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Evaluation of Reproducibility of the Peripheral Tissues in Edentulous Patients

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Abstract: The effect of different techniques and materials on peripheral shaping of the complete denture impressions were investigated by stereophotogrammetric method. Six impressions were taken from each of the 20 edentulous patients by using two different techniques and three impression materials. A non-metric camera was used to produce stereo paired photographs of each model. The measurements were made at the buccal vestibule regions, labial vestibule regions and labial frenilum region on 120 casts. When buccal vestibule regions were evaluated no statistically significant difference was found between double phase and mono phase impression materials.

Key Words: Complete denture, impression materials, retention.

Introduction

Border seal is the biological factor that involves intimate contact of the denture borders with the surrounding soft tissue. The seal encompasses the circumference of the denture and includes features such as beading and posterior palatal seal to enhance its effectiveness as suggested by Jacobson and Krol (1). Fisher (2) and Klein and Broner (3) all emphasized the need to seal the denture periphery in order to obtain retention. More recently, Klein and Goldstein (4) and Klein and Broner (3) have described techniques for peripheral extention, using a modified basal seat loading which attempts to combine the best features of the mucostatic and definitive pressure techniques.

According to Jankelson (5) the borders of the denture must fill the vestibul completely to the form it assumes at the very beginning of contraction of the draping musculature.

The importance of correct accomodation of impression material in the peripheral sulcus for the retention of the dentures and the comfort of the patient is also emphasized by others (4, 6-8)

The purpose of this study was to analyse the effect of different materials and techniques in current use on the peripheral shaping of the complete denture impression. The range of reproducibility of the border outline of the maxillary working impression in five regions was adapted as a criterion of compatibility.

Materials and Methods

Twenty edentulous patients who needed maxillary complete denture were elected randomly as test subjects. Preliminary impressions were made by irreversible impression material (Kromopan, Lascod S.p.A., Fierenza, Italy) and poured in dental stone (Duralit-S, Degussa A.G., Frankfurt). Six individual trays of self-curing acrylic resin were constructed on each cast and four stops were incorporated on the fitting surfaces. The trays were fully checked in the mouth to ascertain that the borders were approximately 2 mm short of the vestibular reflections. On four trays made for each cast, border shaping was completed with an impression compound (Kerr, Kerr Manufacturing Comp., Romulus, U.S.A.). The other two trays were border molded with putty type polyvinyl siloxane (Xantropen M Mucosa, Bayer, Leverkusen, Germany).

In this study two impression techniques were tested using different impression materials. One of the impression techniques was the conventional method. Border molding was passively done by hand manipulation of cheeks and lips. The second technique (TENS) employed with an electronic stimulator redesigned by the investigators and modelled on Jankelson's myomonitor. This electronic stimulator is programmed to deliver precisely controlled, uniform stimuli transmitted by transcutaneous electrical neural stimulation through fifth and seventh cranial nerves.

For the impressions, two different condensation and

Table 1. Impression materials applied by both conventional and TENS techniques.

Product	Manufacturer	Type	Border molding material
Deguflex	Degussa-Frankfurt, Germany	Addition (Monophase)	green stick impression compound
Coltex	Coltène-Altstatlen, Switzerland	Condensation (Monophase)	green stick impression compound
Xantropen M Mucosa	Bayer-Leverkusen, Germany	Condensation (Doublephase)	polyvinylsiloxane (putty)

Table 2. Means (unit) and standard deviations of the measurements at the regions (1-5).

		1		2		3		4		5	
Technique	Material	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
	COLTEX	11.95	3.38	12.68	3.38	9.23	2.09	12.71	3.03	12.69	3.60
TENS	Mucosa	11.99	4.69	13.36	3.82	11.77	9.58	13.92	2.52	12.45	2.59
	Degufllex	11.71	3.86	11.76	2.91	8.58	2.23	12.35	2.77	11.80	3.27
	Coltex	11.98	3.79	12.27	3.40	9.02	2.22	12.90	3.01	12.39	3.87
CONVENTIONAL	Mucossa	12.76	4.63	12.62	3.95	8.49	2.77	14.51	4.48	12.69	4.23
	Degufllex	12.80	4.06	12.64	2.81	8.85	1.98	13.37	4.55	13.36	4.26

Vertical bars indicate the statistical difference at $p<0.05$.

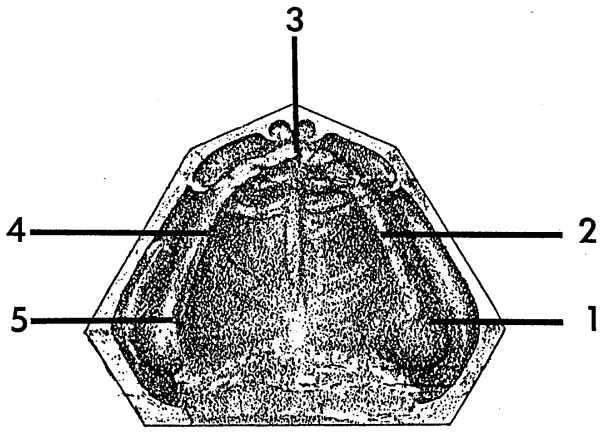

Figure 1. Diagrammatic representation of measurement regions.
1 and 5: buccal vestibule regions,
2 and 4: labial vestibule regions,
3: labial frenilum region.

one addition reaction silicone materials were used following the protocole summarized in Table 1. Impressions were mixed according to the manufacturers' instructions and made by the same investigator at the same appointment for each patient. Thus six impressions were made for each patient by different materials and techniques. All the impressions were boxed and the working casts were poured in the usual manner. Totally 120 casts were obtained. On the final cast of each patient, a putty silicone index to reproduce the measurement cites accurately on the identical casts was constructed. The five observation cites shown in (Fig. 1) were buccal vestibule regions (1 and 5), labial vestibule regions (2 and 4), labial frenilum region (3).

The ability of two impression techniques in establishing a proper border molding with different materials was measured by in the study to produce the stereoscopic paried pictures of six casts of the same edentulous arch. The casts were attached on a table covered by a grid paper. Six reference points outside the model, were chosen on the grid paper. Also the marked points on the casts served as the inner reference points. Object-camera distance was kept constant. Two pictures from one cast were taken by sliding the table a constant distance of 4 cm in every attempt, so totally two hundred and forty pictures were obtained. The photograph pairs were oriented accurately by matching the six reference points outside the cast and five reference points on the cast. In this way it was possible to recreate the dimensions of the object by viewing the stereogram through a stereoscopic instrument (Planicomp C 100, Zeiss, Oberkochen, West Germany). From the projection the measurement of the object could be made in three dimensions. However in the present study, only the depth of the sulcus, the most variable criteria in border molding was considered. So the distances between the marked points on the casts and deepest points in the sulcus were meausured by photographic measuring instrument. Totally six hundred measurements were obtained. All the results were assessed for statistical significance using two way analysis of variance and student-t test.

Results

The data obtained from this study are shown in Table 2. With all techniques and materials evaluated, it was noted that there was a tendency for the reproducibility to increase as one approached the anterior segment of alveolar ridge. Variations among all the groups were found to be least in the labial frenilum region ($p<0.05$).

Analysis also demonstrated that contours produced by various materials in the buccal regions were significantly different at the 95% confidence level when conventional method was employed. However in TENS technique these differences among impressions were small and lie within the range of what was clinically acceptable.

Discussion

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.

For many years the studies carried out and the measurements have been made by graphic registrations and microscope (10-11). Recently sterophotogrametry has been used in dental research (12-14) and suggested to be used to evaluate the immediate change in ridge form volume resulting from different impression techniques and used to evaluate the reproducibility of the peripheral tissues (12).

The reproducibility of the shape of the prosthetic space has already been noted by Karlsson and Hedegard (10). These authors observed that anterior segment of working impression was more reproducible than the distal parts of the impression. More recently, Krysinski and Prylinski (15) analyzed the contour repeatibility of lower jaw functional impressions made according to the Slack-Herbst method and reported similar results. This was attributed to a more functional model constituted by the muscles having fibers directed perpendicularly to the border of the impression when comprared to the buccinator muscule with it's horizontally positioned fibers. In the present study, highest mean difference indices occured in the posterior regions with a tendency for the reproducibility to increase toward the anterior region, confirming the previous studies. However, it was interesting to note that the differences among materials were small and clinically acceptable for the related regions when the muscle trimming was accomplished by TENS through fifth and seventh cranial nerves. 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. As to Jankelson (5, 6) conventional manipulative movements of the cheeks and lips during the impression procedures will inevitably result in underextensions of the borders when the muscles return to their resting lengths. On the contrary the denture borders should lie passively against the surrounding, draping musculature in its relaxed state. The more intimate the relationship of the border to the musculature, the greater will be the retention. In view of these facts and the findings of the present study, TENS technique may be suggested as an alternative to the currently employed conventional approaches.

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 (5-10, 12, 15). Recently, as an alternative to the conventional method where borders were molded with modelling compound, Appelbaum and Mehra (7) recommended polyvinyl siloxane putty and light body impression material for the final impression. Smith et al. (8) used polyether in a one step impression procedure. Moreover, tissue treatment materials and impression waxes were advocated by others (3, 4). In the present study the draping tissues were molded againts modelling compound when monophase impression materials were tried. With double phase impression materials, simultaneous molding of borders were accomplished by an elastomeric heavy material. The results indicated that materials applied by conventional technique displaced the peripheral tissues significantly at the posterior regions when compared to TENS.

In view of our findings, where conflicting results were obtained with the same materials in two different approaches, it seems that traditional border molding procedure including hand movements of cheeks and lips might have been a factor contributing to the variations noted in reproducibility. On the contrary, all the compared materials irrespective of their different compositions allowed similar contours when borders were imprinted automatically without intervention or decision made by the dentist or the patient. This is in agreement with those of Abdel-Hakim et al. (16). They concluded from their study that tissue contours produced by any impression procedure was not repeatable since all the impression methods in current use displace the surrounding tissues and details of any procedure can only modify this displacement.

When we evaluate the materials clinically, two points are worthy of special attention. The first is that simultaneous molding of all borders reduces the number of

insertion of the tray thus producing a great time and motion adventage. Secondly addition reaction silicone impression materials polymerized against heavy bodied silicones exihibit good dimensional stability because of the greater bond strength between materials of putty and wash consistency.

Conclusion

From this study it may be concluded that:

1. Currently used impression techniques produce some displacement of the peripheral tissues especially toward the posterior regions.

2. Precise control of the surrounding tissues is needed. In this respect TENS technique may be an alternative approach.

3. Putty wash addition reaction silicone material is recommended for the final impression in edentulous mouth in view of its ideal physical properties, simplicity and convenience to the patient and clinician.

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References

1. Jacobson TE, Krol AC. A contemporary review of the factors involved in complete denture retention stability and support. Part I: Retention. J Prosthet Dent. 49: 5-15, 1983.
2. Fisher RD. Six fundamental rules for making full denture impressions. J Prosthet Dent. 1: 135-138, 1951.
3. Klein IE, Broner AS. Complete denture secondary impression technique to minimize distortion of ridge and border tissues. J Prosthet Dent. 54: 660-664, 1985.
4. Klein IE, Goldstein BM. Physiologic determinants of primary impressions for complete dentures. J Prosthet Dent. 53: 611-616, 1984.
5. Jankelson B, Radke JC. The Myo-Monitor: It's use and abuse (I). Quintessence Int. 2: 47-52, 1978.
6. Jankelson B, Radke JC. The Myo-Monitor: It's use and abuse (II). Quintessence Int. 3: 35-39, 1978.
7. Appelbaum EM, Mehra RV. Clinical evaluation of polyvinylsiloxane for complete denture impressions. J Prosthet Dent. 52: 537-539, 1984.
8. Smith DE, Toolson LB, Bolender CL, Lord JL. One-step border molding of complete denture impressions using a polyether impression material. J Prosthet Dent. 41: 347-351, 1979.
9. Thomas CJ. Impression material consistency and peripheral tissues. Aust Dent J. 35: 134-140, 1990.
10. Karlsson S, Hedegard B. A study of the reproducibility of the functional denture space with a dynamic impression technique. J Prosthet Dent. 41: 21-25, 1979.
11. Hung SH, Purk JH, Tira DE, Eick JD. Accuracy of one-step versus two-step putty wash addition silicone impression technique. J Prosthet Dent. 67: 583-589, 1992.
12. Adams LP, Wilding RJC. A photogrammetric method for monitoring changes in the residual alveolar ridge form. J Oral Rehabil. 12: 443-450, 1985.
13. Adams LP, Wilding RJC. A stereometric technique for measuring residual alveolar ridge volumes. J Prosthet Dent. 60: 388-393, 1988.
14. Özden AN. Porselen restorasyonlarda oklüzyonun elde edilmesinde kullanılan yöntemlerin kıyaslanması, Ankara, University of Ankara. PhD thesis, 1990.
15. Krysinski Z, Prylinski M. Reproducibility of the border outline of working impressions of the edentulous mandibule obtained by the Slack-Herbst method. J Nihon Univ Sch Dent. 28: 139-145, 1986.
16. Abdel-Hakim AM, Al-Dalgan SA, Al-Bishre GM. Displacement of border tissues during final impression procedures. J Prosthet Dent. 71: 131-138, 1994.