Effect of Age and Ordinal Number of the Dentures on Alveolar Bone Density around Abutment Teeth with Clasps

Daniela Kovačević
Zdravko Delić
Zoran Kovač
Ivone Uhač
Nataša Blečić

Department of Dental Prosthetics
Study of Dentistry
Faculty of Medicine
University of Rijeka, Croatia

Summary

The aim of this study was to determine the effect of the age of the patient and ordinal number of partial dentures (PD) on alveolar bone density around abutment teeth with clasps.

The study consisted of 50 subjects of both sexes, with PD. All examined teeth were radiographed twice by standard retroalveolar technique/recording within a period of three months. A copper calibrated peg, 0.1.0.5 mm thick, was stuck onto the X-ray film. Seven regions of interest (ROI) were chosen on each radiograph around the tooth root, 4 pixels in size. The method of intraoral microdensitometry according to Knezović-Zlatarić (1) was used to evaluate changes in alveolar bone density, by which the level of the grey regions of interest was converted into equivalent thickness of the copper pegs.

The density of the alveolar bone in the examined ROI was analysed. Difference between the two radiographs was not statistically significant (ANOVA: $p > 0.05$) regardless of the age of the patient and ordinal number of the PD. However, in all the examined ROI a positive trend was registered of reduction in alveolar bone density at the second recording, without statistical significance.

It can be concluded that neither age nor ordinal number of the dentures led to a significant reduction in alveolar bone density around the abutment teeth with clasps. However, because of the positive trend it is possible that during longitudinal monitoring of changes in alveolar bone density statistically significant difference may occur.

Key words: *alveolar bone, intraoral microdensitometry, retroalveolar radiographs, partial dentures.*

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Address for correspondence:

Daniela Kovačević
Department of Dental Prosthetics
Faculty of Medicine
Krešimirova 40, 51000 Rijeka
Croatia
phone: 051/1213255
e-mail:
Daniela.Kovacevic@medri.hr

Introduction

Reduced alveolar bone density is an individual process which depends on many factors such as age, sex, duration of edentulism, patient's state of health etc. (2-9). Numerous investigations have studied changes in the density of alveolar bone under total and partial dentures, and around implants (10-15). Data on changes in alveolar bone density around abutment teeth with clasps is almost non-existent

in the literature. It is well known that a great part of the masticatory forces are transferred over the occlusal rest and clasp onto the retention tooth, and via its supportive structures onto the alveolar bone (16). Such forces which effect a single tooth are significantly greater than in the eugnathic set of teeth. In the case of axial effect of masticatory forces increased alveolar bone density is expected. All such oblique/indirect forces which concentrate on a small area will lead to a reduction in alveolar bone. In the case of younger patients it can be expected that they will compensate the harmful effects of the masticatory forces and reduction in density will not be significant. Data from the literature show that the greatest changes in alveolar bone density occur at the beginning of a new situation (tooth extraction, receiving total and partial dentures etc.) (17). Consequently, it can be anticipated that patients who receive PD for the first time will have greatest changes in alveolar bone density. For each following dentures the changes should be significantly less, because the situation in the mouth has stabilised.

Changes in alveolar bone density can most simply be documented by a series of radiographs, for which standardised conditions of recording are most important (18). This is not easy to achieve because of changes in the filming process, such as intensity and electrical current, strength of the X-rays, sensitivity of the film. In order to annul these differences calibrated pegs of different material and thickness are used (19, 23). By different mathematical methods the read densitometric values are corrected enabling measurement of relative values of the mineral content of the bone (24, 25).

The aim of this study was to determine the effect of age and ordinal number of the PD on changes in alveolar bone density around abutment teeth with clasps.

Materials and methods

Fifty subjects, wearing partial dentures, participated in the study (32 women, 18 men). They were chosen at random from patients wearing partial dentures at the Dental Department of the Faculty of Medicine University of Rijeka. The Ethical Committee of the Faculty of Medicine approved the study and all patients gave their written consent. All the examined teeth were radiographed twice by standard retroalveolar radiography within a period of three months, i.e. on receiving their partial dentures and after wearing them for three months. All the radiographs were recorded under the same conditions on X-ray apparatus "Ei Niš" (Niš, Yugoslavia) with 1s exposure, voltage X-ray apparatus of 70kW with constant current strength of 15mA/s. "Kodak ultraspeed" films (Eastman Rochester, N.Y.) were used. The films were developed in an automatic dark chamber "Dur Dental XR 24 nova" (Germany). Five copper calibrated pegs, 0.1-0.5mm thick were stuck onto each film prior to exposure. The calibrated pegs were stuck onto the edge of the film in order not to cover the hard tooth and bone tissue. The films were scanned by an "Umax Astra 3450" scanner with 8--bit resolution and 300 dpi. On each radiograph seven ROI were selected around the tooth root, 4 pixels in size, and the levels of greyness measured.

The position of the ROI:

ROI 1 - 1mm mesially along the alveolar edge of the tooth root.
ROI 2 - 1mm distally along the alveolar edge of the tooth root.
ROI 3 - 1mm mesially from the apex of the tooth root.
ROI 4 - 1mm distally from the apex of the tooth root.
ROI 5 - 1mm vertically from the apex of the tooth root.
ROI 6 - 1mm mesially from midway between the distances of RO1 1 and RO1 3.
ROI 7 - 1mm distally from midway between the distances of ROI 2 and ROI 4.

In the case of multi-rooted teeth one root was selected and measurement performed on it. The same ROI were selected on both recordings. The levels of greyness were calculated in equivalents of the copper calibrated pegs by software "Scion image (Beta 4.0.2.)" by polynomials of the 3. grade and the method according to Knezović-Zlatarić (1). The difference between the two radiographs was calculated from the equivalents, depending on the age of the patient and ordinal number of the dentures. The patients were classified according to age into three groups: up to 50 years, 50-65 years and older than 65 years, and according to the ordinal number into those with the first, second, third and more partial dentures.

Statistical methods

Data were grouped and analysed in the Statistical Package for Social Sciences; Ver 10.0.1; Chicago, IL). The level of reliability of the study was checked by coefficient variability. One way analysis of variance was chosen for analysis of the difference in alveolar bone density in the examined ROI on two radiographs, depending on the chosen variables.

Results

The level of reliability of the measurements was checked by variability coefficient. The results were within limits of normal distribution (SD/x<0.44).

Twenty-two percent (22%) of the subjects in this study were younger than 50 years, 36% 50-65 years and 42% older than 65 years.

Thirty-six percent (36%) of the subjects had their first dentures, 48% second dentures and 16% third denture and more.

One way analysis of variance did not show statistically significant difference between the first and second radiograph, depending on the age of the subject (Table 1). Furthermore, there were no statistically significant differences either with regard to the ordinal number of dentures (Table 2). Mild reduction was observed on the second radiograph in both examined variables, without statistical significance.

Discussion

The density of alveolar bone and its reduction is an indicator of the general condition of health. Its determination by means of a radiograph is one of the simplest and cheapest non-invasive methods. However, as loss of alveolar bone can only be detected visually after 30% loss new methods have been discovered which can detect loss of bone of as little as 10% (26, 27). During which computer estimations and calibration pegs are used by which it is possible to obtain the actual value of bone density, transformed into equivalent thickness of the calibrated pegs.

In this study copper calibrated pegs were utilised. Copper has a great atomic number (Z=29) which means that in thin layers it adequately absorbs X-rays. This was important in the present study because we used small dental radiographs, on which it would have been impossible to apply thick calibrated pegs.

We decided to use the method according to Knezović-Zlatarić (1) because in her investigations she demonstrated that the correlation coefficient with polynomial function of the third grade is close to value one, which indicates the great accuracy of this method.

Although the majority of investigators report a reduction in alveolar bone depending on age, this was not the case in our study. A probably reason for this is the correct construction of partial dentures and axially transferred masticatory forces. Alveolar bone successfully compensated for the increased burden. Statistically significant difference did not occur even in the variables of the ordinal number of the dentures, although it was expected that the patients with first dentures would have greatest resorption. According to the investigations of Tallgren (17) the greatest changes occur at the beginning of a new situation in the mouth, and thus it can be expected that patients with their first dentures will have greatest resorption of alveolar bone. According to the investigation of Čelebić et al (28) patients are uncritical toward their dentures and often keep their old, non-functional partial dentures for a long time. Consequently it can also be anticipated that resorption will be greater in first dentures.

However, it should be mentioned that a positive trend of reduced alveolar bone density was observed in both examined variables in all examined ROI, although without statistical significance. It can therefore be concluded that correctly constructed DP did not lead to significant loss of bone, although they did cause a minor reduction during a period of three months. Thus, a longitudinal study is needed in order to establish whether statistically significant difference will later occur.

Conclusion

Age and ordinal number of the PD did not cause statistically significant reduction in alveolar bone

density during a period of three months. However, a positive trend of reduction in alveolar bone density, depending on the examined variables, indicates certain changes in the alveolar bone around abutment teeth with clasps. Thus, a further longitudinal study of the examined patients is needed in order to determine whether, after a certain period, changes will reach a statistically significant level.