

A New Computerized Method for Evaluation of Alveolar Bone Heights for Canine Supported Mandibular Overdenture

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Abstract

Introduction: The use of natural teeth as abutments for overdenture has become a logic solution of the extraction of the present teeth over the previous decades. In comparison with complete dentures, roots remaining under the denture base help in keeping the alveolar ridge, provide sensory feedback and improve the stability of the dentures.

Aim of the Work: The purpose of the present study was to evaluate clinically and radiologically (Panoramic x-ray) the effect of using canine supported overdenture and its effect on alveolar bone at different sites by new computerized method to preserve it and improving function, aesthetic and psychological factors..

Material and Methods: To determine the average of the different bone heights at different tooth locations. 24 patients ranged from 45-60 year old (12 males and 12 female) came to the Department of Prosthodontics, Alexandria University with past medical history. The measurement were done at various sites related to Medline (ML), anterior near canine (FC), premolar (FP), molar (FM), and mental foramen line (ALC-MF-IBM) as a reference points for edentulous and dentate sites also were registered. At the follow up periods (at starting of treatment at one month, after 6 and 12 months) the evaluation of alveolar mandibular bone height using a new computerized method (Image J program) which was not used in the previous studies for proper assessment of bone height measurements.

Results: There was no statistically significant difference between right and left in female. There was statistically significant difference between right and left in male in FM after 12 months, in FC at 1st, 6th, 12th months, in ALC- MF-IBM at 1st month. Patients' satisfaction about the prosthesis in relation to function and prosthetic were recorded.

Conclusions: The successful treatment of canine supported overdenture and increased in its durability rates are considered specific useful and low cost methods for treatment of an overdenture prosthetic patient. The use of periodontally compromised canines, still have the excellent value for providing enough support to preserve the supporting structure and improving function and esthetic.

Key Word: Panoramic x-ray, Overdenture, Metal coping, aesthetic, retention.

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I. Introduction

The logic solution of the extraction of remaining teeth over the past decades was the use of remaining natural teeth as abutments for overdenture prosthetic treatment which depend in its support and/or retention are depend on using one or several teeth or roots, that are existing on the denture's basal seat surfaces¹⁻³, or it may be used to get its mechanical retention on a substructure; or as covering of remaining roots with metal, which are also called telescopic crowns, short-coping, long-coping, and also to be used as attachment depending on the type of root coverage. The remaining teeth height will be detected by the analysis of the vertical dimension and teeth's vertical bone height^{3,4}.

DeVan's golden statement, "permanent maintenance of the remaining tissues and structures is more useful and important than the replacement of what is missing from it," still holds true. In comparison for using complete removable denture prosthesis in many ways, overdenture is considered the most important and practical solution used in prosthetic dentistry and considered as a valuable treatment option⁵.

Also, it provides good feedback sensation, good stability to denture and a proper solution for an old age patient whose have few remaining teeth. When comparing with complete denture it was evaluated that overdenture gave better function and esthetic. The most famous complication for the treatment of mandibular complete denture is retention and stability and alveolar ridge resorption; hence care must be taken to preserve it⁶.

When long edentulous span is detected in RPD in case of distal extension cases, so the treatment of partially edentulous arch can be challenging. In dental treatment, also overdenture is recommended when the natural remaining teeth is very weak and cannot withstand the force of mastication. Distal extension denture base have unfavorable effect on the present oral structures mainly on abutment teeth and the residual ridge⁷⁻¹⁰.

Previous studies showed that different material used for the construction of denture base has a major impact on chewing ability and the occlusal force¹¹, in addition to significant differences in bone reduction level around the terminal abutments⁸. The other methods like biting force used as a valuable assessment method in the dental treatment for prosthetic restoration is considered one of the important functions of the stability of stomatognathic system¹²⁻¹⁵.

II. Material and methods

To determine the average of the different bone heights at different tooth locations. 24 patients ranged from 45-60 year old (12 males and 12 female) came to the Department of Prosthodontics, Alexandria University with past medical history with two mandibular canines. The measurement were done at various locations correlating to anterior near canine (FC), premolar (FP), molar (FM), and mental foramen line (ALC-MF-IBM). Edentulous and dentate regions also were recorded. At the follow up period the evaluation of alveolar mandibular bone height were registered at starting of treatment at one month, after 6 and 12 months by using of a new computerized method (Image J Program) for proper assessment of bone condition.

They had no medical problems. Past dental history: they extracted many teeth, all because of dental caries. The patient complaining from the inability to masticate food properly, and constipation, so they need to have prosthesis to eat on.

The patient was instructed to obtaining medical and dental treatment plan as follows:

- 1- Exact oral prophylaxis and oral hygiene instructions.
- 2- Root canal treatment for the two canines with metal coping on them in the lower jaw and filling of all the other caries teeth.
- 3- Conventional partial denture for the maxillary arch and overdenture was planned in the mandibular arch.

The decided treatment plan consists of history taking, past medical history, they had no medical problems. Past dental history: they extracted many teeth, all because of dental caries.

Intra-oral examination: There are multiple teeth needing restorations and it was treated by feeling the maxillary and mandibular remaining teeth and periodontally treated by scaling and removal of gingival inflammation to improve its health. The inter-arch space is so limited due to their over-eruption.

Radiographic examination: From radiographs and clinical examinations. The upper left canine and the lower left and right canines need endodontic treatment. Treatment planning:

Phase (I) Taking alginate primary impressions for maxillary and mandibular jaws, surveying the study casts for maxillary and mandibular arches, mount them (to determine the inter-arch distance, any interfere with path of insertion, and the necessary modifications needed).

Phase (II) Restorative phase: I made the necessary endodontic treatments in L/Lt & Rt 3 and U/Lt 3, and other simple fillings.

Phase (III) The prosthetic phase: L/Lt & Rt 3 to have metal coping with root canal post preparations will be done on them. The final impression was taken by rubber base (heavy body) and mono phase impression materials. The final impressions for the maxillary and mandibular arches (4) the jaw relation was recorded, teeth arrangement were made and try-in was done.

Try-in of L/Lt crowns on prepared teeth: (5) Partial dentures were fabricated after that with the creation of the cavity was created on the impression surface for the mandibular denture to receive the abutments. Construction of dentures finishing and polishing and insertion in the patient mouth.

Phase IV, The patient was instructed about correct insertion and removal of the finished dentures and preservation of good oral hygiene. Periodic follow-up was carried out. Post instruction care and follow up with evaluation of the alveolar mandibular bone heights at all the study periods (1, 6 and 12 months) using a new computerized method (Image J Program).

The study was carried to the patients who receive overdentures as prosthetic treatment. While the evaluation was done using panoramic x-ray and the same similar technique¹⁶.

Radiographs were done with fixed criteria and selected for measurement and selected with the following criteria: (1) Only films of the patients with fully developed jaws and same dentitions can be used; (2) sites of mandibular first premolars and first molars must be detected in normal relationship; (3) evidence of alveolar crest resorption in the sites of premolar and first molar must be very small or absent; (4) the image of the mandible must be clear; and (5) left and right sides of the radiographic film must follow the preceding criteria.

Two lines were drawn, one tangential to the mandibular inferior edge and the other at equal distance to it and about 10 mm above it. According to results from the dentate subjects the canine area located anterior to

mental foramen incisive canal area, the sites of the first premolar and the first molar were located approximately 35 and 55%, respectively, from the length of the body of the mandibular arch starting from the midline. The measurements ML (midline) FC (Canine), FP (mandibular first premolar), FM (mandibular first molar) and mental foramen line (ALC-MF-IBM) were vertical height from the interior border of mandible to the alveolar crest¹⁶. These measurements were made on both sides of the mandible, and the mean was calculated¹⁷.

The measurements on the panoramic x-ray are done by using Image J program as following¹⁷:

- 1- A line is draw: on the inferior border of the mandibular arch and is longitudinal to it also it is parallel to the longitudinal access of the mandible.
- 2- A line is drawn passing and intersecting the mental foramen (MF) and perpendicular to the tangent line.
- 3- Line is divided into the following:
 - a) Starting from lower border of the mandibular (IBM) arch reaching the alveolar crest (ALC).
 - b) Basal height extends from the lower border of the mandibular arch to the mental foramen.

All evaluated measurements were recorded in millimeters with computerized Image J system which is not used in the previous study¹⁷.

Also, all evaluated measurements were recorded for the mandibular bone height as the reference sites (Midline - anterior canine (FC) – first premolar (FP) and first molar (FM) and mental foramen line (ALC-MF-IBM)). (Figure 1-4)



Figure 1: Cast with metal coping on master model



Figure 2: Cast for metal coping with root canal post preparations



Figure 3: Finished coping in the patient mouth

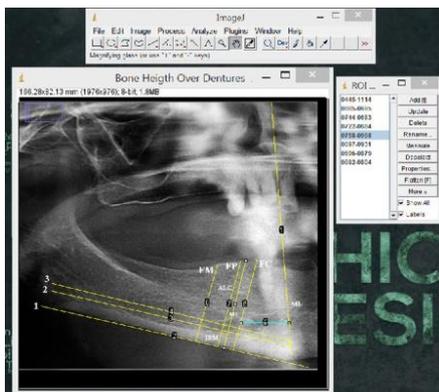


Figure 4: Reference lines and measured length of bone heights at different sites in partially dentate mandible

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov- Smirnov was used to verify the normality of distribution of variables, Student

t-test was used to compare two groups for normally distributed quantitative variables Paired t-test was assessed for comparison between three periods (At starting of treatment at one month, after 6 and 12 months) for normally distributed quantitative variables. Significance of the obtained results was judged at the 5% level.

III. Results

Comparison of subject characteristics as (age, sex and height) were recorded and compared for all the subjects and the mandibular measurements were compared between them. (Table 1)

Table (1): Distribution of the studied cases according to gender and age (n=24)

	No. (%)
Gender	
Male	12 (50%)
Female	12 (50%)
Age (years)	
Mean ± SD.	49.67 ± 5.62
Median (Min. – Max.)	47 (45 – 59)

The means and standard deviation for the length of bone height at different sites anterior near Medline (ML), canine (FC), premolar (FP), molar (FM) and mental foramen line (ALC-MF-IBM) for males and females starting (At starting of treatment at one month, after 6 and 12 months). At 1 month, 6 and 12 months for the right and left sides were evaluated. (Table 2)

Table (2): Comparison between males and females according to length of Bone height at different sites

	Length of Bone height overdenture	Right		Left		p1	p2
		Male (n = 12)	Female (n = 12)	Male (n = 12)	Female (n = 12)		
FM	At Baseline	16.9 ± 2.5	17.2 ± 2.7	17.5 ± 2.1	16 ± 2.2	0.292	0.056
	t (p)	0.203 (0.841)		1.735 (0.097)			
	After 6 months	16.3 ± 2.6	16.2 ± 3	16.7 ± 2.3	15.3 ± 2.4	0.534	0.173
	t (p)	0.142 (0.888)		1.436 (0.165)			
	After 12 months	16 ± 2.5	15.7 ± 2.8	18.2 ± 4	14.7 ± 2.4	0.047*	0.053
t (p)	0.212 (0.834)		2.618* (0.016*)				
FP	At 1 st month	20.7 ± 1.4	19.7 ± 1.7	19.5 ± 2	19.4 ± 2.5	0.082	0.471
	t (p)	1.543 (0.137)		0.107 (0.916)			
	After 6 months	19.8 ± 1.6	18.7 ± 2	19 ± 2	18.6 ± 2.7	0.200	0.641
	t (p)	1.544 (0.137)		0.425 (0.675)			
	After 12 months	19.2 ± 1.5	18 ± 1.9	18.4 ± 1.9	17.8 ± 2.4	0.191	0.509
t (p)	1.721 (0.099)		0.671 (0.509)				
Medline (ML)	At 1 st month	20.5 ± 0.6	19.1 ± 2.7	20.3 ± 0.8	19.1 ± 2.8	0.500	0.800
	t (p)	1.691 (0.116)		1.403 (0.184)			
	After 6 months	19.7 ± 0.8	18.1 ± 2.9	19.4 ± 0.9	18.2 ± 3	0.342	0.604
	t (p)	1.779 (0.099)		1.232 (0.240)			
	After 12 months	19.2 ± 0.8	17.6 ± 3	18.9 ± 1	17.5 ± 2.8	0.291	0.794
t (p)	1.826 (0.092)		1.613 (0.130)				
FC	At 1 st month	20.9 ± 1.7	20.5 ± 2.5	20.1 ± 2	21 ± 2.2	<0.001*	0.251
	t (p)	0.480 (0.636)		1.055 (0.303)			
	After 6 months	20.3 ± 1.8	20.1 ± 2.1	19.6 ± 1.8	20 ± 2.3	0.007*	0.477
	t (p)	0.199 (0.844)		0.466 (0.646)			
	After 12 months	19.6 ± 1.7	19.3 ± 2.1	19 ± 1.5	19 ± 2.1	0.007*	0.190
t (p)	0.426 (0.675)		0.079 (0.938)				
ALC-MF-IBM	At 1 st month	20 ± 1.3	19.6 ± 1.9	19.2 ± 2.5	19.5 ± 2	0.049*	0.440
	t (p)	0.563 (0.579)		0.394 (0.698)			
	After 6 months	19.4 ± 1.5	18.8 ± 2	18.4 ± 2.7	18.6 ± 2	0.054	0.167
	t (p)	0.736 (0.469)		0.163 (0.872)			
	After 12 months	18.8 ± 1.34	18.5 ± 1.9	18 ± 2.5	18 ± 2	0.134	0.066
t (p)	0.353 (0.727)		0.086 (0.932)				

Data was expressed by using Mean ± SD.

t: Student t-test

p: p value for comparing between males and females

p1: p value for Paired t-test for comparing between Right and Left in Male

p2: p value for Paired t-test for comparing between Right and Left in female

*: Statistically significant at p ≤ 0.05

There was no statistically significant difference between right and left in female.

There was statistically significant difference between right and left in male in FM after 12 months, in FC at 1st, 6th, 12th months, in ALC- MF-IBMC at 1st month.

Patients' satisfaction about the prosthesis in relation to function and prosthetic were recorded. (Table 3)

Table (3): Patients' satisfaction about the prosthesis in relation to function and prosthetic were recorded.

	Function		Esthetic	
	Yes	No	Yes	No
At 1st month				
Male	2	10	9	3
Female	3	9	10	2
At 6th months				
Male	9	3	10	2
Female	10	2	11	1
At 12th months				
Male	12	0	12	0
Female	12	0	12	0

The mandibular anterior region is less rapidly resorped than premolar and molar region. This area is protected from extreme alveolar bone loss and reduction in vertical height as a result of the function force of it.

IV. Discussion

The patient's life is affected by the missing of anterior teeth which leading to a major problem and it is solved by the restoration of missing teeth to improvement of the mastication function, speech, and aesthetics. So, the understanding of the reason for tooth missing is an important solution for gaining a perfect treatment results through the evaluation of the previous history and disease courses for each patient. In our study, we try to solve this problem by the constructed of canine supported overdentures which are considered professional and economic methods for patient treatment. Also, using the periodontally compromised canines, still have the benefit for presented sufficient support to preserve the masticatory efficiency by distribution of masticatory force and periodontal support.

Scotti et al.,¹⁸ evaluated the Overdenture supported by the presence of natural teeth when compared to complete denture provides more retention, stability, improve the masticatory function and the psychological advantages due to dental anchorage, helping the patient to be more confident in his social life, and also become more relevant. The future conversion of overdenture to complete denture become very simple, achieved in quick manner, and helps to the long clinical preservation of the denture and this agree with our study.

Construction of tooth that supported over denture is successful prosthetic treatment used as preventive prosthodontics¹⁹. With advanced age and for adaptation to denture prosthesis, the residual ridge reduction with reduce dexterity is found. Preventing denture troubles is an important factor for preserving the natural teeth²⁰ and improves health of teeth with compromised periodontal status which leads to modification and retention for psychological and biomechanical advantages. All this factors helped by using of an overdenture²¹. So, for success of the overdenture it is important to keep good selection of the patient and provide careful method for treatment which will improve satisfaction for the dentist and the patient. According to Zarb et al.,²² in mandibular denture, the advantages of overdentures preserve retention and stability and for maxillary arch treatment the important value occur when the mandibular anterior teeth opposed to the overdenture helping the transformation of the ridge against resorption as a result of subjected to masticatory forces, and this agree with our study.

Waddell et al.²³, concluded that subjects with a previous history of osteoporotic fractures would have attendance to have thinner mandibular cortex which leading to increase resorption.

Alnafisah and Mahmoud²⁴ support the use of over complete denture and considered suitable treatment for the patient, and it is more applicable for the patient. Its success depends on ideal selection of critical monitoring of various steps. Also, it improves function, esthetic and psychologically factors improving morale of the patients especially when the patient is of younger age and this agree with our study.

Barman et al.²⁵, found that there were many advantages for preservation of remaining natural roots such as good support for proprioceptive feedback which help preservation of alveolar bone, excellent esthetic and psychological factors and this agrees with our study.

Comparing between male and female, it was resulted that the men have more bone height of the mandible bone in the anterior teeth, first premolar, and first molar regions than in women. And also, these findings were agreed with Xie et al.²⁶, while exactly as the finding of Saglam²⁷.

The results of presence of the reversal line in the lower prosthetic posterior region presented toward beside the tongue and the mylohyoid ridge^{28,29}. Also, the attachment for the genial muscles is found at the inner

aspect of the anterior area of the mandible which leads to protection of the alveolar bone and vertical height from reduction with the function force.

In group A, the mean bone height around abutment teeth decreased gradually with advance of time and between intervals. The mean of bone height of abutment teeth at the 1st month was decreased gradually and continuous to decrease gradually after 6 and 12 months. In group B, the mean bone height around abutment teeth decreased gradually with advance of time and between intervals. The mean of bone height of abutment teeth was found to be decreased from the 1st month and continuous to decrease gradually after 6 and 12 months and this measurement were done to women and men in left and right side.

V. Conclusions

Canine supported overdentures are considered professional and economic methods for treatment of a prosthetic patient. In our study, the use of two roots of canine abutment helps to support and retain of the denture. Using of overdentures has been preferred often for its increase the mechanical and retentive advantages of the prosthesis. In case of treating compromised canines, still have the benefit for presented sufficient support to preserve the masticatory efficiency by transmission of masticatory load biting force and periodontal ligament receptors to motivate and starting a jaw opening reflex. The rate of alveolar bone resorption is decreased through increasing retention support and stability of the finished overdenture and improves the aesthetic for the patient. This means of clinical treatment can be more useful and can be used more efficiently as a success preventive treatment in general dental practice.

In panoramic x-ray for the mandibular bone if there was a parent erosion or porosity in elderly it was as a result of the presence of osteoporosis resulting in fracture. And also for vertical height measurements are consider clinically effective and it was found that the edentulous women were smaller than that of the men statistically.

Even after adjustment of other factors (sex, smoking, number of teeth, height and weight, age, and hormone replacement therapy), so the use of overdenture need more strong abutment teeth, sufficient bone support to withstand and distribute the force of mastication and to provide accepted functional and esthetic satisfaction for the patients.

When decision for using overdenture as a prosthetic treatment it should depends on several important factors such as strong abutment teeth and sufficient bone support to help in distribution of masticatory force, withstand any heavy function force also to provide good functional, esthetic and satisfaction for the patient.

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