



DETECTION OF PRESSURE AREAS FOR ELASTOMERIC IMPRESSIONS WITH AND WITHOUT SPACER USING NOVEL DIGITAL ANALYZING SOFTWARE AND ITS CORRELATION WITH RETENTION.A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

This study was conducted to evaluate the significance of using wax spacer in the impression technique regarding the pressure areas and retention of the complete dentures constructed. Forty patients with edentulous maxillary arches were selected from the outpatient clinic of removable prosthodontics department, faculty of oral and dental medicine, Cairo university .The patients were randomly divided into two groups. Group I received dentures constructed from impression technique with wax spacer while group II received dentures constructed from impression technique with no spacer. On the day of denture insertion pressure areas were detected using pressure indicating paste and denture retention was measured using force gauge. The data was collected and analyzed using student's t-test. **Results:** The results showed the percentage of pressure areas for dentures constructed with no spacer were higher than those constructed with spacer showing statistically significant difference $p<0.0001$. For the retention values dentures constructed from impression technique with spacer showed higher retentive values compared to those constructed from impression technique with no spacer yet not statistically significant $p=0.4966$. It was concluded that the dentures constructed using impression with spacer showed less pressure areas and higher retentive values than those constructed with no spacer.

Keywords: complete denture, pressure areas, elastomeric impression,retention

INTRODUCTION

The intimate contact of the denture with its supporting tissues is a major factor for retention, which dramatically improves the stability and support of denture in addition to factors that affect denture retention.^{1,2}

The final impression is a very important step regarding the success and final outcome in complete denture construction.³ This necessitates careful assessment of the tissues to be recorded in the impression, type of impression tray, impression material, and the technique to be used.^{3,4} For the management of completely edentulous arch,

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a careful combination of the movable soft tissue topography with integrating different materials and a proper technique for accurate reproduction is very important for denture success.⁴ Adequate space for the impression material within the impression tray should be available with different relief areas according to the impression technique.⁵

Full spacers cover the entire residual ridge except posterior palatal seal area in maxilla and buccal shelf and retromylohyoid area in the mandible providing space for the impression material. Ideal thicknesses of wax spacer for completely edentulous and partially edentulous situations are 1-3 mm. The thickness of the spacer is determined by the type of impression material used for final impression.⁶⁻⁹

Impression borders should be in harmony with the anatomic and functional limits of the denture foundation and adjacent tissues. Therefore impression borders should be identified using functional movements. Border molding defined as the shaping of impression material along the border areas of an impression tray by functional or manual manipulation of the soft tissue adjacent to the borders to duplicate the contour and size of the vestibule; determining the extension of a prosthesis by using tissue function or manual manipulation of the tissues to shape the border areas of an impression material.¹⁰ Several materials have been used to border mold an impression tray; including modeling compound, medium to heavy body vinyl polysiloxane and polyether materials. Modeling compound and vinyl polysiloxane (VPS) are excellent materials for border molding yet vinyl polysiloxane (VPS) is not as viscous or rigid as modeling compound. Therefore cannot be used to correct borders that are under extended by more than 4-5mm.^{11,12} Also adequate retention of complete denture bases was obtained using sectional border molding using the low fusing compound and putty type condensation silicone with metallic oxide and light body condensation silicone as a final impression materials.¹³

Differences are noticeable between the materials and methods used for final impression in complete denture prosthodontics. Three basic impression philosophies proposed over years for impression making are: mucostatic, mucocompressive, and selective-pressure impression techniques.¹³⁻¹⁵ The selective pressure technique is considered the most accepted as it combines the benefits of the other two techniques.⁷ The spacer design for the selective pressure is directly governed by the knowledge of the stress-bearing and relief areas.⁷ The amount and location of this pressure exerted during making the impression has a great effect on the final retention and stability of the final denture.^{4,7} The materials used are impression plaster, zinc oxide eugenol impression paste, (elastomers) polysulphide, addition silicone and polyether.¹⁴ Accuracy and consistency are best maintained by the use of custom tray and adhesives to retain polyvinylsiloxanes.¹⁵ The silicone, polysulfide rubber, and polyether impression materials can record the shape of soft tissues accurately if they are adequately supported by an accurately fitted tray.¹⁶

The original disadvantage of using elastomeric impression materials was their hydrophobic characteristics, producing an adverse effect on the surface quality of the polymerized impressions.¹³ There is a direct relation between the wettability of the material and the adaptation and retention of the final denture, the better the material spread and flow the better recording of the surface details and so the adaptation of the final denture to the underlying tissues.^{14,15}

Therefore both polyether and polysulphide rubber base materials are more suitable for this inherent property of the oral environment.^{14,15} Polyether elastomeric impression material of ethylene oxide and tetra-hydrofluoro copolymers that polymerizes under the influence of an aromatic ester.¹⁷

Also the dimensional stability of the impression after polymerization is very important regarding the delay time to pour the impression.¹⁸ The polyether

impression materials have sufficient body to make up discrepancies between tray borders and the reflecting vestibular tissues of up to 4 or 5 mm also they can be shaped by the fingers. It appears that it is the material of choice for the optimal recording of the functional peripheral seal in maxillary full dentures.¹⁸⁻²⁰

The aim of this RCT is to detect the amount of pressure areas generated in dentures constructed from two polyether elastomeric impression techniques and to measure the retentive values for the dentures.

MATERIALS AND METHODS

Forty patients were selected from the outpatient clinic, Removable prosthodontics department, Faculty of oral and dental medicine, Cairo University. This study was approved by the Scientific Ethics Committee, Faculty of oral and dental medicine, Cairo University. The age ranged from 50 to 60 years. The study started on the 1st of June and ended by the end of July 2017. All patients had completely edentulous upper and lower arches. Patients were recruited according to the following inclusion criteria: well to moderately developed ridges, no flabby or flat ridges, no bony undercuts or exostosis, the mucosa was firm with no signs of inflammation, ulceration or hyperplasia, saliva of average viscosity and amount, absence of neurological disorders, also all patients had Class I maxillo-mandibular relationship with normal temporomandibular joint with no clicking or mandibular deviation. The nature of study to be carried out was explained to all subjects and the patients were allowed to sign a written consent. The patients were randomly distributed using closed envelope technique into two groups each group consists of twenty patients. The patients names were kept in closed envelopes until complete allocation. Participants were enrolled, and assigned interventions by the removable prosthodontic secretary section. The participants and data assessors were blinded of the intervention made.

Group I patients received dentures constructed from polyether elastomeric impression with spacer while **Group II** patients received dentures constructed from polyether elastomeric impression with no spacer. For both groups primary upper and lower impressions were made using irreversible hydrocolloid impression material (Tropicalgin, Zhermack, Italy) in a suitable sized perforated stock tray and poured in dental stone (Kalstone, Kalabhai Pvt. Ltd., Mumbai, Maharashtra, India) to obtain primary cast. **Special tray construction:** **Group I:** Wax spacer one thickness of base plate wax was made over the cast according to Davis technique, adjusted to be 4mm shorter than the full extension of the vestibule and the post dam part was cut as a butterfly i.e. left uncovered Cold cure acrylic resin (Auto cure denture base material, Pala, Kulzer, Germany) was used for custom tray fabrication. The tray was fabricated to be 2mm shorter than the full depth of the cast, so that it would be properly adapted on the tissues and to ensure proper adaptation on the palatal tissues. **Group II** Auto cure acrylic resin custom tray was fabricated according to the manufacture's instruction was directly constructed on the cast 2mm shorter than the full extension with no wax spacer. **Border molding;** For group I. Single step border molding was done using medium polyether rubber base (Impregum F 3M, ESPE, California, USA) with the spacer in place. (**Figure 1**) After border molding was finished the spacer was carefully removed using blade no. #15 (Aspen Surgical Products, Caledonia, USA) after which the final impression was made using the same border molding material. For group II the same procedure was made as group I taking into consideration that there was no spacer for this group. The steps of construction of both groups were continued as follows: The impressions were boxed, and the casts were poured. Occlusion blocks were constructed over the casts. face bow record, centric relation registration, and mounting on semi adjustable articulator HANAU H (Arcon, Louisville, KY USA 40209), selection and arrangement of artificial teeth,

try in of the trial denture bases. During the waxing up of the dentures a depression was made in the geometrical center of the palatal surface for future attachment of the wire loop for measuring retention. Then packing procedure was made using heat cured acrylic resin(Pala, Kulzer,Germany). Processing finishing and polishing of the dentures were done conventionally for both groups. After polishing for both groups pressure indicating paste(Mizzy, Mfg, Cherry Hill, NJ 08002) was applied to the fitting surface according to the manufacturer's instructions to create a uniform layer of pressure indicating paste to detect the pressure areas for dentures of the two groups then the dentures were seated in the patients mouths applying index fingers pressure on both sides at the premolar molar areas and the dentures were removed in downward vertical direction.

All patients continued till the end of the study there was no drop outs.

Evaluation of the fitting surface:

The fitting surfaces of the dentures with pressure indicating paste were captured using digital camera(NIKON COOLPIX P500-Japan) with standardized photographic position in which the distance between the camera and the fitting surface was 20 cm, to allow comparison of the two techniques under the same conditions, top views were taken for the denture fitting surface. Then the pictures were transferred to the computer, saved as JPEG format. Analysis was done using Image J software(ImageJ, 1.46, National Institute of Health, USA) for the pressure areas as a percentage of the denture total surface area induced by each technique as shown in the figure.(**Figure 1**)

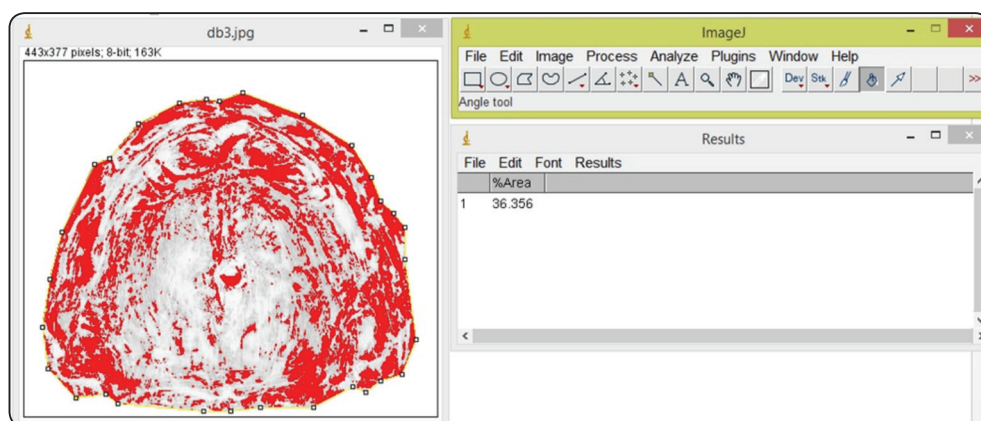


Fig. (1) Measurement of pressure areas using the Image J software



Fig. (2) Digital force meter

Retention measurement

A wire loop of 19 gauges orthodontic wire (K.C. Smith & co.)for connection of the force gauge. The wire was fixed by cold cured acrylic resin on the centre of the palatal vault, geometrical center of the palatal surface.¹⁸A digital force gauge was used for measuring retention.(**Figure 2**) The device was prepared to display the readings in Newton. The patient was seated with the back in an upright position.The force gauge hook was attached to the wire loop and then downward pull was made to measure the values of retention. Five readings were taken to take the average value of retention.

Data were collected and statistically analysed using Student’s t test.

RESULTS

A) Regarding the analysis of the pressure areas:

The means for pressure area exerted using both techniques were tabulated in table (1). Group I exerted 11.013±0.9420% area of the total denture fitting surface area whereas group II recorded higher value of 38.832±5.041846663%. The recorded difference was statistically significant p<0.0001

TABLE (1) Showing pressure area percentage in both techniques:

	Group I	Group II	
Pressure area percentage	11.013±0.9420%	38.832±5.0418%	p<0.0001

B) Regarding the retention values:

TABLE (2) Showing retention values in both techniques:

	Group I	Group II	
Retention value (N)	52.251±3.38N	48.353±3.39N	P=0.4966

The means for retention values using both techniques were tabulated in table (2). Group I recorded 52.251±3.38N whereas Group II recorded 48.353±3.39N. The recorded difference was statistically not significant (P=0.4966)

DISCUSSION

The pressure areas resulted from group I were less than those obtained from group II and this was attributed to the presence of the spacer which decreased the excessive pressure according to *Duncan et al 2004* amount of pressure applied during an impression procedure can be partly due to the viscosity of the impression material and partly due to the approximation of the tray to the oral tissues and so the final denture.²¹

Regarding the retention results although the retentive values for group I were higher than those of group II as it is considered a selective pressure one with pressure applied on the peripheries of the denture due to the contact of the superior border of the flange and the posterior part of the palate which is the main factor in denture retention and these results were the same as *Sykora O, Sutow EJ 1993*.²² As the posterior palatal seal area enhanced the retention and stability of complete maxillary denture by providing intimate contact with the posterior palatal tissues in addition to reduction of the gagging reflex and so improving patient tolerance to the denture and so muscle adaptation on the denture borders. Also the results were non-significant as a successful and patient satisfying denture results from a skilled clinician properly managed technique irrespective to its type.

And so this study revealed that the group I technique with the spacer resulted in less pressure areas yet higher retentive values due to pressure on the posterior part of the palate which is the main factor in denture retention. On the other hand the technique with no spacer the viscosity of the material exerted pressure on the tissues during impression making lead to the appearance of the pressure areas and so the tissues were stressed during impression procedure, this obviously lead to some rebound in the tissues due to strain release that affected the final retention value of the denture constructed from this technique.

CONCLUSION

On the basis of the present study, the following conclusions have been drawn:

The dentures constructed from impression technique with spacer showed less pressure over the supporting structures and higher retention values.

The dentures constructed from the impression technique with no spacer showed more pressure over the supporting structures yet lower retention values.

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