



Comparative study of maxillary complete denture base retention using different impression materials

Dr. Mohammed Adnan B.D.S, M.Sc.

Dr. Hikmat J. Aljudy B.D.S,M.Sc,PhD.

Dr. Abdalbasit A. Fatihallah B.D.S, M.Sc

Abstract

An impression taking for edentulous ridge is the first step in the fabrication of the complete denture prosthesis. Various theories have been proposed by different authors as how to achieve an optimum impression in different ways.

The purpose of this study was to compare the retentive forces required to dislodge maxillary complete denture bases fabricated by using different impression materials.

Twenty completely edentulous patients were selected and three types of impression were made for each patient. The 1st group; final impression were made with zinc oxide eugenol "ZOE", 2nd group; final impression were made with light body addition silicone impression material and 3rd group; final impression were made with condensation impression material. Three stone casts were obtained for each patient and three denture bases were fabricated by short curing cycle, retention force examined and compared using strain gauge force transducer.

Statistical analysis for the data collected using descriptive statistic, ANOVA and LSD, the result revealed that group A "Impression with ZOE" and B "Impression with addition silicone" show nearly the same results while group C "impression with condensation silicone" significantly less retentive force than that of group A and B.

Retention of complete denture bases is greater in denture bases produced by zinc oxide eugenole final impression material than the other examined final impression materials.

Keywords: Impression, retention, maxillary complete denture

Introduction

Internal adaptation of resin bases to the residual ridge is a fundamental requirement for the final success of complete dentures and may be compromised during the several phases of denture processing. Many materials and techniques have been proposed to obtain prostheses with better adaptation and resistance⁽¹⁾.

Denture retention has been expressed as the resistance to vertical

and torsion stresses, or the resistance of a denture to removal in a direction opposite to that of its insertion. In effect, retention was related to the forces that are necessary to completely remove the denture from its basal seat⁽²⁾.

Retention is defined as the quality inherent in the dental prosthesis acting to resist forces of dislodgement along the path of placement. Retention is an important pre-requisite for stability⁽³⁾.

Jacobson and Krol⁽⁴⁾ claimed that complete denture retention is the resistance to displacement of the denture base away from the ridge in vertical direction. Making accurate final impression for complete dentures is a multistage process that involves a preliminary impression, a customized final

impression tray and a final border impression^(5, 6). It is important to thoroughly examine the patient's mouth and select the most appropriate impression technique⁽⁷⁾. A major requirement for final impression of complete dentures is to develop the peripheral contours to accommodate normal muscular function and to ensure peripheral adaptation without allowing air penetration between the future denture base and the mucous membrane⁽⁸⁾. Impression philosophies and techniques were investigated by many authors. The impression techniques and materials used vary depending on the condition of oral cavity and the dentist's perspective on impression making. An accurate impression could be achieved by molding the borders of the individual tray with modeling compound, and finally an impression is completed with an impression material that flows easily. Many clinical methods and techniques have been developed in the past to investigate the phenomenon of denture retention. These methods include the use of spring balances, hand scales, dynamometers, loading apparatus and various classes of levers⁽¹⁰⁾.

Recognition, understanding and incorporation of certain mechanical, biological, and physical factors are necessary to ensure optimal complete denture treatment, through achieving retention, stability and support⁽⁹⁾.

Impressions of edentulous arches must accommodate the anatomy and function of the oral tissue. Zinc oxide

eugenol paste impression material has been standard for definitive edentulous impressions because of their material properties and handling characteristics.^(6, 11)

Condensation silicone is one of the frequently used dental materials for many years; condensation silicone impression material has been a staple of dental practices. They form a major bulk of our clinical practice even today. A study has shown that condensation silicone impressions can be used as final impressions^(13, 14).

Several studies have been carried out aimed at enhancing the physical properties of silicone impressions. Of the physical properties which may adversely affect the fit and retention of dental prostheses, dimensional change in the impression material is considered the most serious. It is therefore considered the main feature of any impression material, and needs to be taken into consideration to achieve a good restoration,⁽¹⁴⁾ thus the will of the present study is prompted to evaluate the retention of complete denture bases produced by different final impression materials.

Materials and methods

Twenty completely edentulous patients half of them male and the others are female were selected for this study from the prosthodontic department clinic, college of dentistry, Baghdad University according to the following criteria that have been evaluated by two qualified prosthodontists; the patient's age ranges from 45 to 60 years, free from systemic diseases which could affect denture retention. Patients had healthy firm mucoperiosteum without signs of inflammation or flabby tissues covering the edentulous ridge. Oral saliva was within average amount and consistency and they had normal

temporomandibular joint function. Patients had extreme shaped palatal vaults and undercuts were excluded. All participants possessed no physical disability which would interfere with the study and all of them were willing to participate and cooperate throughout the entire study.

For Each participant a non perforated stock tray with the same size for completely edentulous maxillary arch were checked and evaluated for its accuracy, in order to a preliminary impressions for their maxillary arch by using impression compound materials(Hoffmann dental manufaktur GmbH-Berlin Germany). These impressions were poured with dental stone (Zeta, Selensor, Industria Zingardi s.r.i. Italy) to obtain the study models, on which three acrylic resin (Major prodotti dentari S.P.A- Italy) custom trays were fabricated. The whole trays were tried in the patient's mouths and trimmed 2mm for border molding materials, posteriorly the trays were extended from one hamular notch to the other and extended approximately 2mm beyond the vibrating line. Following the completion of exact border molding, three final impressions were made for each patient, these impressions included:

I-First final impression was using zinc oxide eugenol (S.S white group- England) impression material.

II-Second final impression was using addition silicone (Zhermack clinical -Italy) final impression material.

III-Third final impression was using condensation silicone (Zhermack clinical-Italy) impression material.

The finished impressions were tested for their details accuracy; by having sufficient anatomical details and record the entire denture bearing area without distortion of impression

materials. Each impression was undergone beading and boxing and poured immediately with stone by using vibrator. The resultant casts were marked. A post dam carved for each of three casts for each patient by using No. 4 round bur in order to obtain a depth and width of 1 mm. Denture bases were fabricated for the three groups of cast for individual patient by placing a one layer of sheet wax (QD-England) then converted to heat cured acrylic (Major prodotti dentari S.P.A-Italy) by conventional method of curing. A specially designed strain gauge force transducer was used in order to measure the force values that are required to dislodge denture bases for completely edentulous arches. The experimental apparatus consist of load application apparatus which included (load application screw, cantilever beam, hook assembly) with the supporting structure or the platform.

The active element of the transducer was 2 foil strain gauges that bonded to the prepared surfaces of the stainless steel cantilever beam and wired with lead wire to form 2 arms of the Wheatstone bridge circuit. they were connected so as 1/2 bridge the tension and compression occur within the 2 strain gauges from the bending of the cantilever beam during the dislodgment of the maxillary denture bases will produce a signals that amplified on the strain measuring device which provide reading in voltage unite (milivolt) then by referring to calibration test converted to load in grams.

Astringe of about 1 inch length was secured on the polished palatal surface of each of the maxillary denture bases in region relating to the second premolar and first molar teeth⁽¹⁷⁾ with autopolymerizing acrylic resin so to serve as a mean of connection for the hook assembly as shown in figure(3). The geometric centre was determined

by measuring half the distance between the incisive papillae and the fovea palatine. The hook used being light in weight and easy to disinfect by using 70% solution of isopropyl alcohol. The dislodging force that is directed to the maxillary denture bases was applied at the middle of the denture base where the middle location is considered the most reliable region for testing the retention of complete maxillary dentures bases. ⁽¹⁸⁾ The patient head was held firmly on the head rest with occlusal plane parallel to the floor, all measurements of retention involving in a given subject were conducted at one sitting; each test denture base was subjected to three retention tests. The force values at which the denture base was dislodged completely from the palate at a steadily increasing force was displayed on strain measuring device represented by (mv) and by referring to the calibrated data, the force values in grams could be calculated.

Results

The mean values of the statistical analysis for the data collected between the three impression materials used in the present study shown in Table 2 and Fig 4, the results indicated that the higher mean value of retentive forces was detected in denture bases produced by zinc oxide eugenole impression material, while the least mean value of retentive forces was detected in condensation silicone in comparison to zinc oxide eugenole and addition silicone impression materials, where as the results of ANOVA and LSD showed in Table 3, the result show that there was a very highly significant difference between the ZOE and the other types of silicone impression materials when the $P < 0.0001$, while the difference is only significant between the addition and condensation

silicone impression materials when the $P < 0.05$ as shown in Table 2.

Discussion

Complete denture must be retentive to achieve its goals as speech, mastication and esthetics' One of the most important factors to achieve such needed retention is peripheral seal, and to have this peripheral seal, border molding must be done. ⁽⁹⁾

The adaptation of the denture borders to the surrounding, draping tissues at the time of their contraction is an important factor for the attainment of optimal, comfortable and long lasting retention of complete dentures. Based on these findings it appears that a more precise control of muscle contraction during impression procedure is needed to minimize the possible peripheral distortion. The more intimate the relationship of the border to the musculature, the greater will be the retention. ⁽²¹⁾

In the present study patients were selected free from systemic diseases which could affect denture retention as Parkinson's disease "hemiplegia or dyskinesia and any abnormalities in the temporomandibular joint as they may result in prosthetic failure due to lack of neuromuscular control. All patients should possess healthy firm mucoperiosteum without signs of inflammation or flabby tissues and no resilient tissues in the oral vestibule to prevent denture base movement over rebound tissues which could affect denture base stability and consequently give false records during testing the retentive quality of the denture The alveolar ridge was selected without undercuts to eliminate the effect of mechanical factors on denture retention. The three denture bases were made of even thickness and shape by using 1 layer base plate wax to standardize the effect of gravity as

thickness increase effect of gravity on the denture bases, Standardization of thickness was done also as thicker denture base specially at the peripheries would displace peripheral tissues, lips and cheeks leading to inaccuracy of the recorded results.

Denture bases of each patient were flaked, packed and processed at the same time to avoid variation in dimensional changes occurring during fabrication. A metallic hook was used to allow gauge attachment during force application for retention test" was fixed to the geometrical center of the denture bases according to Colon et al (18) as this attachment showed more variability of the forces needed to dislodge the bases and so it was nearly considered as the most reliable region for testing the retention of complete region. The patient was nearly sitting in dental chair so that upper arch was parallel to the floor.

Various methods and impression materials have been tried for successful shaping of the borders of a denture according to the morphological and functional conditions of an edentulous mouth, in the present study, final impression in custom tray is mandatory procedure as the tissues would be compressed to a certain extent during the preliminary impression, and we are being in the same line with Shetty et al⁽¹⁷⁾ and Singla⁽¹²⁾.

The adaptation of the denture borders to the surrounding, draping tissues at the time of their contraction is an important factor for the attainment of optimal, comfortable and long lasting retention of complete dentures⁽²¹⁾, These were applicable for final impression using zinc oxide eugenole impression material since this impression material is highly precise and registered the final details accurately and with good dimensional stability and these being in agreement with Nawar et al , while the addition

silicone impression material produced casts with better copy of residual ridge tissue less than zinc oxide eugenole but greater than the condensation silicone impression material since the addition silicone final impression material exhibit good dimensional stability when polymerized against heavy bodies and greater bond strength between materials. These results were being in line with finding of Hasanreisoglu et al⁽²¹⁾ and Monterio et al⁽²²⁾.

Conclusion

From the results of this study the following can be concluded that the retention of complete denture bases is greater in denture bases produced by zinc oxide eugenole final impression material than the other examined final impression materials.

References

- 1- Gomes M, Broilo J R, Walber L F, Maccari P C A, Shinkai R S A: Adaptation of complete denture babes submitted to chemical polishing. *J Appl Oral Sci* 2004; 12(4): 322-5.
- 2- The glossary of Prosthodontic terms. *J Prosthet Dent* 2005; 94:10-92.
- 3- Levin B. Impressions for complete dentures. Chicago: Quintessence Publishing Co. Inc; 1984.
- 4- Jacobson T.E and Krol A.J: A contemporary review of factors involved in complete denture retention, stability and support. Part I Retention *J Prosthet Dent* 1983; 49(1): 5-15.
- 5- Heartwell CM, Rahn AO. Syllabus of complete dentures. 4th ed. Philadelphia: Lea & Febiger; 1986.
- 6- Zarb AZ, Bolender CL, Hickey JC, Carlsson GE. Boucher's prosthodontic treatment for edentulous patients. 11th ed. St Louis: C V Mosby; 2005.
- 7- McCord JF, Grant AA, Quayle AA. Treatment options for the edentulous mandible. *Eur J Prosthodont Restor Dent* 1992; 1:19-23.
- 8- Suenaga K, Sato T, Nishigawa G, Minagi S. Relationship between size of complete foundation area and resorption of alveolar

- ridge in the edentulous mandible. *J Oral Rehabil* 1997; 24:315-319.
- 9- Navtar:N., Etd.H., Sabet.M.: A study on the effect of border molding on retentive efficiency of maxillary complete denture. *Cairo Dental Journal* 2005; 21(2):135-140.
 - 10- Hamrick JE: A Comparison of the retention of various denture base materials. *J Prosthet Dent* 1962; 12(4): 666-677.
 - 11- Ross RA. Zinc oxide impression pastes. *J Am Dent Assoc.* 1934; 21:2029-2032.
 - 12- Singla S: Complete denture impression techniques: Evidence-based or philosophical. *Indian J Dental Res* 2007; 18(3):124-127.
 - 13- Ratnaweera PM, Yoshida K, Miura H, Kohta A, Tsuchihira K. A: clinical evaluation of agar alginate combined impression: Dimensional accuracy of dies with a new master crown technique. *J Med Dent Sci* 2003; 50:231-8.
 - 14- Rosenstiel S, Land MF, Fujimoto J. *Contemporary fixed prosthodontics*, 2nd ed. St. Louis, Mosby, 1998:332-6.
 - 15- Padmakar S Patil, Ramesh Chowdhary, Sunil Mishra: Comparison of custom trays and stock trays using polyvinylsiloxane to evaluate linear dimensional accuracy: An in vitro study. *JIPS* 2008; 8(3):156-161.
 - 16- AL-Loaibi MA: The effect of palatal reduction of the maxillary complete denture on the retention and patient satisfaction. M.Sc.D thesis, college of dentistry, university of Baghdad.2004.
 - 17- Shetty S,Nag VR,Shenoy K K.: the selective pressure maxillary impression: A review of the technique and presentation of an alteration custom tray design. *The Journal of Indian Prosthodontic society* 2007; 7(1):8-10.
 - 18- Colon A, Kotwal K, and Mangelsdroff AD: Analysis of the posterior palatal seal and the palatal form as related to the retention of complete dentures. *J Prosthet Dent* 1982; 47(1): 23-27.
 - 19- Bomberg TJ, Hatch RA, Hoffman W Jr. Impression material thickness in stock and custom tray. *J Prosthet Dent* 1985; 54:170-2.
 - 20- Thangthammachat S, More BK, Barco MT, Hovijitra S, Brown DT, Andres CJ. Dimensional Accuracy of Dental Casts: Influence of Tray materials, impression materials and Time. *J Prosthodont* 2002; 11:98-108.
 - 21- Hasanreisoglu U, Gurbuz A, Özden N, Kesim F. Evaluation of Reproducibility of the Peripheral Tissues in Edentulous Patients. *Tr. J. of Medical Sciences* 1998; 28: 291-294.
 - 22- Monteiro W.,Corradi CA.,Conani S.,Mendes WB.: Dimensional changes occurred in cast for complete dentures evaluated by tri-dimensional measurements. *Cienc Odontol Bras* 2007; 10(3): 6-11.

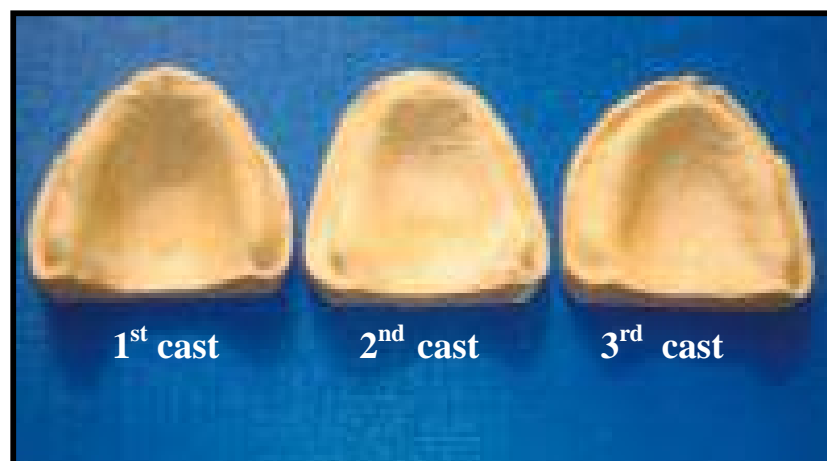


Fig (1): Show the casts results from different impression materials



Fig (2): Retention measurement apparatus



Fig (3): denture bases for the three groups with a string of 1 inch attached to each denture bases.

Table (2): Mean values (grams), standard deviation, maximum, and minimum of measured retentive forces of denture bases produced by different impression materials.

Groups	N	Mean	Std. Deviation	Minimum	Maximum
ZOE	20	1950.20	270.04	1575	2350
Addition silicone	20	1380.10	207.82	1017	1700
Condensation silicone	20	1127.80	112.68	949	1315

Table (3): ANOVA Table with LSD of retentive forces of dentures bases produced by different impression materials.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3550036.867	2	1775018.433	41.340	VHS
Within Groups	1159296.100	27	42936.893		
Total	4709332.967	29			

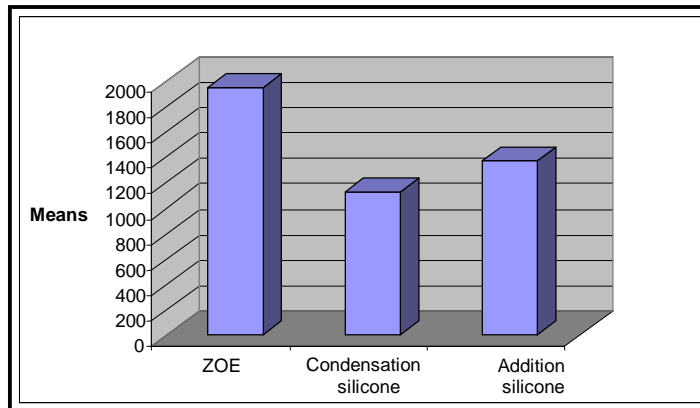
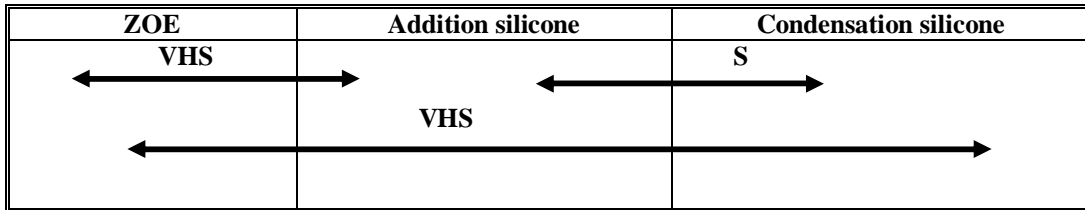


Fig (4): Show the mean of the retentive forces of denture bases produced by different impression materials.