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IMPACT OF VARIOUS IMPRESSION TECHNIQUES ON MAXILLARY FLABBY RIDGE TISSUE DISPLACEMENT (WITHIN-SUBJECT EVALUATION)

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ABSTRACT

Purpose: This study was conducted to determine the effect of various impression techniques on the displacement of flabby tissues overlying the edentulous maxillary ridge. In this study Ten completely edentulous maxillary arches patients with anterior flabby ridges participated in this study. For each patient five secondary impressions were recorded and divided into five groups according to impression technique used. Group I: comprised impressions following the mucocompressive technique. While, in Groups II, III, IV and V had used different mucostatic impression techniques. Soft tissue displacements in X, Y, Z axes and total 3-D in relation to a fixed reference point were recorded for each impression using modified Measurescope. The data were collected and statistically analyzed. The results obtained showed that there were significant differences in soft tissue displacement of all tested groups in both three coordinates (X, Y and Z) and total 3-D. Also; the results showed significant difference in soft tissue displacement of tissues recorded by the four mucostatic impression technique groups compared to mucocompressive impression technique. A significant difference was found between one step mucostatic impression technique group, and two step mucostatic impression techniques.

Conclusions: Based on the results of this study, soft tissue displacement of maxillary flabby ridge during impression procedure occurred along X, Y and Z directions for all tested impression techniques. The mucostatic impression techniques generated less soft tissue displacement than the mucocompressive technique. Two-step mucostatic impression techniques produced less soft tissue displacement compared to the one step mucostatic impression technique.

KEY WORDS: Maxillary anterior flabby ridges, soft tissue displacement, mucocompressive impression technique, mucostatic impression techniques

INTRODUCTION

Complete dentures are functioning in the oral cavity of patients; they must be constructed in a way that they are in harmony with the oral muscular function. All oral functions, such as Esthetics, Phonetics, swallowing, mastication, laughing and, smiling, necessitate the interactive actions of

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muscles of the lips, tongue, floor of the mouth, and cheeks, which are extremely compound and highly independent. [1] The accomplishment of a complete denture usually depends on fundamental principles of impression making, i.e. peripheral seal without involvement with muscular functional movements, maximum coverage of supporting area, and precise adaptation to the underlying tissues without damaging displacement. [2]

However, problems appear when the quality of the supporting areas is not suitable for this purpose. As, presence of flabby ridge, which is a superficial area of mobile soft tissue affecting the maxillary or mandibular alveolar ridges, that gives rise to looseness relating to a complete denture that rests on them. [2,3] Due to the recoil of flabby tissue which is compressed during conventional impression making, resulting in dislodge of the overlying denture; that adversely affected stability, retention and support. Also, patient discomfort and gross occlusal disharmony are among the consequences. [4] Treatment options for these patient's include surgery, implant retained prosthesis or conventional prosthodontics treatment without surgical intervention. [3]

Treatment modality has to be chosen depending on extent of flabby foundation tissue, patient's state of health and need, financial capacity and skill of the dentist. In generality circumstances, use of implants or surgical intervention is not reasonable or conservative management [5] Two impression concepts have been reported to overcome the problem of flabby foundation tissue. First, is the mucocompressive impression technique, which records the loose flabby tissue in a compressed form in a try to obtain functional support for the denture. The other is the mucostatic impression technique, which relies on obtaining support from firm areas of the arch. [3]

Hence, for these patients, various impression techniques have been proposed for the impression of a flabby ridge which will support the flabby foundation tissue but at the same time will not displace it,[6] these impression techniques were Mucocompressive impression technique,[7] Single step mucostatic impression technique, [8,9] injected two step mucostatic impression technique, [10,11] two step window mucostatic impression technique,[12,13] two step sectional tray mucostatic impression technique. [14]

Management of flabby maxillary ridge can be a challenging problem. The impression of denture bearing area and occlusal surface detail is given utmost priority in managing it. [15] Until now, the published evidence does not clearly support the superiority of either of these techniques from the maxillary flabby ridge tissue displacement point of view. [16] Thus, this study was conducted to evaluate the effect of various impression techniques on the displacement of flabby maxillary ridges.

MATERIALS AND METHODS

Study Setup and Patient Population

The study was conducted as a within-subject comparison for which permission from ethical committee of Faculty of Dentistry, Mansoura University was obtained. Ten healthy patients whose ages ranged between 50 to 60 years, with a mean of 55 years participated in this study. All the selected cases had completely edentulous maxilla with flabby ridge in the anterior region. The study protocol and objectives were described to all participants and a written informed consent was obtained from each patient.

Prosthetic Procedures

For every patient preliminary impression of the maxillary denture bearing area was recorded with irreversible hydrocolloid impression material (CA37. Superio Pink. Cover. HOLLAND BV) the anterior maxillary flabby ridge was marked intraorally using indelible pencil and transferred to the preliminary impression. Impression was poured in dental stone. Two uniform thicknesses

of modeling wax were placed over the displaceable area as a spacer on the predetermined area of the cast and one thickness over non-displaceable area. Wax was cut at the planned tissue stop sites. Thin aluminum foil was adapted onto the wax spacer. The special tray was made over the aluminum foil. The cast with the overlying waxed up special tray were flasked to standardize the polished surface of the trays, Flask was opened and the waxed up tray was removed and auto-polymerized acrylic resin dough was packed. Plaster index was constructed for the polished surface of the custom tray, (fig.1).

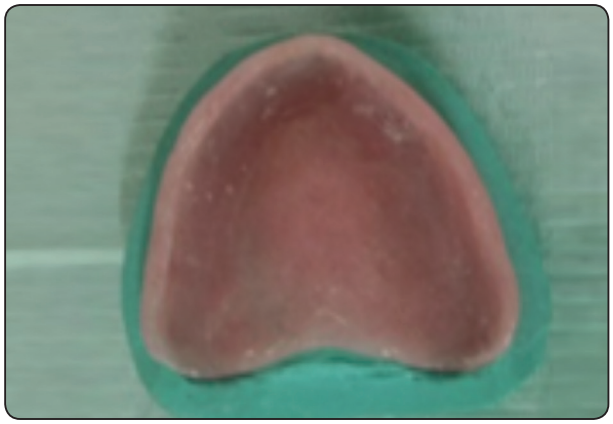

Fig. (1) Plaster index for the polished surface of the tray.

The Custom tray was used for making, five secondary impressions and divided into five groups according to impression technique used as follow:

Group I Mucocompressive impression technique: The impression procedure for this technique was carried out following the technique described by **Watt and MacGregor,** [7] based on the fact that thermoplastic properties of this material enables simultaneous manipulation to compress the normal tissues. without distortion of the flabby tissues. Compound impression of the preliminary cast was made using custom tray. Periphery of the impression compound was softened and molded in the mouth. The flabby area in the patient's mouth was outlined with indelible pencil and the impression compound was reinserted to transfer the mark. The compound overlying the firm area of the ridge was softened leaving the compound overlying the flabby area hard. The impression compound was tempered and reseated firmly in the mouth and a zinc oxide wash impression was made.

Group II Single step mucostatic impression technique: The impression procedure for this technique was carried out following the technique described by **Shum and Pow,** [8] **Saluja et al.,** [9] for recording flabby ridges when minimal mucosal displacement. The custom tray was border molded with softened green stick compound. The wax spacer was removed and multiple holes were drilled in the flabby tissue region, (fig. 2). The posterior area of normal tissues and the anterior flabby tissue area were recorded in a single step impression technique using light bodied silicone based condensation type elastomeric impression material (BMS DENTAL sililight).

Fig. (2) Border molded special tray with a multiple holes in the flabby tissue region.

Group III injected two step mucostatic impression technique: The impression procedure for this technique was carried out following the technique described by **Hobkirk,** [10] **and Singh et al.,** [11] The impression was made using medium body poly siloxane condensation silicone impression material (C- Silicones, Thixoflex M Zermack) for

the posterior area of normal tissues. The anterior flabby tissue area was recorded using syringed light body low viscosity silicone based condensation type elastomeric impression material (BMS DENTAL sililight), (fig. 3).

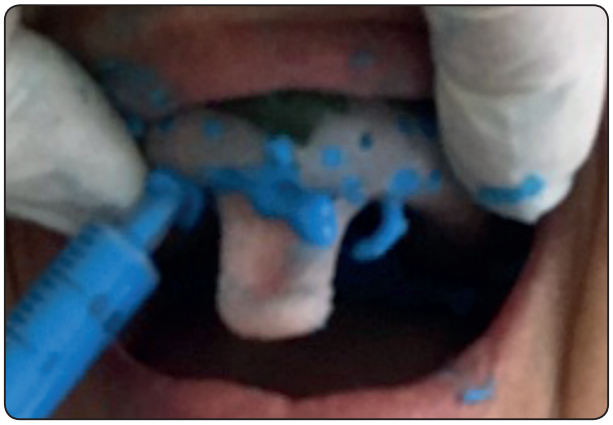

Fig. (3) The anterior flabby tissue area was recorded using syringed light body low viscosity silicone

Group IV two step window mucostatic impression technique: The impression procedure for this technique was carried out following the technique described by **Watson** [12] in which a window was created in the custom tray at the area corresponding to the flabby tissue, the healthy denture bearing tissues were recorded with zinc oxide eugenol impression paste (Cavex, Holland, BV) and the displaceable soft tissue area with impression plaster. This technique was modified by **Rashid et al.,** [13] where addition cured silicone instead of impression plaster used to record the anterior flabby area of the residual ridge. The impression technique used was the modification by **Rashid et al.,** [13] the anterior area was recorded by using syringed light body elastomeric impression material, (fig. 4)**.**

Group V two step sectional tray mucostatic impression technique: The impression procedure for this dual impression technique was carried out using sectional tray following technique modified from that described by **kumarsundar et al.,**[14]

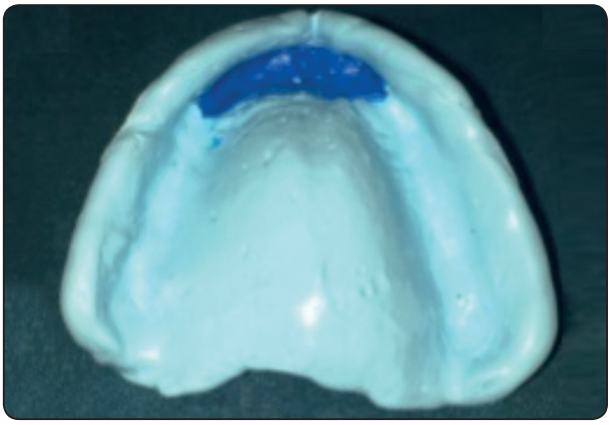

Fig. (4) Impression for both anterior and posterior areas (Group IV two step window mucostatic impression technique).

The custom tray was modified to form the posterior part of the sectional tray as follow: labial flange was trimmed, the anterior third thickness was reduced from the polished surface and three rectangular projections were added. The posterior tray part was returned to the cast and double thickness of wax spacers were adapted on the palatal aspect of the flabby ridge and extending to the crest. The posterior tray part was modified by wax to extend anteriorly to the palatal slope of the flabby ridge till the level of ridge crest. This is followed by waxing up the anterior part of the sectional tray that had three slots in the fitting surface. Both tray parts were separated by aluminum foil on the relieved cast and flasked. The flask was opened, the waxed up anterior tray part was removed and self cure acrylic resin was packed. After polymerization, the flask was opened again and the waxed up posterior part of the tray was removed and self cure acrylic resin was packed. Both tray parts locked together through the slots and projections to form one unit sectional tray. During impression procedure unlocked the sectional tray and the anterior part was perforated. Border molding for the posterior part was carried out using green stick compound. Reassembled parts of the tray and border molding were carried out for the anterior part. Unlock two parts again; the impression for the posterior area was made

using medium body poly siloxane condensation impression material. This was followed by removal of excess material. The posterior tray was placed in the patient's mouth, while the anterior tray was loaded with light body low viscosity silicone based condensation type elastomeric impression material and seated into position guided by the stops. The impression was removed as a single piece, (fig. 5).

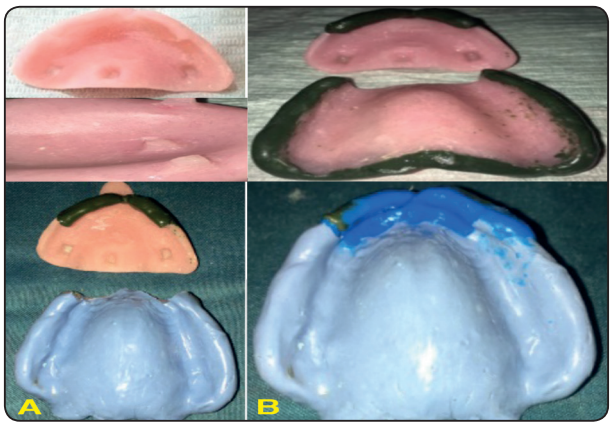

Fig. (5) **A.** Anterior parts of the tray, **B.** Border molding of anterior and posterior parts of the tray, **C.** Impression of the posterior part of the tray, **D.** Impression of anterior and posterior parts of the tray.

Measuring Displacement of Flabby Maxillary Ridges

Displacement of flabby maxillary ridges was measured using the two dimensional X&Y axes measurescope (Monocular Measurescope type – 10 Nikon – Japan). The device was modified to provide three dimensional measurements; the main lens was replaced by sensitive dial gauge to measure the third dimension (Z-axis). For proper custom tray standard position during repeated measurements, a specially designed Perspex box with rounded metal post exhibiting a pointed deep depression on its top was manufactured and fixed on the traveling table of the device. This depression was considered as a reference **point (R)** from which, all measurements started. The base of the Perspex box had a recess for fixation of the plaster index of the custom tray's polished surface, (fig. 6).

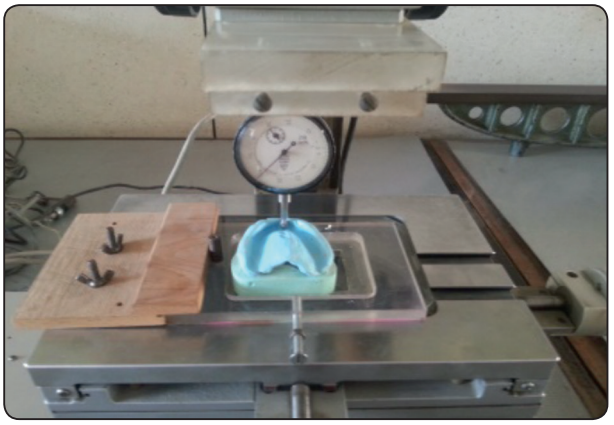

Fig. (6) Modified Measurescope

Four fixed points were determined for measuring flabby maxillary ridges displacement. These points were **(point P)** the highest point of the median palatine raphe, **(point I)** the deepest point of the incisive papilla and, **(points, R1 and R2)** the deepest points of the right and left tuberosities. The positions of these points were determined in three dimensions by recording their **X, Y**, and **Z** coordinates in relation to reference **point (R)**.

The previous measurements were first made on the wax spacer that used as a control for subsequent measurements. After removing of the wax spacer and secondary impression recording, the custom tray was reseated on its index, and the three-dimensional positions of (P, I, R1 and R2) points were recorded on the impressions. Flabby maxillary ridges displacement for each impression technique in X,Y and Z dimensions was determined by comparing the three coordinates of each of the four working points on the spacer and on the impression.

Statistical analysis:

Results were subjected to revision and the collected data were coded, processed and analyzed through SPSS (Statistical Package for Social Sciences) (Standard version release 16.0). Descriptive statistics were applied using frequency analysis to detect mean X± SD for parametric data. Independent **one way ANOVA** was used for

comparing flabby maxillary ridges displacement measurements in (mm) in X, Y and Z directions for all tested impression techniques.

RESULTS

Means and standard deviations of flabby maxillary ridges displacement in (mm) in (X) lateral, (Y) anteroposterior, (Z) vertical and total (3-D) directions for the five tested groups are presented in table (1) and figure (7). **Group I** represent the highest flabby maxillary ridges displacement value in X,Y,Z and total 3-D while **Group IV** represent the least value in X,Y,Z and total 3-D. A statistically significant difference in tissue displacement was found in X,Y,Z, and total 3-D) axes between all tested groups and the control. Table (1) and Figure (7) also, show significant difference in (X,Y,Z, and total 3-D) axes between mucocompressive impression techniques **Group I** and the four mucostatic impression techniques (**Group II, III, IV and V**). Regarding four mucostatic impression techniques, soft tissue displacement measurements of two step impression techniques **(Group III, IV, V)** showed a statistically significant less flabby maxillary ridges displacement in the X, Y, Z and total 3-D axes compared to the one step impression technique (**Group II**). Statistically insignificant difference was found between the three groups of two step impression technique **(Group III, IV, V)** in the X, Y , Z and total 3-D axes. **Group IV** (mucostatic window impression technique demonstrates the lowest flabby maxillary ridges displacement values. It was 0.62±0.03 in X direction, 1.02±0.094 in Y direction, 0.2±0.03 in Z direction and 0.61±0.07 in total 3D direction.

Table (2) reveals the comparison between X, Y, and Z axes for each of the five groups. A Statistically significant difference was found between X, Y and Z directions for all tested **Group** (I, II, III, IV and V). The highest flabby maxillary ridges displacement value was related to Y direction in all groups followed by X direction. Z direction revealed the lowest value except in five group mucocompressive technique group that shows the highest value.

TABLE (1) Means, Standard deviations and ANOVA test for soft tissue displacement measurements in (mm) in (X, Y,Z and total 3-D) directions for each tested impression technique.

Direction / Technique	X	Y	Z	Total 3-D
	(X± SD)	(X± SD)	(X ± SD)	(X± SD)
Control	0.00±0.00 [d]	0.00±0.00 [d]	0.00±0.00 [d]	0.00±0.00 [d]
Group I	1.690.13± [a]	2.02±0.19 [a]	2.1±0.279 [a]	1.94±0.214 [a]
Group II	1.12±0.09 [b]	1.61±0.13 [b]	0.91±0.08 [b]	1.21±0.14 [b]
Group III	0.75±0.07 [c]	1.4±0.11 [c]	0.4±0.02 [c]	0.85±0.09 [c]
Group IV	0.62±0.03 [c]	1.02±0.094 [c]	0.2±0.03 [c]	0.61±0.07 [c]
Group V	0.72±0.059 [c]	1.1±0.10 [c]	0.35±0.042 [c]	0.72±0.054 [c]
F one way ANOVA	**4.582**	**5.608**	**4.117**	**9.921**
(P)	**0.001***	**0.001***	**0.0001***	**0.0001***

X = Arithmetic mean. ***S.D. = Standard deviation.***
Values having different letters are statistically significant different (p< 0.05).

TABLE (2) Means, Standard deviations and ANOVA test for soft tissue displacement measurements in (mm) in X, Y and Z directions for all tested impression technique

Technique Direction	Group I (X± SD)	Group II (X± SD)	Group III (X ± SD)	Group IV (X ± SD)	Group V (X ± SD)
X	1.690.13±	1.12±0.09	0.75±0.07	0.62±0.03	0.72±0.059
Y	2.02±0.19	1.61±0.13	1.4±0.11	1.02± 0.094	1.1±0.10
Z	2.1±0.279	0.91±0.08	0.4±0.02	0.2±0.03	0.35±0.042
F one way ANOVA (P)	**6.388 0.0001**	**7.074 0.0001**	**8.119 0.0001**	**8.117 0.0001**	**6.253 0.0001**

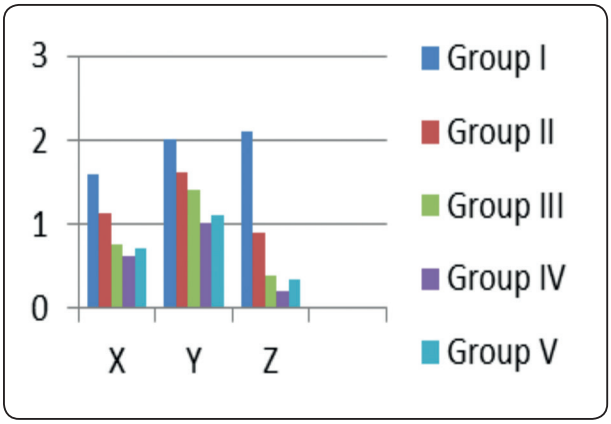

Fig. (7) Means of flabby maxillary ridges displacement in (mm) in (X) lateral, (Y) anteroposterior, (Z) vertical directions for the five tested groups

DISCUSSION

Management of fibrous tissues overlying residual ridges often results in prosthodontic challenges. Surgical removal of fibrous tissues is controversial as it usually ends up with loss of in adequate bony foundation, which in turn affects the support, retention and stability of removable prostheses. Implant retained prostheses proposed to offer a solution to the problems of stability and retention of prostheses overlying flabby ridges, however, the condition of residual ridge may hinder this treatment option. This conservative prosthodontic management of flabby edentulous ridges seems a feasible and non-invasive treatment modality. When conservative conventional prosthodontics approach is considered, impression techniques used for recording the ridge has a paramount role.[17] For this reason; variety of impression techniques were proposed to address problems caused by the flabby unsupported denture bearing mucosa. However, lack of scientific evidence that supports the preference of any of these techniques is lacking in the dental literature, hence was the aim provoking this study.

In this study, light body rubber base impression material was used instead of plaster of Paris to record flabby area in window mucostatic impression technique as it is dimensionally stable and do not need to be poured immediately. It is also less brittle than plaster of Paris and do not need to be handled as carefully.[9]

Soft tissue displacement produced with the mucocompressive technique was significantly higher than that produced by the four tested mucostatic impression techniques. This displacement could be related to the fact that this technique could conceivably cause a degree of compression of the mobile tissue aiming to achieve maximum support from it. But this compression proved to be hazard to the health status of the bony foundation. Also, it was proved to result in prosthesis instability due to rebound of the compressed mucosa when at rest and not in function.[18] This result is in agreement with the results of a previous study that recommended to

use the mucostatic impression techniques for flabby ridge or even for normal residual ridge to avoid the effect of tissue compression of the supporting mucosa.[19] This result is in contrast with study done by **Lamb** [20] who claimed that, by performing the impression in this way, the original relatively undistorted shape of the fibrous tissues is retained while the tissues more capable of functional denture support are recorded in a displaced state.

The significantly less tissue displacement produced when using the two stage minimal pressure impression techniques compared to that produced by the one step minimal pressure impression technique is in agreement with the finding of many advocates supporting the two step impression technique.[10,18,21] In addition, two tray technique represent a minimal degree of flabby ridge distortion because the structure of the posterior tray that creates a space on the palatal aspect of the mobile area allowed the recording of posterior denture bearing tissue with slight anterior distortion. Furthermore, the presence of the supporting impression material should prevent backward displacement of the mobile ridge during the second stage of impression that record the flabby area as explained by Osborne, [22] who claimed that this technique aimed to maintain the contour of the easily displaceable tissue while the rest of the denture bearing area is recorded. And, added that the anterior tray should be inserted from in front to backwards to prevent backward displacement of the mobile ridge.

In window technique, structure of the tray that allowed recording the posterior denture bearing tissue separately without causing distortion and displacement to the anterior flabby ridge area while the anterior flabby area was recorded separately by injecting a high flow impression material to ensure minimal displacement in X, Y, Z and total 3-D directions.

However, the importance of one step impression technique could not be ignored as it was proved to be beneficial and was previously recommended when the residual ridge exhibited little degree of displaceable flabby tissues. [22]

From the results of this study, it was observed that no definite impression technique produced the same reading as that of the control group. Hence tissue displacement evident established with different impression techniques followed in this study whether mucostatic or mucocompressive compared to the control group. This could be attributed to the previously reported opinion that any contact between tray material and mucosa may lead to soft tissue displacement even with the normal tissue.

CONCLUSION

Based on the results of this study, it can be concluded that

- Flabby ridges can be conservatively managed by using modified impression techniques.
- Two step mucostatic impression technique is preferred for recording flabby tissue as it allow the least amount of soft tissue displacement when compared to other impression techniques.
- The window mucostatic impression technique using light body impression material for recording flabby area is the best impression technique from the point of tissue displacment.

RECOMMENDATION

Long term clinical study of the effect of various impression techniques on the health of the edentulous ridge and on the success of complete denture treatment modality is also recommended.

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