

A COMPARATIVE STUDY OF THE EFFECT OF THREE DIFFERENT DENTURE BASE MATERIALS ON THE RATE OF CHANGES OF MANDIBULAR ALVEOLAR BONE HEIGHT AND DENSITY IN OSTEOPOROTIC FEMALES

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دراسة مقارنة لتأثير ثلاثة أنواع من قواعد الأطقم (الصفائح الكاملة) على معدل تغير إرتفاع وكثافة عظام الفك السفلي في مرضى تخلخل العظام عند الإناث

الهدف من البحث هو تسجيل التغيرات التي طرأت على إرتفاع وكثافة الحافة المتبقية من عظم الفك السفلي تبعاً لنوع مادة قاعدة الطقم المستخدمة في خلال فترة متابعة مدتها ستة أشهر. وقد تم قياس السمك الحفافي عند نقطة زاوية الفك السفلي بعد مرور ستة أشهر.

وقد أجريت الدراسة على خمسة عشرة سيدة من ذوي الفم الأدرد فوق سن الخمسين واللاتي تعانين من مرض تخلخل العظام. وقد تم تقسيم المريضا بالتساوي إلى ثلاثة مجموعات تبعاً لنوع قاعدة الطقم السفلي، والمجموعات كالآتي :

أ - اشتملت المجموعة الأولى على خمس مريضات تستخدم كلا منهن طقم سفلي قاعدته مصنوعة من مادة الراتنج الحراري.
ب - اشتملت المجموعة الثانية على خمس مريضات تستخدم كلا منهن طقم سفلي قاعدته مصنوعة من مادة الراتنج الحراري المبطن بإضافة السيليكون.

ج - اشتملت المجموعة الثالثة على خمس مريضات تستخدم كلا منهن طقم سفلي قاعدته مصنوعة من المعدن. أما الأطقم العلوية لجميع المرضى في الثلاث مجموعات فقد كانت من مادة الراتنج الحراري. وقد استخدمت أفلام أشعة سينية جانبية لقياس التغيرات التي حدثت في إرتفاع حافة عظم الفك السفلي بعد مرور ستة أشهر كما استخدمت أفلام أشعة سينية بانورامية لقياس التغيرات التي حدثت في الكثافة المرئية لعظم الفك السفلي بعد ستة أشهر.

وقد أسفرت نتائج البحث عن التالي :

- كان هناك انخفاض ذو دلالة إحصائية في متوسط قياسات إرتفاعات حافة العظم المتبقية من الفك السفلي في جميع المناطق بعد مرور ستة أشهر.

Abstract

This study compared the effect of different denture base materials on the rate of reduction of alveolar bone height and density. The study was conducted on fifteen completely edentulous females above the age of 50 suffering from osteoporosis. The patients were divided equally into three groups according to the type of denture base material used for their lower dentures. The first group received acrylic resin denture base, the second group received silicone lined acrylic resin denture base and the third group received metal denture base. Patients in all groups received complete maxillary dentures made of acrylic resin. Measurements were taken at the base line and six months later using lateral cephalometric x-rays for mandibular optical density. Measurement of cortical thickness at the gonion was used to monitor the skeletal status of the patients. The result indicated a generalized decrease in mandibular alveolar height in all the groups but the greatest was in metal denture wearers and the least was among the silicone lined denture wearers. In all groups, the greatest reduction in height was in the molar region while the least reduction was anteriorly. There was a decrease in the optical bone density of the alveolar bone after six months in all groups. However, the least optical density reduction was in the acrylic denture wearers, while the greatest was in the silicone lined denture wearers. The correlation between height and density revealed statistical significance only in metal denture wearers as both measurements decreased by the same rate in this group after six months.

Introduction

Bone is a dynamic tissue capable of adapting to meet tension or compression forces falling upon it. The structure and the function of bone are dependent on the complex interactions between its constituents, although the precise

composition of bone differs with species, site, ages and disease states.^{1,2}

There is a gradual deterioration of body functions with age and any general systemic disability would make denture success uncertain. Further, people of the complete denture age are likely to have contributing health problems which cause denture difficulties.³

Osteoporosis is one of the most important clinical conditions facing the aging population due to the associated high incidence of femoral neck fracture. Recent evidence revealed that the prevalence of osteoporosis is on rise and incidence of femoral neck fracture may be increasing by 40% each decade.^{4,6} It has been found that severity of bone

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loss, in both osteoporosis and residual ridges, increases with the advance of age and favors the female sex for predisposition. Post menopausal women comprise most of the female edentulous population with severe residual ridge resorption. The effect of menopause on the mandible was thought to be similar to the effect on the rest of the skeleton and therefore places the post menopausal women at a higher risk of becoming complete denture patients with severe residual resorption.⁷

Utilizing radiograph, the femoral trabecular pattern was reported as a relatively sensitive index in identifying patients with osteoporosis.⁸ Although conventional radiography may be helpful in diagnosing mandibular osteoporosis, 30% to 40% reduction in mineral content is required before reduced bone density is detectable. More than one method of quantitative measurement is required to determine changes in trabecular and cortical bone^{9,10} Measurement of the thickness of the mandibular angular cortex at the gonion was considered to be a valuable parameter and is used for determination of metabolic bone loss.^{12,13} A record of bone mineral content, and bone mineral distribution can aid in studying changes in residual alveolar ridge.^{14,15}

There is an increase in the porosity and cortical thinning of the mandible after the age of 50 in both sexes. The bone density at the lower border of the mandible is reduced with age, the trabecular spaces may increase due to reduced demands on the surrounding bone structure, and both condylar and genial angles increase due to bone resorption.^{16,21}

Measurements of mandibular bone mass, density, cortical thickness at the gonion and skeletal bone mass in postmenopausal women with osteoporosis was demonstrated to be related.^{22,24} As a matter of fact, the mandible seems to be the bone within the human skeleton that is most exposed to severe decrease in its mineral content as it is one of the primary source of the available calcium in the body.^{25,26}

The resulting shape and size of the residual ridge influence the degree of stability and retention of the denture and affect the amount of applied load.²⁷ Since the overlying mucoperiosteum varies in its visco-elastic properties from patient to patient and from maxilla to mandible, its energy absorption qualities (causing a damping effect) may influence the rate of residual ridge resorption.²⁸

The mechanical factors associated with dentures are the result of the impression, jaw relation record, occlusion, and adaptation of the base to the tissue. These factors can be controlled such that directional forces provide a stimulus that slow down bone resorption.^{29,30} The type of denture base has been cited as one of the prosthetic factors that influence the rate of residual ridge resorption.^{31,32} The fact that women over the age of 50 years with clinical osteoporosis required new full dentures three times more

frequently than women of the same age not suffering from clinical osteoporosis calls for specific precautions in the construction of their dentures.^{33,40}

The aim of this work was to compare the effect of three denture base materials on the height and density of mandibular residual alveolar ridge in three different groups of osteoporotic menopausal women, during a six-month period. The research also aimed to test whether a correlation exists between the height and the density. Measurements of the cortical thickness at the gonion were also performed at the beginning and end of six months.

Materials and Methods

Fifteen edentulous females over the age of fifty were selected from nursing homes (Dar El-Hana, Zizinia, Alexandria Egypt). The selection was based on:

1. An in-depth questionnaire was conducted with each patient including family, nutritional habits, systemic drugs, and dental history.

2. A thorough examination of each patient's general physical and oral conditions was performed, to standardize the condition of patients.

3. An anteroposterior X-ray view of both hips was taken (Hoffman-Combigraph X-ray machine-West Germany - 60 KV and 50 Ma). The radiographs were used in evaluating the grade of osteoporosis following Singh's index.⁸ Patients selected were between grade two and three osteoporosis but mostly grade three.

4. A dental panoramic X-ray was taken for the purpose of diagnosis and obtaining both the cortical thickness at the gonion and the optical bone density of the mandible. 12 An aluminum step wedge of 10 mm increment steps provided a standard compensation for radiographic processing variations. The wedge was attached to the lower border of the patient's mandible prior to making the panoramic X-ray.⁴¹ The fifteen selected patients were then divided equally into three groups according to the type of denture base material to be used for the lower complete denture as follows:

Group A: Five patients received lower complete dentures made of heat curing acrylic resin*.

Group B: Five patients received lower complete dentures made of heat curing acrylic resin lined with permanent silicone resilient liner**.

Group C: Five patients received lower complete dentures with metallic denture base***.

All the upper complete dentures for the three groups were constructed of heat curing acrylic resin. The technique used for denture construction followed the standard technique of Tuncay et al⁴² and Klemetti et al.⁴³

For Group B patients, the silicone rubber resilient liner was used in lower dentures in such a way that it also formed

* Fast Cure WHW Plastics, Hull, England.

** Molloplast-B, Regneri GmbH & Co, Karlsruhe, Germany.

*** Wironit, Bego, West Germany.

the borders of the denture and was supported by hard acrylic resin as it was described by Schmidt.^{44,45}

For Group C, the metallic denture bases were designed to form the lingual flanges and extended occlusally over the crest of the mandibular ridge. All the labial and buccal flanges for all metal bases were made of heat curing acrylic resin as for the other two groups following the same procedures according to the manufacturer's recommendations.^{46,47}

All dentures were inserted, adjusted and patients were given instructions to care for their dentures according to the type of material used for the denture base. Immediately after insertion, each patient was asked to have a lateral cephalometric X-ray film for the purpose of measuring the height of her mandibular residual ridge. To facilitate this measurement, lower acrylic bases were constructed with four holes drilled at varying distances from the midline. Holes were drilled 2.5 cm and 4.5 cm on the right side and 1.5 cm and 3.5 cm on the left side of the acrylic base. The four holes were filled with radio-opaque material* so they would not overlap in the lateral cephalometric radiograph. All exposures were made using Palomax-OY orthopantomograph (Siemens, Germany) of 80 KV & 1.6 milliamperes/second with 180 cm tube.

Six months later, each patient was asked to have another cephalometric radiograph and a dental panoramic X-ray for the purpose of comparison with those of the base line.

Techniques of Measurements:

Residual ridge height:

The lateral cephalometric X-ray films were utilized for this purpose. Acetate Tracings were made of the craniofacial structures as well as of the reference points for each patient.⁴⁸ Double contours of bilateral structures were bisected. This was where the mandibular line (ML) was passing through the menton and gonion. Vertical lines were dropped from the four reference points to be perpendicular to the mandibular line (ML). An additional four vertical lines were drawn, each parallel and 0.5 cm anterior to each reference point [Fig. 1]. Measurements of the mandibular residual ridge height were obtained from points of intersection of the eight vertical lines (the four reference lines and the four additional anterior lines to them) with the crest of the ridge to their points of intersection with the mandibular line using a dial caliper.

Optical Bone Density

A 2 mm parallel light beam recording computerized auto densitometer** was used to measure the optical density in each panoramic X-ray film. The site of scanning on the

* Temporary Filling-Cavfill, PSP, United Kingdom.

** Welhofer Kernphysik WP 600, Schwarzenbruck, Germany.

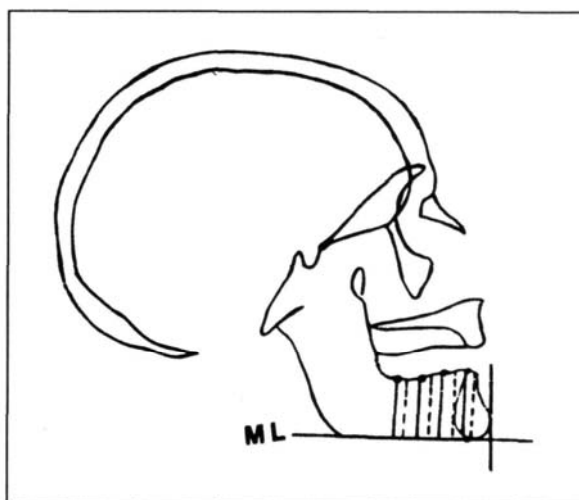


Fig. 1 Illustration of the technique of mandibular ridge height measurement on tracing of lateral cephalometric X-ray films. Solid lines represent the original reference lines while the dashed lines represent the additional ones.

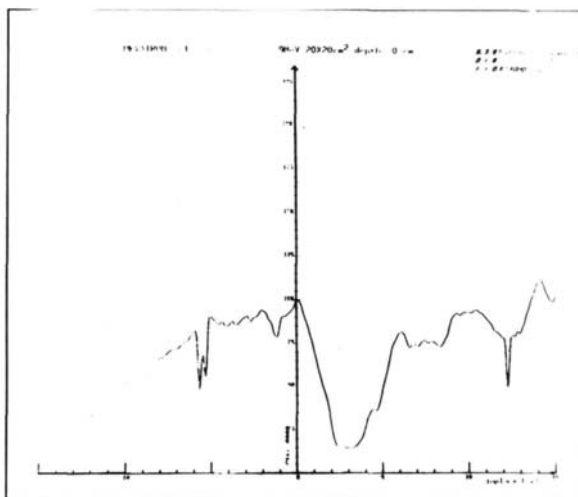


Fig. 2 An example of an optical bone density curve obtained from scanning a panoramic X-ray film at the base line (before treatment).

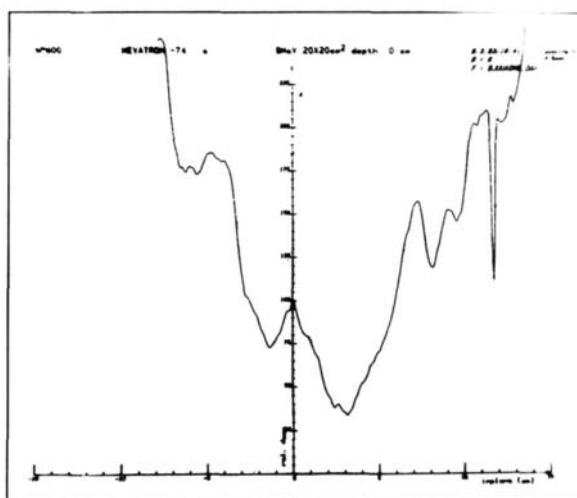


Fig. 3 An optical bone density curve obtained from scanning the same site of the panoramic X-ray film taken for the same patient in Fig. 2 but six months later.

radiograph taken at the base line, was marked and transferred onto the radiograph taken after six months. The trabecular bone present inferior to the crest of the alveolar ridge and superior to the level of the mental foramen was scanned from right to left. 11 The recordings show an average of the attenuation coefficients for all the structures present along the line scanned by the densitometer (Scan trajectory). The information from the scan was graphically printed using color writer* [Figs. 2 and 3]. A compensating-polar planimeter** was used to integrate the region (mm²) under each derived curve. The planimeter needle was traced along the curves for a minimum of three times. The value thus obtained was entered into several mathematical equations⁴⁹ to give the area measured under the optical bone density curve with the horizontal distance being standard for all the patients. The equations used for calculating the areas under the optical bone density curves were:

$$\frac{\text{Area measured by scale used}}{\text{Actual area}} = \frac{\text{Actual scale}^2}{\text{Scale used}}$$

Area measured by scale used = Mean (M) of three readings taken by the planimeter xK, where K is a constant = 8.

Cortical thickness at the gonion:

The minute thickness of the cortical bone present at the gonion was measured on both right and left sides at the base line and after six months on the panoramic X-ray film using a caliper*** following the technique described earlier by Brasetal.¹²

Statistical analysis:

Means and standard deviations were calculated at the base line and after six months for each group. The paired t-test was used to test the significance of the mean differences between the observation periods for the same group. Significance was at 5% level (P=0.05).^{50,51} The percent changes were computed⁵² according to:

$$\text{Percent difference} = \frac{\text{final measurement} - \text{initial measurement}}{\text{initial measurement}} \times 100$$

Statistical significance of the relationship between the different groups was determined using one way analysis of variance (ANOVA) (F-value). The least significant difference (L.S.D.) was calculated if the F-value obtained from the ANOVA was significant^{50,51} The correlation coefficient (r) was used to test the mutual correspondence between two quantitative variables for each group individually.^{50,51}

* Gould Electronics Inc. Cleveland, Ohio, U.S.A.

** MOM Planimeter, Budapest, Hungary.

*** Dial Caliper-General National, New York, U.S.A

Results

Alveolar Ridge Height:

The mean and standard deviation values of alveolar ridge height measurements (in millimeters) for groups A, B, and C obtained from lateral cephalometric X-rays at the different regions (anterior, premolar and molar) at the base line and six months later are presented in Table 1. A statistically significant decrease in the height of alveolar ridge was observed in groups A and C after a six-month lapse. Group B did not show a statistically significant decrease in alveolar ridge height after six months. These findings are clearly depicted in Table 2 where the greatest absolute difference in mean alveolar ridge appeared in group C (metal denture wearers) followed by group A (acrylic denture wearers) with the least absolute difference demonstrated in group B (silicone-lined).

Analysis of variance, comparing the percent difference in mean alveolar ridge height measurement of each region between the three groups, revealed F=4.3441 in the anterior region which was statistically significant (p<0.05). The least significant difference (L.S.D.) test showed that the percent change in the mean height measurements in the anterior region of group B was equal to 1.40 (5.63 and was lower than that of group A (-5.06(4.11) and group C (-5.56+1.55). However, there was no statistically significant difference between the last two groups (<0.05).

In the premolar region, the F-ratio for the three groups was 4.9034 which was statistically significant (p<0.05). LSD showed that the percent change in the mean height measurements in the premolar region of group B (-0.06+4.60) was lower than that for each of groups A (-6.00+3.95) and C (-7.14+2.74). However, there was no statistically significant difference between the two latter groups (p<0.05). The F-ratio obtained for three groups in the molar region was 0.7645 and was not statistically significant (p<0.05).

The F-ratio obtained for all the regions together for the three groups was 5.6794, which was statistically significant (p<0.05). LSD revealed that the percent change of mean height measurements for all regions of group B (-0.64+3.45) was lower than that for group A (-5.09+2.66) and for group C (-6.47+2.25). There was no statistically significant difference between the latter two groups with p<0.05. Measurement of all the regions for all the groups at the base line and six months later using paired t-test was done. The absolute difference t-value of 3.3889 was statistically significant (p<0.001) and the percent difference t-value of 4.2951 was also significant (p<0.05).

Areas under the Density Curves

The values of the mean measurements of the areas under the density curves obtained at the base line and six months later for each group are represented in mm² in Table 3. This table also shows the differences calculated for these values.

Table 1. Mean and standard deviation values of alveolar ridge height measurements in mm. at the three regions (anterior, premolar and molar) for all the patients in Groups A, B and C.

	Group A		Group B		Group C	
	Baseline x(SD)	After 6 mo. x(SD)	Baseline x(SD)	After 5 mo. x(SD)	Baseline x(SD)	After 6 mo. x(SD)
Anterior	2.10(0.43)	2.01 (0.48)	2.00 (0.39)	2.03 (0.40)	1.88(0.33)	2.78 (0.33)
Premolar	1.62(0.38)	1.53(0.39)	1.52(0.38)	1.52(0.41)	1.28(0.26)	1.19(0.25)
Molar	1.60(0.41)	1.53 (0.39)	1.76(0.35)	1.71(0.33)	1.31 (0.22)	1.21 (0.20)
Mean (all regions)	1.77 (0.40)	1.69(0.41)	1.76(0.36)	1.75(0.37)	1.49(0.26)	1.73(0.25)
P-value	0.009		0.713		0.004	

Table 2. Absolute and percent differences in mean alveolar ridge height measurements in mm. after six months lapse in the three investigated groups.

	Group A		Group B		Group C	
	Absolute Difference x(SD)	Absolute Difference x(SD)	Absolute Difference x(SD)	Absolute Difference x(SD)	Absolute Difference x(SD)	Absolute Difference x(SD)
Anterior	-0.036(0.119)	-5.06(4.11)	0.028(0.120)	1.40(5.63)	-0.096(0.021)	-5.56(1.55)
Premolar	-0.088 (0.064)	-6.00 (3.95)	0.003 (0.064)	-0.59 (4.60)	-0.098(0.039)	-7.14(2.74)
Molar	-0.08 (0.025)	-4.32(1.16)	-0.05(0.116)	-2.78 (6.67)	-0.94 (0.095)	-6.92(6.35)
Mean (all regions)	-0.068 (0.40)	-5.09 (2.66)	-0.006 (0.057)	-0.64(3.45)	-0.093 (0.035)	-6.47(2.25)

Table 3. Mean and standard deviation values (in mm) of areas measured under the density curves and cortical thickness at the gonion measured for the three groups.

		Group A		Group B		Group C	
		x(SD)	P-value	x(SD)	P-value	x(SD)	P-value
Area under density curve	Baseline	9.9(3.1)		11.52(5.22)		12.42 (4.60)	
	6 mo. after Absolute difference	14.4 (4.9)	0.11	21.2(14.5)	1.46	20.4(9.1)	0.122
	Percent difference	4.5 (4.9)		9.6(1.46)		8.09 (9.20)	
Area under density curve	Absolute difference	0.072 x(0.016)		0.064 x (0.01)		0.073 x (0.017)	
	Percent difference	0.063 x (0.013)		0.065 x (0.01)		0.081 x (0.017)	

Table 4. Correlations between the absolute difference in mean values of areas under the density curves, and percent difference in mean alveolar height measurements and mean cortical thickness at the gonion.

	Absolute difference in areas under the Density Curves					
	Group A		Group B		Group C	
	r	P	r	P	r	P
Percent difference in height	0.4737	0.210	0.3591	0.276	0.8393	0.038*
Cortical thickness at gonion	-0.4624	0.216	0.5441	0.172	0.2942	0.315

Denotes statistically significant ositive correlations between variables.

There were no statistically significant differences in the t-value for any of the groups. Group A (acrylic denture wearers) exhibited the least mean of absolute and percent difference followed by group C (metal denture wearers) followed by group B (silicone-lined). It should be noted that an inverse relationship exists between the area under the optical density curve and the actual bone density. Further analysis using ANOVA for comparison between the mean values of the areas measured under density curves in the three groups showed $F=0.3203$ which was not statistically significant ($p=0.7319$).

Cortical Thickness at the Gonion

The means of the cortical thickness at the gonion of both right and left sides on the panoramic X-ray for the patients in each group at the base line and six months later are represented in Table 3.

Table 4 shows the correlations that were made between the absolute difference in the mean values of the areas measured under density curves, and the percent difference in mean alveolar ridge height measurement for all the regions, and mean cortical thickness at the gonion for each group separately occurring during six months.

There were no statistically significant positive or negative correlations between the mentioned variable in group A or group B. There appeared to be a statistically significant positive correlation between the percent difference in mean alveolar ridge height measurements of all the regions and the difference in the mean values of the areas under the density curves during the six-month period in group C exhibiting a correlation coefficient of 0.8393 ($p=0.038$). This means that an increase in the values of the percent difference in height was accompanied by an increase in the values obtained for the absolute difference in areas under the density curves which represent a decrease in the actual bone density values.

Discussion

Mandibular bone resorption has challenged prosthodontists for years.^{53,54} Characteristically, loss of bone in osteoporosis, characteristically occurs without loss of bone shape. In the edentulous ridge, progressive resorption increases with age. Osteoporosis can affect the resorption rate of the mandible leading to pathological fractures.¹⁶³⁵

Among women over 65 years of age, 70% are edentulous. Postmenopausal women seem to comprise most of the edentulous population. These women suffer from systemic effects of generalized osteoporosis and local effects of severe alveolar ridge resorption.^{2,17,25,29,53}

The elderly females who participated in the present investigation were being osteoporotic and above the age of 50 are considered menopausal. They were all living under the same sedentary living conditions and dietary habits. Therefore, in the age bracket under investigation, it is not possible to obtain a control group that has not begun to show signs of osteoporosis. In 1986, Soness⁵³ found that with the combination of low calcium diet and changes in gonadal hormones osteoporosis is inevitable. Until now, there was not a prescription for a control group since one cannot distinguish the causes of incidence of osteoporosis when all the population is uniformly exposed (Mazess 1991).⁵⁶ Owing to the fact that the height of the residual ridge decreased according to the severity of osteoporosis almost all the osteoporotic females in this present work were chosen between Grades 2 and 3 osteoporosis, according to Singh's index.⁸

Forces transmitted through the denture bases play an important role as a mechanical factor affecting the rate and amount of bone loss.^{58,60} Regardless of the base material of the denture, metal, plastic, whether hard or soft, the stress induced in the underlying tissues, varies from time to time, according to the patient's habits,

activities, health, diet and local conditions around the denture, besides the shape and fit of the denture bases themselves.^{35,57} This fact emphasized the selection of the osteoporotic females participating in the present work from the same place, living under the same circumstances. Measurements, taken from lateral cephalograms used in this study proved to be reasonably precise.^{53,60,61} Dental panoramic tomography is considered the routine clinical record, and was utilized for densitometric evaluation in elderly subjects with high degree of precision in determining the quantity of bone mineral.^{11,15,23,62,63} Measurements of cortical thickness at the gonion proved to be easier on panoramic than on lateral cephalometric radiographs as superimposition of both sides on one another is not possible with the former type, where both methods are not interchangeable.²¹

Longitudinal studies^{42,43} have not demonstrated whether fabricating dentures based on arbitrary mounting or on the face-bow transfer mounting have an influence on changes observed in the residual ridges. All the procedures of denture construction except denture insertion in the present study were conducted in the nursing homes due to fragility of patients. In the present work within the six months of investigation, group C (metal denture) exhibited the greatest reduction in alveolar ridge height in comparison with the other groups (Table 1). On the other hand, group B (silicone-lined) portrayed the least reduction which was statistically significant (Tables 1 -2). The results thus obtained, reflect the efficacy of having a resilient liner within the permanent denture base to act as a damping agent³⁴ and minimize the vertical displacement of the alveolar ridge under the denture base.

The percent difference in mean measurements of alveolar ridge height between readings (base line and six months), displayed a statistically significant change in the mean anterior and premolar regions for group B. The other two groups showed no statistically significant difference. However, the overall result indicated a generalized bone loss in the mandibular residual ridge.

The largest amount of resorption was shown to occur in the mid lateral aspects of the body of the mandible, while less resorption occurred anteriorly and in agreement with prior reports.⁵⁵ Recently, it was reported that the clinical height of the region distal to the mental foramen in the mandible was more closely correlated with the general bone loss status, than is the anterior region. The latter's loss was strongly dependant on the duration of edentulousness.⁴³ In the present study, the greatest alveolar height reduction for the three groups appeared in the molar region followed by the premolar. The anterior region exhibited the least reduction. This pattern of changes in the mandibular ridges of osteoporotic females, was also observed for long time complete denture

In the past, bone mineral measurements were of little use, because of substantial overlap between findings in normal and osteoporotic subjects.⁶³ Recently, a significant difference was found between the two groups⁶⁵ indicating the validity of these measurements in monitoring the progress of osteoporosis, however.¹⁵

In the present work, there was a general decrease in bone density in all the groups of osteoporotic females (Table 3). Past investigators have shown a greater tendency for a decrease in mandibular bone density in females especially those over 50 years of age and who were edentulous for a while.^{11,62,66,67} Systemic factors are not the sole determinants of bone density, many local factors are involved. One of the important factors for the maintenance of an appropriate amount of bone, is the mechanical stress which deals with the piezoelectric properties of bone.⁶⁰ The desired effect of weight-bearing therapeutic modalities for osteoporosis, on the density of the bone tissue, is for mechanical stress to stimulate bone formation and increase density.⁶⁹

In the present work, group A (acrylic denture wearers) showed the least decrease in bone density in comparison with the other two groups. On the other hand, silicone-lined acrylic denture wearers (group B) portrayed the greatest decrease in bone density. Acrylic denture bases are much heavier than either the metal or the silicone lined acrylic denture bases, so their loading on the underlying bone would be much greater. Metal bases came in second after the acrylic bases because metal bases have shown to enhance the muscle function, which in turn causes piezoelectric currents in bone and help in bone formation.⁷⁰ As for the silicone lined acrylic denture bases, they caused the least mechanical stress stimulation needed to enhance bone density.

Interestingly, the silicone lining has shown its beneficial effect on vertical ridge height by reducing the amount of load which was the same reason for causing a decrease in bone density. Long term follow up is needed to study the effect on both variables at the same time. Measurements of the cortical thickness at the gonion at the base line and six months later were used in the present study in monitoring the skeletal status for all the patients, because of their strong correlation with other bone mass measurements (Table 6).^{21,23,62} Measurements of cortical thickness at the gonion in the present work were in agreement with previous studies.^{12,13,62,63}

A statistical significant positive correlation between the measured variables appeared in group C (metal denture wearers) (Table 4). In other words an actual decrease in the vertical height of alveolar bone was accompanied by an actual decrease in bone density in this group. Although the obtained correlation was different from the results of some investigators,^{71,72} it came in agreement with the results of more recent work by Kribbs.²³

Lack of statistically significant correlations between the different variables, studied for the heat-cured acrylic resin and the silicone-lined acrylic resin denture bases, may not necessarily mean that correlations do not exist but only encourage the idea of further research in this area.

Conclusion

There was a generalized decrease in mandibular alveolar bone height after six months in all the investigated groups. The greatest reduction occurred in metal denture wearers while the least reduction occurred in silicone lined acrylic denture wearers. In all the fifteen patients the reduction in height was more posteriorly and least in the anterior region.

There was an actual decrease in optical density of mandibular alveolar bone in all the groups after six months, which was not statistically significant. The greatest actual reduction appeared in the silicone-lined acrylic denture wearers and the least actual reduction appeared in acrylic denture wearers.

All the groups individually measured or grouped together showed a thickness of less than one millimeter of the cortical thickness at the gonion, which was indicative of metabolic bone disease as osteoporosis, according to previous studies.

Correlation between the studied variables showed a statistical significant positive correlation in the metal denture wearers where reduction in mandibular alveolar height was accompanied by an actual decrease in bone density.

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