

Effect of Acrylic Resin versus Composite Resin Teeth on Supporting Structure of Lower Single Denture

Maha Mahmoud Fahmy, Mahmoud Hassan Al-Afandy** and Heba Allah Taker Mohamed****

Abstract

The aim of the study: was to compare the effect of acrylic and composite tooth material on the supporting structure of lower single denture.

Materials and methods: Fourteen patients were selected from those attending the out-patient clinic of the prosthodontic department, faculty of dentistry, Ain shams university. According to inclusion, exclusion criteria and after clinical examination mandibular complete dentures were constructed to all patients. After jaw relation patients were randomly divided into two groups each consist of seven patients. First group rehabilitated with mandibular single denture with acrylic resin artificial teeth, while second group rehabilitated with mandibular single denture with composite resin artificial teeth. Before dentures delivery all dentures were lined with soft resilient liner. Patients were subjected to CBCT radiographic evolution at time of denture delivery, 6 and 12 months for assessment of mandibular residual alveolar ridge height and width at canine and first molar area.

Results: Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage. The mean of alveolar bone width at the mandibular canine and first molar areas for group (I) was 4.54 ± 1.04 , 4.17 ± 1.03 , and 3.87 ± 1.02 from 0 to 6 months and to 12 months. And show that the mean of alveolar bone width

* Masters Drat Removable Prosthodontics Department, B.D.S 2012 Faculty of Dentistry, Cairo University.

** Associate Professor at Removable Prosthodontic department, Faculty of Dentistry, Ain Shams University.

*** Professor at Removable Prosthodontic department, Faculty of Dentistry, Ain Shams University.

at the mandibular canine and first molar areas for group (II) was 4.54 ± 1.04 , 4.17 ± 1.03 , and 3.87 ± 1.02 from 0 to 6 months and to 12 months. While the mean of alveolar bone height at the mandibular canine and first molar areas for group (I) was 24.59 ± 3.43 , 24.19 ± 3.38 , and 23.92 ± 3.34 from 0 to 6 months and to 12 months. And show that the mean of alveolar bone height at the mandibular canine and first molar areas for group (II) was 22.38 ± 3.48 , 22.11 ± 3.57 , and 21.89 ± 3.68 from 0 to 6 months and to 12 months. Group (I) showed more bone loss both in height and width than Group (II) and the difference was statistically significant through the follow up periods.

Conclusion: Bone loss in cases rehabilitated with mandibular single denture with composite resin artificial teeth was less than those rehabilitated with mandibular single denture with acrylic resin artificial teeth both in height and width.

INTRODUCTION

The mandibular edentulous ridge opposing dentate maxillary arch represents a great challenge to the physician. This situation is often complicated by finding of severe mandibular residual ridge resorption. The rehabilitation of an edentulous mandible is compounded process because of the restricted quality of mucosa, the amount of denture border adjacent to movable mucosa and the influence of occlusal forces produced by static dentate maxillary arch.⁽¹⁾

It was provide that use of resilient liner to mandibular denture provide a cushioning stress reducing effect resist functional and Para functional forces.⁽¹⁻³⁾

As it was reported that intensity of stresses over the residual ridge would be a function of physical properties of the occlusal material use. which considered as a biomaterial factor that affect transmission of forces and maintenance of occlusal contact.⁽⁴⁾

There are different artificial teeth that can be used (vacuum porcelain, acrylic resin, and

recently composite resin. In the early 1930s, resin teeth were produced and still use till now. there are many advantages of acrylic resin teeth cold flow under stress, high fracture toughness, minimal abrasion of opposite dentition, silence on contact, chemically bond with denture base, when use with opposing porcelain teeth decreasing clicking caused by porcelain and decreasing tendency of porcelain to fracture, acrylic resin teeth are easily to adjust and grind.⁽⁵⁻⁷⁾

As there is no artificial teeth material are totally ideal. Acrylic resin teeth have undesirable properties, such as low thermal conductivity, surface micro-porosity, low abrasion resistance which affect masticatory efficiency, cause loss of vertical dimension of occlusion, masticatory muscle disorder.^(5,8-9)

Composite resin artificial teeth were developed in the 1980s as an attempt to improve wear resistance and the mechanical properties of acrylic resin teeth. it is consist offiller particles and cross-linked polymers to be used as artificial teeth. Composite resin artificial teeth are more worn resistance than acrylic resin artificial teeth and more abrasion resistance. Composite resin artificial teeth are reported to have adequate bonding to denture base, excellent esthetics, and greater absorption qualities.⁽¹⁰⁻¹³⁾

The cone beam computer tomography is use in dental filed to measure the bone height and width which aid in diagnosis of different cases. It is solve the problems of computer tomography including the exposure of patient to high dose of radiation, the need of big place and the high cost.⁽¹⁴⁾

The cone beam computer tomography makes a three dimensional image by using single scan and single rotation which expose volume of the body not a layer as the computer tomography and then the computer makes multiple images to allow operator to select area of interest.⁽¹⁴⁾

The cone shape x-ray of cone beam computer tomography produce three dimensional image of area of interest with high accuracy and limited dose.⁽¹⁴⁾

Materials and methods

Fourteen patient were selected from those attending the out-patient clinic of the prosthodontic department, faculty of dentistry, Ain shams university.

Inclusion criteria

- All patients had upper posterior teeth and lower fully edentulous.
- Alveolar ridge was free of any pathological signs, bony undercuts or neoplastic lesions.
- All patients had firm healthy mucosa.

Exclusion criteria

- Patient with uncontrolled systemic disease, Systemic diseases affecting metabolism of bone (Uncontrolled diabetes, bone diseases, hyperparathyroidism and renal disease), Severe blood diseases, Liver problem, Patient undergoing chemotherapy and radiotherapy.
- Patient with flappy ridge
- Patient with recent extraction within last 6 months.
- Smoker patients.

Mandibular complete denture construction

Upper and lower primary impression were made using alginate impression material, Secondary impression for edentulous mandible was made using green stick compound for Border tracing and zinc oxide-eugenol impression material. lower occlusion block were fabricated. Maxillary secondary impression were made using alginate impression material. Face bow record was made to mount the upper cast on the semi adjustable articulator. The lower cast was mounted according to recorded centric occluding relation at proper vertical dimension of occlusion following wax wafer technique.

Occlusal adjustment

Modification of opposing natural teeth was carried out primarily over the master cast then transferred to patient mouth by the use

of a clear acrylic template then The modified teeth were polished and treated with stannous fluoride gel.

Patients grouping:

Patients randomly divided into two equal groups according to the material of the artificial teeth used in the denture construction into:

Group1: patients in this group were rehabilitated with mandibular single denture with acrylic resin artificial teeth. Mandibular single denture with composite resin artificial teeth.

Group2: patients in this group were rehabilitated with mandibular single denture with composite resin artificial teeth.

To standardize the size and shape of the teeth for both groups, the teeth were taken from same company with same sizes and occlusal forms. Setting up of teeth in both groups was done following the lingualized concept of occlusion, the Lingual cusps of mandibular posterior teeth were placed medial to an imaginary line drawn from the tip of the canine to the center of the retromolar pad, setting up of teeth in both groups carried out with no transverse inclination, the interlocking transverse ridges of the occlusal surfaces were ground to provide freedom in occlusion (long centric). The waxed up dentures were tried in the patient's mouth to ensure stability, extension, correct vertical dimension and harmony between centric relation and centric occlusion. The tried dentures were flasked then processed into heat cure resin then laboratory remounting was carried out. Clinical remounting carried out then finishing and polishing after that the denture was ready to deliver to the patient. Before denture delivery soft lining process was carried out using resilient denture liner. With post insertion instructions dentures were delivered to patients.



Figure(1):Delivered Denture with Acrylic Teeth.

Construction of radiographic stent

Before denture insertion clear heat cured acrylic resin was packed into the gypsum mold to obtain a duplicate of the lower denture. This was used as a radiographic stent. Guttapercha was used as a guide to analyze the alveolar bone height and width at constant place for each patient and for all patients sharing in the study. Guttapercha was placed under the distal surface of the maxillary right and left canines to analyze bone in mandibular canine areas and under the mesio-buccal cusps of maxillary right and left first molars to analyze bone in mandibular first molars areas.

Radiographic evaluation

Patients were frequently recalled for inspection, post insertion adjustments and to take a cone beam (CBCT) radiographs for follow up records. These radiographs were taken at the delivery appointment, 6 and 12 months after dentures delivery all data were collected and recorded in the patient`s chart at every follow- up visit.

Results:

Group (1) patients rehabilitated with mandibular single denture with acrylic resin artificial teeth and Group (2) patients rehabilitated with mandibular single denture with composite resin artificial teeth.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean \pm standard deviation (SD). Qualitative data were expressed as frequency and percentage.

-Effect of time on rate of residual alveolar ridge loss in height & width for both groups:

A)-Effect of time on width of residual alveolar ridge:

The data of the right and left canine & first molar areas were pooled together. The average of these data were tabulated, calculated and statistically analyzed.

Table (1), show the mean and standard deviation of alveolar bone width at the mandibular canine & first molar for group (I) and group (II).

The results revealed reduction in the means of the measured bone width during the 12 months follow- up period.

Table (1) and show that the mean of alveolar bone width at the mandibular canine and first molar areas for group (I) was 4.54 ± 1.04 , 4.17 ± 1.03 , and 3.87 ± 1.02 from 0 to 6 months and to 12 months. And show that the mean of alveolar bone width at the mandibular canine and first molar areas for group (II) was 4.54 ± 1.04 , 4.17 ± 1.03 , and 3.87 ± 1.02 from 0 to 6 months and to 12 months.

Table (1): Comparison between group I and group II according to bone width of residual alveolar ridge.

Width	Group II (n=7)	Group I (n=7)	t-test	p-value
Baseline				
Mean±SD	3.63±0.55	4.54±1.04	7.130	0.014*
Range	2.4_4.2	3.4_6.6		
After 6 months				
Mean±SD	3.50±0.52	4.17±1.03	4.127	0.054
Range	2.4_4.2	3_6.2		
After 12 months				
Mean±SD	3.39±0.59	3.87±1.02	2.025	0.169
Range	2_4.2	2.83_6		
Change% Baseline and after 6months				
Mean±SD	-3.55±2.64	-8.36±2.76	19.001	<0.001**
Range	-5.9_0	-13_-4.3		
Change% Baseline and after 12months				
Mean±SD	-7.07±4.76	-15.15±4.40	18.644	<0.001**
Range	-16.7_0	-23.8_-9.1		
Change% After 6months and after 12months				
Mean±SD	-3.59±5.44	-7.43±3.46	4.246	0.049*
Range	-16.7_0	-15.8_-3.2		

T-Independent Sample t-test;

*P-value>0.05 NS; *p-value <0.05 S; **p-value <0.001 HS*

This table shows statistically significant difference between groups according to change in bonewidth of residual alveolar ridge.

B)-Effect of time on height of residual alveolar ridge:

Data of the right and left canine& first molar areas were pooled together. The average of these data were tabulated, calculated and statistically analyzed.

Table (2) shows the mean and standard deviation of alveolar bone height at the mandibular canine& first molar areasfor group (I) and group (II).

The results revealed reduction in the means of the measured bone width during the 12 months follow- up period.

Table (2)shows that the mean of alveolar bone height at the mandibular canine and first molar areas for group (I) was 24.59±3.43, 24.19±3.38, and 23.92±3.34 from 0 to 6 months and to 12 months. And show that the mean of alveolar bone height at the mandibular canine and first molar areas for group (II) was22.38±3.48, 22.11±3.57, and 21.89±3.68from 0to 6 months and to 12 months.

Table (2): Comparison between group I and group II according to bone height of residual alveolar ridge.

Height	Group II (n=7)	Group I (n=7)	t-test	p-value
Baseline				
Mean±SD	22.38±3.48	24.59±3.43	2.455	0.131
Range	16.6_28	20_31		
After 6 months				
Mean±SD	22.11±3.57	24.19±3.38	2.147	0.157
Range	16.4_27.8	19.61_30.6		
After 12 months				
Mean±SD	21.89±3.68	23.92±3.34	1.992	0.172
Range	16.2_27.8	19.45_30.4		
Change% Baseline and after 6months				
Mean±SD	-1.32±1.59	-1.67±0.46	4.842	0.038*
Range	-6_0	-2.3_-0.6		
Change% Baseline and after 12months				
Mean±SD	-2.34±2.67	-2.75±0.64	5.852	0.012*
Range	-8_-0.7	-3.8_-1.8		
Change% After 6months and after 12months				
Mean±SD	-1.07±1.67	-1.11±0.40	0.007	0.934

T-Independent Sample t-test;

*P-value>0.05 NS; *p-value <0.05 S;*

This table shows statistically significant difference between groups according to change in bone height of residual alveolar ridge.

Group (I) showed more bone loss both in height and width than Group (II) and the difference was statistically significant through the follow up periods.

Discussion

Discussion of Methodology

One of the treatment modalities for patients who became entirely edentulous in mandibular arch while retaining either all or some of their natural teeth in the maxillary arch is single completed denture. However, several difficulties are encountered in providing a successful one due to the problems of mobile floor of the mouth, reduced tissue bearing area, lining mucosa have poor mobility and the movement of the tongue which add forces on the residual ridge increasing rate of ridge reorption^(15,16).

In this study two types of artificial teeth material were used in order to study their effect on the residual ridge. Composite resin artificial teeth were found in several studies to have an intermediate impact value in comparison to that of acrylic resin and porcelain teeth. Acrylic resin artificial teeth are among the artificial teeth investigated used as a standard denture tooth material.⁽¹⁷⁾

Resilient lining material was used as a shock absorber for all cases in order to aid in reducing as much as possible of stress transmitted to the residual ridge.⁽¹⁸⁾

For all patients selected in the study maxillary natural teeth were properly diagnosed and adjusted to avoid any overeruption, malposition and any abnormal bony condition to achieve a proper orientation and inclination of the occlusal plane of the denture.⁽¹⁹⁾

Standard clinical and laboratory techniques were followed for the construction of single dentures for all patients. Also, same materials were used for construction of the denture except that of artificial teeth material to avoid any factor that might affect the results of this study.⁽²⁰⁾

One group of patients received composite resin artificial teeth,^(21,22) and another group received acrylic resin artificial teeth. The two types of artificial teeth have a same size and cuspal inclination to avoid any factor that affects the results of the study.⁽²³⁾

Setting up of teeth was done following the lingualized concept of occlusion which carries several advantages.⁽²⁴⁾

A duplicate of denture from clear heat cured acrylic resin were used as a radiographic stent with guttapercha placed over the canine and first molar area guided by the opposing dentition.

Cone beam computed tomography (CBCT) is a radiographic imaging technique that was used to analyze the rate of bone loss in height and width of mandibular alveolar ridge.⁽²⁵⁾

For standardization of the method of evaluation same machine was used for all patient and same place of measurement (canine and first molar areas).all data were collected and recorded in the patient`s chart at every follow- up visit.

Discussion of results:

The loss of residual alveolar bone was evident in all patients sharing in this study in both canine and first molar area this could be attributed to the immediate bone resorption following insertion of single dentures that were certainly predisposed to forces induced by the dentate maxillary ridge. This was previously ascertained by other investigators.^(26, 27)

Since difference in bone loss may be attributed to many biomechanical factors such as occlusal teeth form, length, width of occlusal table, theory of occlusion being followed and type of teeth material, in this study all these factors were standardized between the two studied groups.

The results of this study revealed a decrease in residual alveolar ridge both in height and width for the two groups throughout the study periods. This may be due to bone reaction after loading of the prosthesis and forces of mastication.⁽²⁸⁾

This study showed that the type of occlusal material does in fact have a direct influence on the bone of residual ridge. Previous investigations support this finding as it reported that Pressure transmission and distribution varied among the denture tooth materials, Differences in the modulus of elasticity of each type of denture tooth were demonstrated.⁽²⁹⁾

This different in amount of bone loss between group I (acrylic resin artificial teeth) and group II (composite resin artificial teeth), may be due to their difference in the wear resistance between the composite and acrylic resin teeth where the acrylic teeth wear more than composite teeth.⁽³⁰⁾

The result of this study can be explained by the theory of wear in such a way that acrylic teeth may worn more than composite teeth and this led to loss of occlusal contact affecting the occlusal balance leading to premature contacts with loss of vertical dimension of occlusion which lead to contact between the teeth anteriorly and increase the stresses on the anterior segment of the arch. Although acrylic teeth are more resilient with low modulus of elasticity, they absorb the stresses and protect the underlying tissues. The effect of wear and subsequently the change of force distribution anteriorly and posteriorly was more than the resiliency of the material which resulted in more stress and more bone loss. On the other hand, composite teeth have higher modulus of elasticity and are less resilient than acrylic teeth together with its higher wear resistant allowing them to maintain the occlusal scheme and the

vertical dimension leading to less stresses and more favorable results.

After radiographic calculation and statistical analysis this study find that composite resin as an occlusal material, transmits the stresses more favorably to the mandibular residual ridge than acrylic resin and may be a better alternative as an occlusal material for lower single denture cases opposed by dentate arch.

Conclusion

Based on the results of this study, it could be concluded that: Bone loss in cases rehabilitated with mandibular single denture with composite resin artificial teeth was less than those rehabilitated with mandibular single denture with acrylic resin artificial teeth both in height and width.

References

- 1- **Zarb GA, Bolender CL, and Carlsson GE:** Boucher`s prothodontic treatment for edentulous patients. 11thed., St. Louis. C.V. Mosbyco. 1997: p 467.
- 2- **Tallgren A:** The continuing reduction of the residual alveolar ridge in complete denture wearers: A mix –longitudinal study covering 25 years. *J. prosthet Dent.* 1972; 27:120.
- 3- **Carlsson GE:** clinical morbidity and sequelae of treatment with completed dentures. *J Prosthet Dent.*, 1998; 79: 17.
- 4- **Zarb GA, Bolender CL, Hickey JC, and Carlson CE:** Boucher`s prosthodontics treatment for edentulous patient, CVMosbyCo., St. Louis. 2004.
- 5- **Kreisler M, Behneke N, Behenke A and d`Hoedt B:** Residual ridge restoration in edentulous maxilla in patient with implant –supported over-denture: An 8- year retrospective study. *Int Prosthodont.* 2003; 16:295.
- 6- **Khanna G, and Aparna IN:** compression of micro hardness of three different types of acrylic artificial denture teeth: an in vitro study. *J Orofac res.* 2013; 3:181.
- 7- **Zeng J, Sato Y, Ohkubo C, and Hosoi T:** in vitro wear resistance of three types of composite resin denture teeth. *J prosthet dent.* 2005; 94:453.
- 8- **Saavedra G, Neisser MP, Sinhoreti MAC, and Machado C:** evaluation of bond strength of denture teeth bonded to heat polymerized acrylic resin denture base. *Bra J oral sci.* 2004; 3:458.
- 9- **Bani, D, Bani T, and Bergamini HR:** morphologic and biomechanical changes of the masseter muscles induced by occlusal wear: studies in a rat model. *J dentrest.* 1999; 78:1735.
- 10- **Suzuki S, sakoh M, and shiba A:** impact resistance of highly cross-linked plastic denture teeth. *J Biomed mater RES.* 1990; 24:1661.
- 11- **Hirano S, May K, Wagner WC, and Hacker CH:** in vitro wear of resin denture teeth. *J prosthet dent.* 1998; 79:152.
- 12- **Suzuki S:** in vitro wear of Nano – composite denture teeth. *Jprosthodont.* 2004; 13:238.
- 13- **Kawara M, Cater JM, Ogle RE, and Johnson RR:** bonding of plastic teeth to denture base resins. *J Prosthet Dent.* 1991; 66:566.
- 14- **Scanfe WS, Farman AG, and Sukovics P:** clinical application of the cone beam computed tomography in the dental practice. *J Can Dent Assoc.* 200; 72:75.
- 15- **Yurkstas TW:** Prognosis of maxillary versus mandibular dentures. *J Prosthet. Dent.* 1968; 25:112.
- 16- **Chee W, Jivraj S:** Treatment planning of the edentulous mandible. *British Dental Journal.* 23 September 2006; 201: 337–347.

- 17- **Kawano F, Ohguri T, Ichikawa T, Mizuno I, Hasegawa A:** Shock absorbability and hardness of commercially available denture teeth. *Int J Prosthodont.* May-Jun 2002;15(3):243-7.
- 18- **Wright PS:** The success and failure of denture soft-lining materials in clinical use. *J Dent.* Dec 1984;12(4): 319-27
- 19- **Bruce BW:** Complete dentures opposing natural teeth. *J ProsthetDent.* 1971; 26: 448.
- 20- **Winkeler S:** Essential of Complete Denture Prosthodontics. W.B. Saunders. Co., Philadelphia. 1988; P. 190.
- 21- **Nagaraj E, Mankani N, Madalli P, Astekar D:** Socioeconomic factors and complete edentulism in north karnataka population. *J Indian Prosthodont Soc.* 2014;14: 24-28.
- 22- **Feine JS, Carlsson GE, Awad MA, et al:** The McGill consensus statement on overdentures. Mandibular two implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. *Int J Oral Maxillofac Implants.* 2002;17:601-602.
- 23- **Zeng J, Sato Y, Ohkubo C and Hosoi T:** In vitro wear resistance of three types of composite resin denture teeth. *J prosthetDent.* 2005;94:453
- 24- **Phonix RD, and Engelmeier RL:** Lingualized occlusion revisited. *J Prosthet Dent.* 2010;104: 342.
- 25- **Loubele M, Bogaerts R, Van Dijck E, Pauwels R, Vanheusden S, Suetens P, et al:** Comparison between effective radiation dose of CBCT and MSCT scanners for dentomaxillofacial applications. *Eur J Radiol.* 2009;71(3):461–8.
- 26- **Wismijer D, VanWaas M, and Klak W:** Factors to consider in selecting an occlusal concept for patients with implants in the edentulous mandible. *J prosthet Dent.* 1995;74:380.
- 27- **Lindquist LW, Rockler B, and Carlsson GE:** Bone resorption around fixtures in edentulous patients treated with mandibular fixed tissue-integrated prosthesis. *J Prosthet Dent.* 1988;59: 59.
- 28- **Cox J, and Zarab G:** The longitudinal clinical efficiency of osseointegrated dental implant. A 3 years report. *Int J oral Maxillofac Implants.* 1987; 2:91.
- 29- **Phunthikaphad T, Takahashi H, and Arksornnukit M:** Pressure transmission and distribution under impact load using artificial denture teeth made of different materials.: Department of Prosthodontics, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand. *J Prosthet Dent.* Nov 2009;102(5):319-27.
- 30- **Hirano S, May K, Wagner WC, and Hacker CH:** In vitro wear of resin denture teeth. *J Prosthet Dent.* 1998;79:152.