

Evaluation Of Mandibular Alveolar Ridge Resorption In Complete Denture Wearers

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Abstract:

Background: Following tooth extraction, alveolar ridge resorption, particularly in the mandible, is a chronic, progressive process that can extend beyond the alveolar ridge in severe cases. Research indicates that despite its dense structure, the mandibular ridge is highly susceptible to this type of resorption. This study aimed to evaluate mandibular ridge resorption following complete denture therapy over a six-month to one-year period, assessing changes at the masticatory centre and mental foramen. Differences between patients with complete dentures and those without were examined to determine whether denture fabrication impacts ridge resorption.

Materials and Methods: The study was conducted over a five-year period at the Clinic for Removable Prosthodontics, Faculty of Dentistry, in Skopje. Sixty patients (32 men and 28 women), aged 51 to 70, participated and were divided into two groups: the first received complete dentures after an initial period of post-extraction bone healing, while the second did not receive dentures during this time.

Results: Results demonstrated significantly lower resorption in denture-wearing patients, with a 4.3% resorption rate at the masticatory centre and 3.1% at the mental foramen, compared to 8.5% and 6.3% in the non-denture group, respectively ($p < 0.01$). This difference indicates that patients with complete dentures experience notably reduced mandibular ridge resorption compared to those without dentures.

Conclusion: Our findings suggest that timely, well-fitting complete denture fabrication shortly after tooth extraction plays an essential role in slowing alveolar ridge resorption and preserving ridge height, with potential implications for improved patient outcomes based on cultural, social, and economic factors.

Key Words: mandibular alveolar ridge, bone resorption, orthopantomograms, complete dentures

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I. Introduction

With the loss of all teeth, complete edentulism occurs and the oldest and only conservative method of stomatoprothetic therapy in these cases is a complete dentures fabrication. Complete dentures and their fabrication are not only about to replace the lost dental units, but their purpose is to restore all the units in the affected stomatognathic system as a unique organ.

Unlike other appliances, complete dentures formed under the conditions of oral tissue function are part of the orofacial system. According to the time of when complete dentures are fabricated, they can be immediate and conventional. Some researchers believe that it is necessary to wait until the alveolar ridge is consolidated (classical), while others believe that it is useful to make prostheses on fresh extraction wounds (immediate), dilemmas, mainly because of resorptive changes in the alveolar ridges after the dentures are placed. The bone tissue of alveolar ridges is identical with the physiological processes to other bone tissues, but it is noted that the remodeling process is more intensive in alveolar bone.

The structure of the alveolar bone is the result of constant development of random formation (apposition) and resorption. The ballans between osteoblastic and osteoclastic activity is possible with the effects of local and general factors. Bone remodeling takes place in phases, activation is the phenomenon that causes the focal attraction of osteoclasts to a specific place on the normal surface of the bone, influenced by parathormon, thyroid hormones and calciterol. The second phase is the occurrence of resorption when a group of osteoclasts cuts the surface of the spongy bone, and in the reverse phase multinuclear cells leave the surface of the cut. Then duplication occurs when osteoblasts are attracted to the eroded surface and matrix formation occurs when osteoblasts form a layer of cells in the resorptive layer and synthesize layers of oseid. Mineralization occurs at the end. Due to its construction and architecture, spongy bone in comparison with the compact has 5 to 30 times

larger surface area in the framework of which the remodeling process begins. X-rays distinguish two types of spongiosa, the first type, characteristic of the mandible, trabeculae are placed horizontally one under the other, and the second type, which is posterior to the maxilla, differs in a large number of irregularly placed bone trabeculae. The arrangement of the trabeculae in the first type corresponds to the trajectory of the spongy body, and in the second type the functional need for the transfer of forces is satisfied by the increased number of trabeculae on a single surface. It should be noted that spongy bone does not contain Havers's and Volkman's chanel systems and are nourished exclusively by the diffusion of fluids from the blood vessels of the periosteum and the bone marrow^(1,2,17).

In 1892, Wolf established the law of bone transformation, according to which any force that continuously acts on a certain area of the bone-muscle system leads to an increase in bone density and an increase in thickness in that part of the bone, and the spreading of the bone causes its degradation. When the direction of the force changes, the trabeculae are rearranged in accordance with the new situation. High physiological forces can lead to increased or reduced osteogenesis, but low forces can cause bone loss. In conditions of lack of pressure or its reduction, lamellae of the cortical shell and trabeculae of the spongiosa are reduced in number and size. Bone resorption is considered as "melting" the bone after extraction. Reduction of the residual alveolar ridge means predominance of the resorption process, i.e. the effect of osteoclasts in the bone tissue dominates over the bone apposition process. The resorption of the toothless alveolar ridges is a chronic, progressive and cumulative process. Previously, from a clinical aspect, the mandible was considered a rigid body, which under the influence of functional forces did not change its shape and dimensions.

Grunewald first showed that muscles with their contractions cause changes in the shape and dimensions of the mandible, until the fifties, when the first data appeared to explain the mechanism of elastic deformations of the mandible caused by physiological forces created during muscle contractions⁽³⁾. In each position of the lower jaw, where there is a mismatch between the mandibular and denture base, there is pressure on the jaw from the denture structure. The resistance of the prosthetic structure to the clinical deformations manifests itself as pressure on the tissue. The magnitude of this pressure depends on the dimensions of the elastic deformations of the mandible and the stiffness of the prosthetic structure said Jokić in 1991⁽⁴⁾. Based on the fact that insufficient bone support is one of the factors that most important for the retention and stability of complete dentures, the detection of resorption of the alveolar ridge is of great importance to dentistry. It is important for the dentist to know the factors that lead to the resorption of the residual alveolar ridge and to expect increased resorption in patients with osteoporosis, diabetes, hyperthyroidism, corticosteroid therapy, patients with bad habits such as alcoholism and smoking, and to minimize the local factors. The correct assessment and classification of the process of resorption of the residual alveolar ridges in prosthodontics is of great importance. The success of the therapy with complete dentures is greater if a precise reconstruction of the lost tissues is achieved, placement of the artificial teeth in the optimal position in the neutral space, in relation to the residual alveolar ridges and soft oral tissues, good stabilization, proper adjustment of the supportive tissues, but the success also depends on the degree of resorption of the alveolar ridges during the period when prosthetic therapy is started^(5,6,7).

The aim of our study was to analyse the resorption of the mandibular alveolar ridge after the therapy with complete dentures, for a period of six months (time for extraction wound healing), in the area of the masticatory center and in the area of the foramen mentale.

II. Material And Methods

The examinations were conducted in the Clinic for Removable Prosthodontics, at the Faculty of Dentistry in Skopje, Republic of North Macedonia, during a 5 years period. Sixty patients who came in the Clinic were analyzed, 32 women and 28 men, aged 51 to 70, divided in two groups.

The first group consisted of 30 patients, men and women, completely edentulous, in which after the completion of physiologic resorption (after healing of the alveolar ridge), complete dentures were made.

The second group consisted of 30 subjects of both sexes, with total teeth absence, and after the period of physiological resorption, total prostheses were not made in the period more than 6 to 12 months.

Complete anamnesis and a clinical examination had been included in the examination and several ortopantomographic imagings were performed.

Orthopantomographic imaging was performed with the standard ORTOPANTOMOGRAPH Siemens orthophos 3 device (30-60 kV, 10 mA) by the same technician. As a prerequisite for the analysis of the ortopantomographic images, it is necessary to have clarity of the mental foramen of the ortopantomogram and clear borders of the both sides of the mandible.

On the ortopantomogram, the tangent is drawn below the lower borders of the mandible, and another line parallel to it on the lower edge of the mental foramen. Then a line was drawn from the distal part of the mental foramen to the pick of the alveolar ridge. On the both sides mandible is measured from the lower edge of the mandible to the point that is level with the lower edge of the foramen mentale (X). Multiplying this distance

3times (X) (following methods of Wical and Swope), we count the estimated value of the mandible before any resorptive changes is obtained (fig 1).

As previously described, the right side is measured from the lower edge of the mandible to the top of the residual alveolar ridge (AHM). The obtained difference between the estimated original height (Xh3) and the closed height of the mandible (AHM) represents the degree of resorption of the alveolar ridge (DAR) $(Xh3)-AHM=SRAG$

- Estimated height of the mandible (Xh3)
- Actual height of the mandible (AHM)
- Degree of alveolar resorption (DAR)

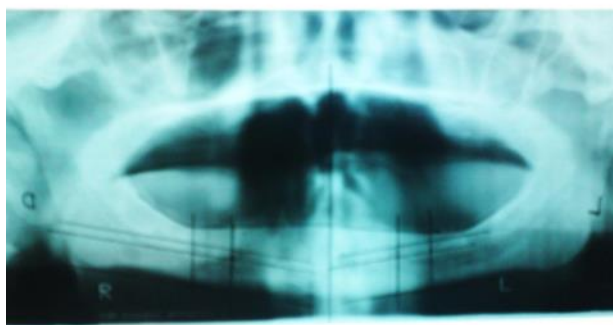


Figure 1. Analyzed ortopantomogram

These results practically allow for every patient the value of the initial height of the lower alveolar crest to be reconstructed, that is, to estimate the magnitude of their reduction.

We measured from the lower edge of the mandible to the edge of the residual alveolar ridge (AHM), in the area of the foramen mentale and in the area of the masticatory center (behind the first molar), which was found to be 53% from the distance from the medial line of the mandible (Marković), both right and left⁽¹⁷⁾.

III. Results

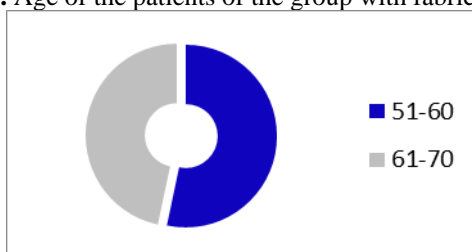
The study included a total of 60 patients (32 women and 28 men) divided into two groups.

In the first group of patients in which prostheses were made after the period of physiological resorption, 12 female and 18 male subjects were recruited.

Table no. 1. Sex of the patients of the group with fabricated dentures

Sex	%
Mail	60
Femal	40

Chart no. 1. Age of the patients of the group with fabricated dentures

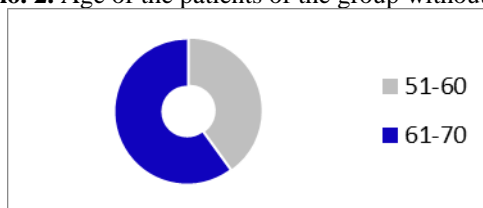


The second group without dentures were included 16 female and 14 mail patients

Table no. 2. Sex of the patients of the group without dentures

Sex	%
Mail	46,6
Femal	53,3

Chart no. 2. Age of the patients of the group without dentures



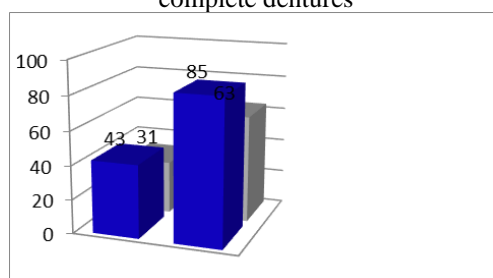
According to the resorption of the mandibular alveolar ridge and the site of the patients, our study pointed to the fact that in the group of patients in which total prostheses were made, the resorption in the area of the masticatory center was 4.3%, compared to the patients without prostheses where the resorption was 8.5%, (table and chart no.1).

From the table and graph number 3, it can be seen that there is a significant difference in the resorption of the mandibular alveolar ridge between the two tested groups. The group of subjects who were made of total dentures demonstrated significantly slower resorption, compared to the group of subjects who were not made of total dentures. This difference in value was statistically highly significant ($p < 0.01$).

Table no 3. Percentage of resorption of the mandibular alveolar ridge resorption for patients with and without complete dentures

Location	With dentures	Without dentures
Masticatory center	4,3%	8,5%
Foramen mentale	3,1%	6,3%

Chart no 3. Percentage of resorption of the mandibular alveolar ridge resorption for patients with and without complete dentures



From the table no.3 and chart number 3, can be seen that there is a significant difference in the resorption of the mandibular alveolar ridge between the two tested groups. The group of subjects who were made of total dentures demonstrated significantly slower resorption, compared to the group of subjects who were not made of total dentures. This difference in value was statistically highly significant ($p < 0.01$).

IV. Discussion

There are significant individual variations in the amount and degree of bone loss after tooth extraction and followed by differences in the shape of the dentures. Although it is accepted that the alveolar ridge resorption is a consequence of the bone remodeling as a result of the functional stimulation of the bone, it is responsible for the huge individual variations.

According to Atwood, the resorption of the residual alveolar ridges represents a serious and very widespread oral disease whose etiology and pathogenesis deserve to be paid serious attention. It describes the resorption of the alveolar ridge as a remodeling process with the collapse of the buccal and lingual cortical layers, especially in the first years after tooth extraction, which leads to the reduction of bone in the horizontal and vertical direction⁽²⁾.

The resorption of the residual alveolar ridges after the loss of the teeth appears to follow a predictable pattern: the labial surfaces are subject to primary resorption, first in width, then in height found Atwood and Tallgren. The highest resorption in the first three years after the loss is 40-60%, and then it decreases to 0.25% per year^(8,9).

Multivariate analyzes related to resorption of residual alveolar ridges are rare. In recent studies, it has been pointed out that the gender and systemic diseases are the most important factors (more than the oral and dental factors), especially for the resorption of the mandible.

Woelfel et al, 1976 years, determined 63 factors that can influence bone resorption under complete dentures, in their analysis they did not find one dominant factor that would have explained the variability of bone

loss. For a long time, the factors that affect bone resorption and the factors that are analyzed are gender, age, facial structure, duration of sleep, habits when wearing dentures, oral hygiene, parafunctions, general health condition, etc.⁽¹⁰⁾.

Jankulovska in 1989, found that the mastication`s habits have influence on the resorption of the alveolar ridge. Some authors like Tallgren 1980 and Douglass JB in 1993 found that the resorption of the maxilla stops after ten years, but in the mandibular bone it lasts continuously^(11,12,13).

Bone`s density with orthopantomographic radiographs was evaluated by Procchio M. et al. 1993, using the method of Wical and Swoope⁽¹⁴⁾.

The loss of the teeth causes alveolar ridge resorption, which affects the height of the mandible, according to Klemetti from 1996, the alveolar part is first to be resorbed, while the basal part remains unchanged⁽¹⁵⁾.

Klemetti E. et al. in 1997 in their study examined whether, after a long period of inactivity, the height of the patient is associated with the height of the residual alveolar ridge, concluding that the height of the subject may play a role in the condition of the alveolar ridge. Heavy individuals with large bones have more bone substance and their supporting tissues provide better options for the use complete dentures than smaller individuals⁽¹⁶⁾. According to Marković and Krstić, the occlusal pressure transmitted through the dentures on the alveolar ridges has an important role in the resorption of the alveolar ridges, and as options for its prevention, they suggest the application of soft acrylics and reduction of the occlusal surfaces. They believe that orthopantomographic images are an acceptable method for measuring the reduction of the residual ridge due to their simplicity, precision, the possibility of repeating the procedure and comparing the radiographs in a certain period of time⁽¹⁷⁾.

Čelebić A. et al. 2002 evaluated the resorption of the alveolar ridges in 50 wearers of total dentures, and found that the resorption of the mandible was 2.5 times greater than that of the maxilla, and that it was greater in the frontal swelling in the bony region, the resorption was greater in the patients who had the last extraction in the period of one year before the dentures, compared to the patients who had early extractions⁽¹⁸⁾.

Knezović Ziafarić D. and Čelebić A. 2003 using panoramic x-rays taken when complete dentures were given to the patients and after 6 months of their use, determined the bone density, including the fact that the BMD (Bone Mineral Density) increased in the area of the gonium, and that the sex and age did not had influence on the BMD for that period of 6 months⁽¹⁹⁾.

The most frequent therapy of complete edentulism is the conventional total prosthesis and despite the increased number of cases where dental implants are used, according to Čelebić et al. In 2003⁽²⁰⁾.

Considering the social-economic possibilities, conventional dentures for mass use will be the number one treatment for some patients says Igić in 1990⁽²¹⁾.

After the extraction of the teeth, numerous changes in the tissue begin, and especially changes in the alveolar bones, as is the resorption of the alveolar ridges. It has been found that the height of the mandibular alveolar ridge in patients who, after the individual period of physiologic resorption are using classical total prostheses, the total resorption of the mandibular alveolar ridge exceeds 0.9 mm (3%) in the region of foramen mentale 1.2mm(4.3%) in the masticatory center. These results show that in patients with correctly made total dentures and regular pressure transfer, the reduction in the height of the alveolar ridge, that is, the inevitable resorption is minimal and evenly distributed. The results of our measurements agree with the results of Van Waas from 1993, who measured an average resorption of 0.7-1.8 mm in the distal parts of the mandible in patients who had complete dentures made in the first year, as and the analysis of Tallgren, according to which the amount of bone resorption in the mandible is the fastest in the first year after the extraction of the teeth, and then it decreases. Their investigation for a long period of time showed that the average size of resorption was about 1 mm a year^(22,23).

Carlsson and Persson in 1967 year, in their five-year study found that the mandibular height decreased by about 2 mm in the first two months after the removal of the teeth, and the average reduction was between 4 and 5 mm after one year, and 7 mm after five years, their results are not the same as we found, probably because it is measured after the period of physiological resorption, which is probably why the values of bone loss decreased⁽²⁴⁾. Guguvcevski in 2003, accordingly to our results, observed that the first year after the teeth extractions so called reduced alveolar ridge appears. The protection of patients only in the first few months after tooth extraction is an important factor in reducing the rate of resorption of the mandibular alveolar ridge⁽²⁵⁾.

In our results, we noted that in patients with classic dentures, after the end of the physiological resorption, after the healing of the extraction wound, in the period from six months to one year, the resorption of the mandibular alveolar ridge is slower about 1mm in comparison with those patients who have not made dentures more than one year after tooth extraction. During that period, they used the residual alveolar ridges for mastication, with an uneven distribution of pressure, mostly in the area of the masticatory center, in the area of the first molar. Here the biggest resorption was found, especially in patients with masseteric type of mastication. Kordatzis, Wright and Meijer found resorption of 1.65 mm in patients wearing conventional total prostheses, which corresponds to the results obtained in our analysis⁽²⁶⁾.

The global trend of increasing the number of the elderly population showed that the treatment of complete edentulism is important for every dentist.

V. Conclusions

Based on the results obtained from our examination and the statistical processing of the data, the following can be concluded:

1. Properly made classic total prostheses in the early period after teeth extraction are very important and have great importance in slowing down the resorption of the residual mandibular alveolar ridge and maintaining the treated height. Cultural, social, economic and educational level of the patients has a huge impact on the in time denture's fabrication.
2. The resorption and remodeling of the alveolar ridges after the extraction of the teeth is common, unavoidable in all people without teeth. There was a generalized decrease in the height of the mandibular alveolar bone in the two tested groups;
3. The resorption of the mandibular alveolar ridges is slower and more common in patients who have had prosthodontic therapy after physiologic resorption, then in patients who have not had prosthetics performed in a period of one year;

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