On Comparing Two Different Tray-Holding Techniques for Edentulous Maxillary Impressions

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Purpose: This study compared tissue three-dimensional (3D) displacements during the material setting phase of two maxillary impression tray-holding techniques: clinician manual pressure and patient occlusal pressure. ***Materials and Methods:*** The resultant two maxillary casts for each of 10 edentulous patients were compared using an optical 3D measurement system. ***Results:*** The junction between the hard and soft palates acted like a rotation center during impression making. The vertical displacements were significantly lower and posteriorly set when the impression was taken with the patient's occlusion, in contrast to being located at the anterior two-thirds during the manual impression technique. ***Conclusion:*** Use of patient's occlusion as a tray-holding technique may be preferred during the material setting phase of maxillary impressions. *Int J Prosthodont 2016;29:169–172. doi: 10.11607/ijp.4347*

Master impression taking for maxillary complete dentures may be affected by distortion due to variations in the compressibility of the supportive soft tissues. Accurate impression depends on the forces exerted during the insertion phase (strain peak) and the material setting phase (strain plateau). This study aimed to compare tissue three-dimensional (3D) displacements during the material setting phase of two maxillary impression-taking techniques: clinician manual pressure and patient occlusal pressure.

Materials and Methods

A convenience sample of 10 edentulous patients (7 women, 3 men; age range: 67 to 80 years) who wore satisfactory complete dentures for a minimum period of 1 year were selected for this study. The project's clinician (CRB) undertook in vitro training with a monoaxial force sensor (Instron) to standardize the applied pressure when making the maxillary impression.

Three maxillary elastomeric casts (Ramitec Penta, 3M ESPE) were obtained from each patient (Fig 1). The first cast was obtained by pouring the existing denture for reference; while the two others were obtained from impression taking using the denture base as a tray (low-viscosity elastomer, Dimension Garant, 3M ESPE). After performing functional border movements during the working time of the impression material, either the clinician manually held the tray or the patient held it with closed mouth in maximum intercuspal occlusion, as the maxillary tray was the complete denture.

A 3D optical sensor (Opto Top, Breuckmann) measured the geometry of the casts by projecting structured light (Fig 1). The results were analyzed in a common coordinate system and compared according to the topography of dimensional differences, the median sagittal sections, and the displacements of some remarkable points in the median section (barycentric and highest points) (Wilcoxon signed-rank test, $P < .05$).

Results

The mean maximum force developed by the clinician during the insertion phase was 72.3 ± 6.7 N for 10 seconds, followed by a force of 21.0 ± 2.62 N during the material setting. The mean maximum occlusal force during deglutition is comparable with the manually recorded force.[1]

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Table 1 Comparison of Vertical Displacements of the Barycentric Point and the Highest Point

	Barycentric point (mm)			Highest point (mm)		
Subjects	M–R	O–R	M–O	M–R	O–R	M–O
1	0.605	0.322	0.283	0.564	0.134	0.43
2	0.832	0.781	0.05	0.788	0.201	0.588
3	0.75	0.061	0.689	1.008	0.051	0.956
4	0.522	0.466	0.056	0.272	0.236	0.036
5	1.244	0.417	0.827	1.53	0.182	1.348
6	1.241	0.277	0.963	2.501	0.216	2.285
7	0.874	0.503	0.371	1.071	0.31	0.762
8	0.722	0.179	0.543	1.093	0.2	0.894
9	0.811	0.315	0.496	0.765	0.136	0.629
10	0.729	0.671	0.058	0.531	0.216	0.315
Mean	0.833	0.399	0.433	1.012	0.188	0.824
SD	0.239	0.217	0.329	0.631	0.069	0.629
P	$< .05$	$< .05$	$< .05$	$< .05$	$< .05$	$< .05$

Data analyzed with Wilcoxon signed-rank test for paired group comparisons ($P < .05$). SD = standard deviation; M = manual; O = occluding; R = reference.

Table 2 Comparison of Sagittal Displacements of the Barycentric Point and the Highest Point

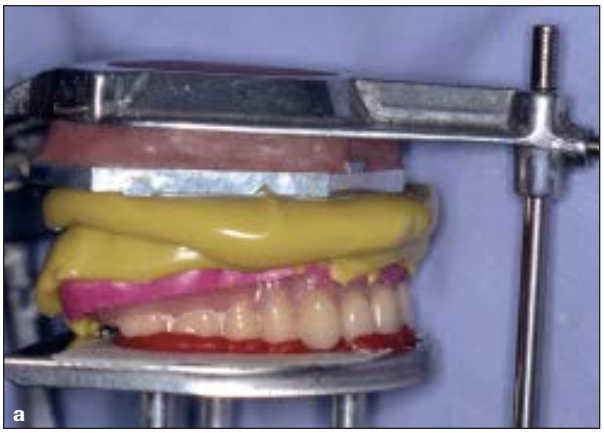
	Barycentric point (mm)			Highest point (mm)		
Subjects	M–R	O–R	M–O	M–R	O–R	M–O
1	0.075	0.254	−0.179	0.079	−0.091	0.171
2	0.592	0.116	0.477	−0.737	0.256	−0.994
3	0.804	1.578	−0.773	0.464	0.625	−0.161
4	−0.385	0.028	−0.413	−0.223	−0.233	0.011
5	−0.026	0.05	−0.076	−0.179	−1.043	0.864
6	0.713	0.25	0.463	−1.32	−0.034	−1.286
7	−0.32	−0.1	−0.22	−0.774	0.125	−0.899
8	−0.204	−0.058	−0.145	−0.323	1.051	−1.374
9	−0.188	−0.342	0.154	0.487	0.424	0.063
10	0.393	0.696	−0.303	1.674	0.349	1.325
Mean	0.145	0.247	−0.101	−0.085	0.143	−0.228
SD	0.445	0.541	0.384	0.834	0.56	0.905
P	.43	.232	.492	.62	.27	.56

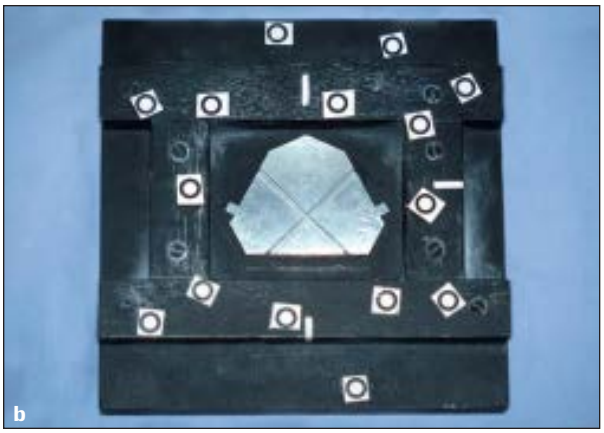
Data analyzed with Wilcoxon signed-rank test for paired group comparisons ($P < .05$). SD = standard deviation; M = manual; O = occluding; R = reference.

The junction between the hard and soft palates acted like a rotation center during impressions (Fig 2). Significant vertical variations (≥ 1 mm) were located at the anterior two-thirds of the palatal vault during the manual impression technique, and at the posterior third of the palatal vault and around the tuberosity zones during the occluding impression technique (Fig 2). When compared with the reference, the mean displacements after manual impressions were significantly greater than after occluding impressions (Table 1): twofold for the barycentric point and fivefold for the highest point. There was no significant difference in displacements in the sagittal plane (Table 2).

Discussion

The displacements of the tissue/denture base interface were significantly lower when the complete denture tray was held by patient occlusion. This measurement procedure offered several advantages, such as absence of mechanical contact between casts and the sensing units (Fig 1), high accuracy, and reproducibility for longitudinal studies. Several limits to this method have been observed. The study was demanding for the patients, as they had to be available for a period of 48 hours. Also, measurements were made on casts rather than directly on impressions; however,





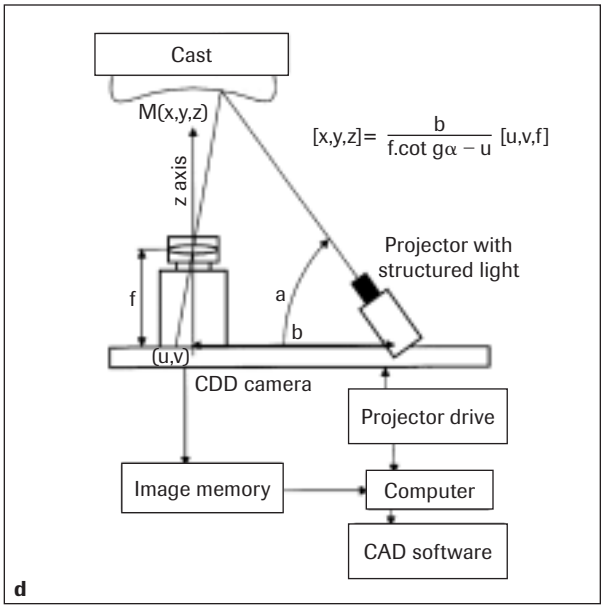


Fig 1 Measurements of the casts. **(a)** Semiadaptable articulator for cast calibration. **(b)** Elastomeric cast. **(c)** Optical targets for photogrammetric controls. **(d)** Block diagram of 3D measurement system.

dimensional variations have previously been shown to be negligible.[2]

Few studies shared the present conclusions about vertical displacements of the denture-bearing tissue/denture base interface during maxillary impressions: Lytle reported 1.3 mm to 1.8 mm displacement means and a maximum of 2.5 mm on the maxillary anterior ridge in 55 patients with unsatisfactory dentures,[3] and Woelfel et al reported a 2.41 µm highest point displacement using silicone comparing five impression materials.[4]

Furthermore, occlusal forces are centered in the middle of the edentulous arch during swallowing and clenching, which is also the application point of manual force. However, during the manual impression the applied force is directed upward and slightly backward, compared with upward and slightly forward during the occluding impression (Fig 2). During mandibular impression making, the displacements of the denture-bearing tissue/denture base interface were shown to be similar with both manual and occluding methods using the study protocol.[5] An explanation for this is that the force location and direction were equivalent for both techniques during the material setting phase of mandibular impressions.

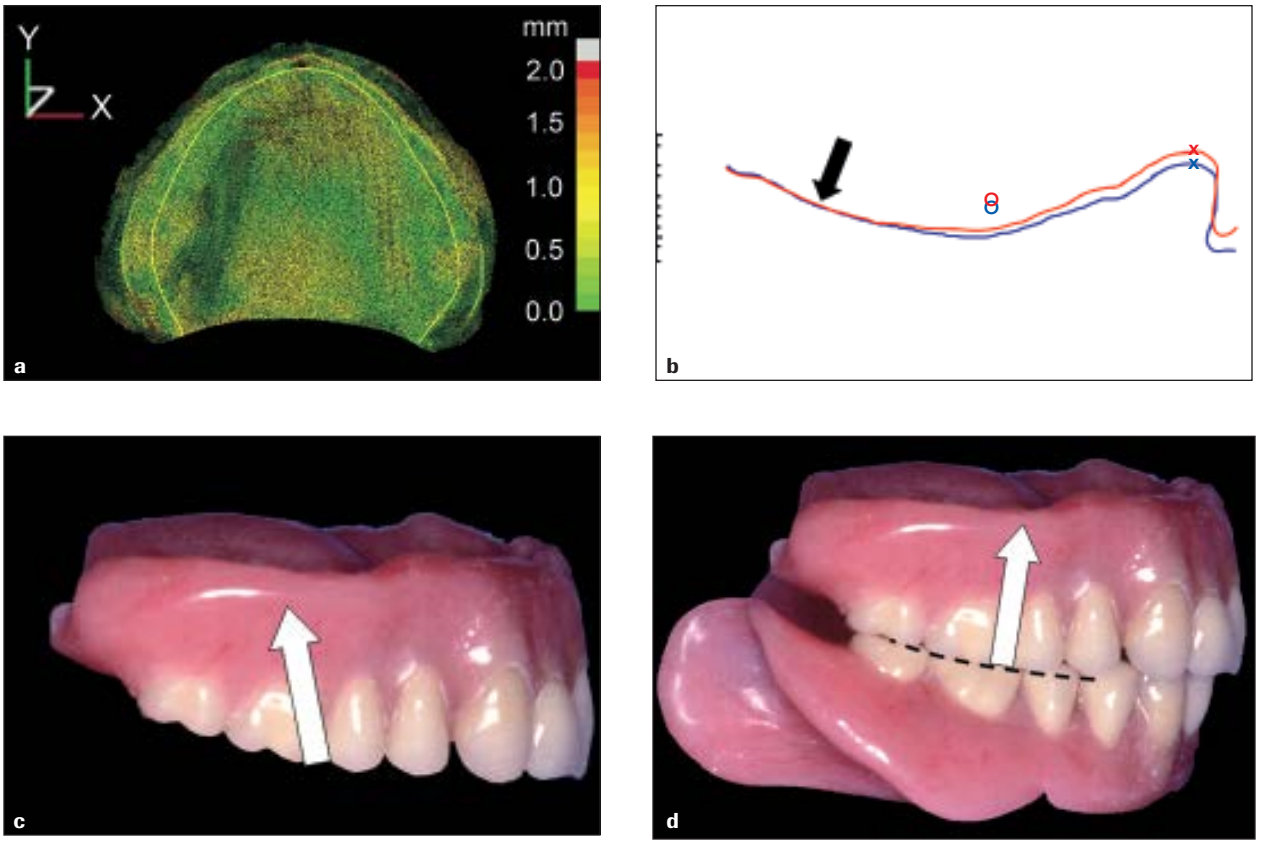


Fig 2 Comparative analysis of cast geometry. **(a)** Topography of distances between two superimposed maxillary casts. **(b)** Rotation displacement of the median sagittal section between two casts (circle = barycentric points; x = highest points; red = occlusal impression technique; blue = manual impression technique; arrow = rotation center). **(c)** Direction of applied forces during manual impression technique. **(d)** Direction of applied forces during occlusal impression technique.

Conclusion

Displacements of the tissue/denture base interface were significantly lower with the use of an occluding impression technique than with the manual one. The direction of the applied force may explain this difference. Clinicians should use patient's occlusion whenever the maxillary tray is adapted to the occlusion, such as during rebase impressions.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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