

# Study on Accuracy of Two Polyvinyl Siloxanes and a bis Acrylate-based Bite Registration Materials

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*The dimensional changes of the materials used for bite registrations are critical for the accuracy of the records meant for programming the dental articulators. The purpose of this study was to determine the long-term dimensional changes of three bite registration materials. We selected two polyvinyl siloxanes and a bis acrylate-based material. The study was carried out in a semi-adjustable articulator. The data were collected by a photo camera in standardized conditions and then analyzed using an appropriate program and statistical analysis. We did not find significant long-term dimensional changes of the used materials. In the limits of this study we concluded that the polyvinyl siloxane, as well as the bis acrylate based bite registration materials are accurate enough to provide reliable records to program the semi-adjustable articulators.*

*Keywords: polyvinyl siloxane, bis acrylate, bite registration, dimensional changes*

Most prosthetic rehabilitations require occlusal records with various impression materials in order to program the semi-adjustable articulators [1]. There are some reference studies on occlusal records [2-6]. The main properties of the materials intended to perform such registrations were also the subject of some interesting investigations. Some of these studies revealed the importance of the material structure before setting [7], the linear dimensional changes of the recording material and the compressive strength (including the occlusal force!) after setting [8]. Other papers focused on the dimensional stability of the obtained occlusal registration [9-12]. This last property is critical, since it is susceptible to cause vertical discrepancies to the articulated models.

The purpose of this experimental study was to determine whether there are differences in the vertical positioning of the models in an articulator consecutive to the dimensional changes of the occlusal registrations occurred in time.

The null hypothesis assumed no long-term dimensional changes of the studied occlusal registrations.

## Experimental part

### Materials and methods

We used the Dentatus nonarcon semi-adjustable articulator and Frasco practice models, widely used in mannequin simulation systems.

The selected occlusal registration materials consisted of two polyvinyl siloxanes (addition reaction silicone material) namely Affinity (DMG) and O-Bite (DMG). We also used a material containing glass particles in an acrylic multifunctional matrix (LuxaBite, DMG).

Mounting the models in the articulator was achieved by arbitrary positioning so that the occlusal plane had a slightly cranial orientation in the posterior region of the dental arches, situation that results using a face bow transfer from a human subject. We engraved the mounted models by two landmarks on their left side (an anterior mark located in the canines area and a posterior one in the area between the first and the second molar).

Once prepared, the articulator position has never changed throughout the experiment. The same was true

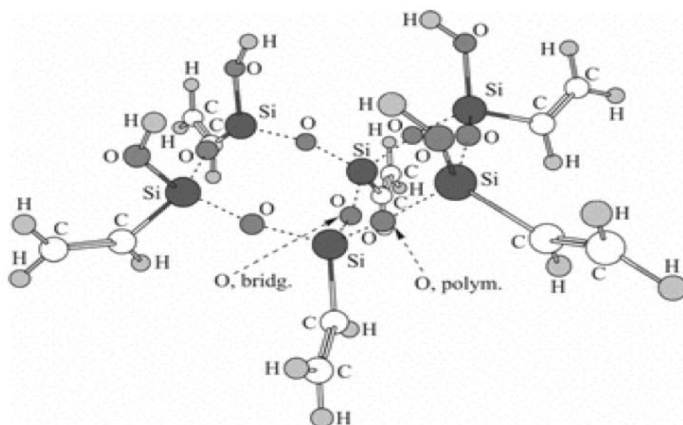


Fig.1. The structure of a polyvinyl siloxane according to Vovna V.I. et al. (2010) [13]

for the used camera (Panasonic DMC-FZ20 model) and its tripod, set at 40 cm away from the articulator. The camera lens pointed perpendicularly to the left side of the articulator (fig. 2). Camera settings also remained unchanged throughout the study.

We performed the occlusal records with those materials successively, the materials being applied on the occlusal surface of the lower arch. During the recording procedures, the articulator was closed and on its upper arm the standard weight of 39.2 N (approximately 4 kg) was placed. After



Fig. 2. The occlusal load is of 39.2 N

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Fig.3. The measurement of the distance between the standardized anterior and posterior marks using Adobe Photo Shop application

**Table 1**  
THE VALUES IN PIXELS OF THE VERTICAL DISTANCE BETWEEN THE SELECTED MARKS

	Immediately after setting		After 24 hours		After 72 hours	
	Anterior marks	Posterior marks	Anterior marks	Posterior marks	Anterior marks	Posterior marks
AFFINITY (DMG)	529	481	521	475	526	477
O-BITE (DMG)	526	479	526	476	528	475
LUXABITE (DMG)	528	479	532	478	532	483

the setting, for each material a photo capture of the left side of the articulator assembly was made. The occlusal registrations were then removed, labeled and stored for the subsequent session.

We interposed the collected records between the arches 24 and 72 h after the first session. The same operations as in the first session were performed each time (of course without the need for material setting). The images collected while each record were then analyzed using Adobe Photo Shop 7.0 application, by measuring the pixel distance between the engraved landmarks on the left side of the models (fig.3). The obtained data are presented in the table 1.

We used the GraphPad Instat3 program for the statistical analysis of the obtained data. The nonparametric Kruskal-Wallis test was applied to compare differences between the recording sessions, at a significance level of 0.05.

### Results and discussions

The results of the present study confirmed the null hypothesis. We did not find significant dimensional changes of the used materials either for the anterior mark ( $p=0.7822$ ) nor for the posterior one ( $p=0.2225$ ). The table 1 shows the measurements given in pixels of the distance between the anterior landmarks (A) and the posterior ones (B) immediately after the bite registration materials setting, after 24 h and after 72 h.

In this study, we made our choice for measurements between points located on the models and not on the articulator condylar mechanism. As Muller 's research showed, the measurements on condyle mechanisms can not detect vertical discrepancies induced from the occlusal surfaces [14]. The accuracy of a bite registration material is highly dependent on its dimensional stability. The presented results are consistent with those of other authors accrediting the idea that the bite registration materials dimensional changes have no clinical significance. To avoid an excessive shrinkage of the material due to its thickness or compressive strength [15], we considered useful to apply on the upper arm of the articulator a slightly higher occlusal load (around 40N) while recording. Utz et al. an in vivo and vitro study used a force of 10 N. This loading is below the force of about 25 N accredited to occur by manually positioning the mandible in centric relation [16]. According to an experimental study carried out by Faria et al., the accuracy of the model is dependent on the impression material used to make it. The authors point out the need for selecting the same type of material for bite registration as for impression one [17]. Saha et al. undertook one of the few studies that combine the researches in vivo

with those in vitro. They found the superiority of the polyvinyl siloxanes in terms of dimensional accuracy [18]. Hatzi et al. also sustained the good dimensional stability of polyvinyl siloxane bite registration materials [19].

A multicenter study showed that the dimensional stability of polyethers, polyvinyl siloxanes decreases with increasing time since the record [20]. Moreover, it is known that polyethers as the polyvinyl siloxanes seem to suffer different contractions during polymerization, even after setting time indicated by the manufacturer. The methacrylate - based materials, as Luxa Bite is, show an initial expansion in the first second [21]. It is well known that the polyvinyl siloxanes show the smallest dimensional changes on setting. This shrinkage occurring within the first three minutes after the removal of the registration is due to continued polymerization, and it is as low as 0.1-0.05% [22,23]. This dimensional change is not clinically significant. The polyvinyl siloxanes have a good long-term dimensional stability because they do not undergo any further chemical reactions or release any by-products during the addition reaction [24].

### Conclusions

In the limits of this study we concluded that: a) there are no significant differences in the vertical positioning of the models in an articulator due to the dimensional changes of the bite registrations occurred in time; b) the polyvinyl siloxane, as well as the bis acrylate - based materials are accurate enough to provide reliable recordings in order to program the semi-adjustable articulators.

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