot was resorbed and replaced with woven bone. The second phase includes resorption from the outer surface of both bone walls [5]. A considerable amount of literature suggests the presence of profound effects of strain on bone mass and bone structure. The lamellae of cancellous bone are preferentially aligned with the principal strains caused by the dominating loads [6]. The reduction of the buccolingual as well as the apico-coronal dimension of the alveolar bone ridge, commonly observed soon after tooth extraction, can be explained by the physiological law, according to which the maintenance of the bone anatomy requires a certain daily stress/strain forces [7, 8].

Progressive ridge resorption is one of the great reasons for loss of stability, retention, functional suitability for chewing and malnutrition in prosthetic restorations with complete mandibular dentures [9, 10, 11, 12].

It is known that the poorly made dentures and the trauma which they cause accelerate the resorption of the underlying tissues [13]. According to J. Pavlova et al. in the upper jaw, the prevalent stage of atrophy is class I in almost 55% of the cases and the rarest is class III stage of atrophy (11%). In the cases of atrophy of the lower jaw, class I and class III stage of atrophy are equally observed – about 23% each [14]. Today, modern prosthetic dentistry is focused on new digital methods for making complete dentures [15, 16, 17, 18]. They are known and widely used by denture-glue patients in cases of advanced bone resorption. However, the question about morphological features of the upper and lower jaw remains open and generates scientific interest.

Aim:

The aim of the present research is to characterize the morphological features of the upper and lower jaws in cases of completely edentulous patients.

MATERIAL AND METHODOLOGY

Ninety-six edentulous patients (54 female and 42 male) aged 49-88 were included in the study. The patients were chosen at random. All participants were informed about the purpose of the research in oral and written form, and informed consent was obtained. The study methods included...
an individual interview, observation, palpation, and clinical and laboratory measurements. The variables considered in this article – Part 1, are presented in Fig. 1.

**Fig. 1.** Variables included in the analysis of part 1.

<table>
<thead>
<tr>
<th>Name</th>
<th>Patient card Nr:</th>
<th>Age:</th>
<th>Sex:</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Since when are you completely edentulous?</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Upper jaw: Lower jaw:</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Have you ever used dentures?</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Since when do you use the dentures?</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Equability: UJ: IJ:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symmetry: UJ: IJ:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Degree of atrophy: UJ: IJ:</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Inclination of the alveolar ridge /vertical, Vestibular, Lingual/:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upper Jaw</td>
<td>Lower Jaw</td>
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<td>Front</td>
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<td></td>
<td>Right</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Tuber maxillae:</td>
<td>Retromolar pad:</td>
<td></td>
</tr>
</tbody>
</table>

The indicators - stage of atrophy of the alveolar ridge, equability and symmetry of the atrophy, inclination of the alveolar ridge, condition of the tuber maxillae and retro molar area of the lower jaw were characterized according to the classification proposed by T. Uzunov [9]. Participants were interviewed regarding the period of complete edentulism and usage of full dentures.

Statistical analysis was performed with the environment for statistical processing R. Descriptive and graphical analyses, chi-squared test for goodness of fit and association and Kruskal-Wallis test for group comparison with Dunn’s post-hoc analysis were employed to characterize the sample.

**RESULTS**

The age and gender distribution of the study sample are presented in Fig 2.

**Fig. 2.** Age (left) and gender (right) distribution across the study sample.

The female participants are slightly more than the males but without a significant difference in proportion ($\chi^2_{gof}=1.50$, $p=0.221$). The age of the participants follows a normal distribution with a mean of 68.06±7.66 years. The youngest was 49, whereas the oldest 88 years old.

**Morphological characteristics of the edentulous ridges:**

Edentulous ridges are often characterized in the literature according to the degree of bone resorption. The degree of atrophy of the alveolar ridge in the current study was evaluated according to the classification proposed by T. Uzunov [9].

The most prevalent degree of atrophy in the upper jaw was “second”, with half of the sample – $n=48(50\%)$ falling in this category. Forty percent of the patients were with “first” (initial) degree of atrophy, and just 10% with advanced “third” degree of atrophy. In the lower jaw, 44% of the investigated patients were with a “third” degree of atrophy, whereas 2% showed a “fourth” degree category absent in the upper jaw in our sample. The most prevalent degree of atrophy in the lower jaw was “second” but with almost identical frequency to the “third”. Nine percent of the patients are with “first” (initial) degree of atrophy. Chi-squared test was used to evaluate the similarity in the distribution of the variable “degree of atrophy” between both jaws. The results showed a significant difference ($\chi^2(3) = 39.86$, $p <0.001$).

Kruskal-Wallis test with Dunn’s post-hoc pairwise comparisons were used to determine if there is a difference between “degree of atrophy” and “age being completely edentulous” in the upper and lower jaw Fig. 4. A significant difference was observed between all tested pairs except second and third degree of atrophy in the maxilla - Fig. 5. The 4th degree of atrophy in the lower jaw was excluded from the analysis due to an insufficient number of observations.

**Period of edentulism:**

An important factor determining the state of the alveolar ridges is the period of complete edentulism. The patients in the study sample were edentulous for a mean of 7.18±6.23 years for the upper jaw and 7.81±6.5 years for the lower jaw – Fig. 3. The period of edentulism between both jaws was evaluated with the Wilcoxon-Mann-Whitney test but did not yield a significant difference ($p<0.05$).

**Fig. 3.** Years of edentulism in the upper and lower jaws for the study population.

![Years of edentulism in the upper and lower jaws for the study population](https://www.journal-imab-bg.org)
Fig. 4. Age distribution across different degrees of atrophy - upper jaw (left), lower jaw (right)

Fig. 5. Symmetry and equability in the upper and lower jaws

The morphological features Symmetry and Equability were used for further qualitative assessment of the edentulous ridges. Symmetry of the atrophic alveolar ridge is considered the equality in height and width between the left and right distal areas of the alveolar ridge. Equability denotes comparable bone resorption throughout the alveolar ridge from the frontal to the distal area. The patients included in the current study showed prevalent symmetrical and equal atrophy of the edentulous ridges for both jaws – Fig 6. However, the proportion of asymmetric and non-equal atrophy was statistically different between the maxilla and mandible ($\chi^2_{\text{symmetry}} (1) = 11.60, p < 0.001; \chi^2_{\text{equability}} (1) = 4.74, p < 0.05$).

Fig. 6. Degree of atrophy for the upper and lower jaws
Inclination of the alveolar ridge:

Within the study sample, 74% had a vestibular inclination in the frontal area of the alveolar ridge on the upper jaw, whereas 24% had a vertical slope (no inclination) Fig. 7. Only 2% showed a lingual inclination for the studied variable.

In 14% of the investigated patients, a vestibular inclination in the left distal area of the alveolar ridge of the upper jaw was observed. Most of the cases (83%) had a vertical slope (no inclination), and only 3% had a lingual inclination.

In 10% of the study sample, vestibular inclination in the right distal area on the maxillary alveolar ridge was observed. The majority of cases (82%) had vertical slopes (no inclination), whereas 7% had a lingual inclination. An equal number of patients in the sample – 40 (42%) had the vestibular inclination or a vertical alveolar ridge, and 17% had a lingual inclination in the frontal area of the alveolar ridge on the lower jaw. Only 4% of the investigated patients had a vestibular inclination in the left distal area of the alveolar ridge on the lower jaw. Slightly more than half of the participants - 51% had a vertical slope (no inclination), whereas 41% had a lingual inclination. In 6% of the investigated patients, vestibular inclination in the left distal area of the alveolar ridge on the lower jaw was observed.

Characteristics of tuber maxillae and retromolar pad

Fig 8:

More than half of the patients were with pronounced maxillary tubers – n = 49 (51%), followed by the undercut variability constituting nearly a third of the sample – n = 30 (31%). The smallest group in the study – n = 17 (18%) had atrophic tubers.

The retromolar pad is an analogous morphological bone feature to the tuber maxillae situated on the lower jaw. Fifty-five of the patients (57%) had no undercut in this area, whereas 49 (43%) had an undercut. A chi-squared test was used to assess a possible association between the degree of atrophy and the prevalence of pronounced bony structures in the maxilla and mandible. The results yielded a significant association only in the lower jaw between the variables atrophy and features of the retromolar pad ($\chi^2(3) = 12.74, p < 0.05$).
DISCUSSION AND CONCLUSION

The main objective of dentistry is to preserve the patient’s natural dentition and increase the age when total edentulism occurs [7]. Results in the present study suggest that this variable significantly influences the degree of atrophy. The latter is in accordance with previously reported findings in the scientific literature [14].

The most prevalent degree of atrophy in the upper and lower jaw was “second”, which is similar to Uzunov’s findings but deviates from the results reported in Pavlova’s research [7, 14]. According to Pavlova et al., the most prevalent degree of maxillary atrophy is the “first degree”. For the mandible, the authors reported a similar proportion for the “first” and “third” degree, whereas in our research, a comparable frequency was observed between the “second” and “third” degree of atrophic mandibles.

Regarding the relationship between morphological features - tuberculous maxillae, retromolar pads and alveolar margin atrophy - it is assumed that patients with a “third” degree of atrophy are less likely to have pronounced bone structures. The results of this study only partially confirm these reported findings - there is a significant relationship between the degree of atrophy of the mandible and the morphological characteristics of retromolar pads until associations for the maxilla were found.

The results obtained cannot support the claims of delayed resorption of the alveolar ridge in patients wearing complete dentures [7]. Based on the data obtained, we can assume that there is no relationship between the degree of atrophy and the use of dentures in completely edentulous patients.

The prevalence of the second degree of atrophy in the patient’s morphology (50% on the upper jaw and 45% on the lower jaw) is associated with retention and stability problems when using complete dentures [3, 9]. The high frequency (43%) of the “third” degree of mandibular atrophy observed in our sample further contributes to the risk for decreased retention and stability of complete dentures in addition to the general unfavorable conditions in the lower jaw [12].

Morphological features of the oral cavity after complete tooth loss are very important for the future treatment process. These include the oral mucosa, the A line, the alveolar bone, hard and soft palate, muscles, tongue, and salivary glands. All these features determine the type of impressions, type of artificial teeth arrangement, materials for the prosthetic restorations and, in general, the type of treatment. The accurate analysis contributes to correct treatment planning, which in turn increases the quality of treatment in completely edentulous patients.

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