Application Times for the Single-Step/Double-Mix Technique for Impression Materials in Clinical Practice

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Hydrophilicity of unset impression materials underlies changes occurring during working time. Hence, the clinical application time when impression materials contact oral tissues after mixing may play a critical role in successful impressions. The aim of this study was to analyze the clinical time course of impression taking applying the single-step/double-mix technique. Application times of 86 impressions, comprising 265 prepared teeth and 46 implants, taken by 14 different clinicians at a university dental clinic were analyzed. The mean time from loading the impression tray until its final position in the patient's mouth (total application time) was 51.2 seconds; confidence intervals were 46.9 (lower limit) and 55.5 (upper limit). The number of registered teeth and implants did not influence the duration of impression taking. Related to wettability data, several polyvinyl siloxane impression materials show decreased hydrophilicity with respect to estimated application times. The authors suggest considering clinically relevant application times for impression taking in future in vitro studies on physicochemical characteristics of impression materials. *Int J Prosthodont 2011;24:562–565.*

Flow properties and the wetting behavior of unset elastomeric impression materials are important for the detailed reproduction of impressions.[1] Hydrophilicity is regarded as beneficial to obtain optimal impressions for fixed restorations, which is still a challenging procedure in dentistry.[2] Therefore, polyvinyl siloxane (PVS) impression materials have been modified by the addition of surfactants to increase their hydrophilicity. Recent studies, however, indicate that the hydrophilic characteristic observed directly after mixing is reduced during working time.[3,4] Hence, the clinical application time between mixing and when the materials contact the oral tissues may play a critical role in creating successful impressions.

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The aim of this study was to analyze the clinical time course of impression taking. Among different techniques, this study was limited to the single-step/double-mix technique applied by the clinical staff at a university dental clinic using a regular-body and light-body PVS impression material. Based on the measured application times, recently published wettability data[4] encompassing the complete working times of unset impression materials were evaluated to improve the hydrophilic state during clinical use after mixing.

Materials and Methods

Application times of 86 different impressions taken from 48 patients by 14 different clinicians at the Department of Prosthodontics, University Hospital Tuebingen, Tuebingen, Germany, were measured and analyzed. In all, impressions were taken from 265 prepared natural abutment teeth for fixed or removable partial dentures, as well as from 46 implants that served as stabilization for fixed or removable partial dentures.

Single impressions included 1 to 10 teeth/implants. The impression materials used were Impregum Penta (3M ESPE) as a type 2 impression material (regular-body, working time: 165 seconds) and Permadyne Garant 2:1 (3M ESPE) as a type 3 impression material (light-body, working time: 120 seconds). Impressions were taken according to the single-step/double-mix

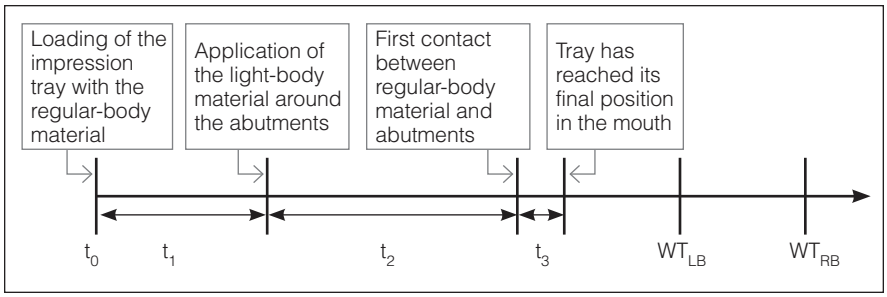

Fig 1 Scheme highlighting the clinically relevant application times t_1, t_2, and t_3 measured within this study. WT = manufacturer-given working time; LB = light-body material; RB = regular-body material.

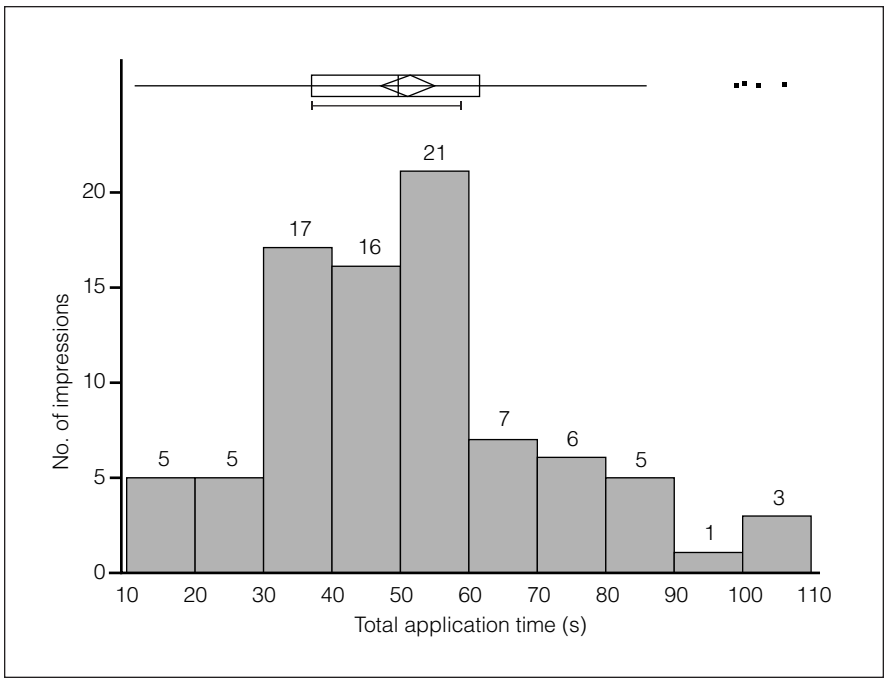

Fig 2 Frequency of the number of impressions distributed by ascending, equidistant ranges of the total application time. For example, the application time for 21 of the total 86 impressions was 50 seconds $\leq t_1 + t_2 + t_3 < 60$ seconds. The total application time represents the time from the start of loading of the impression tray with the regular-body impression material to the final placement of the loaded impression tray in the mouth. The bracket along the edge of the outlier box above the histogram identifies the shortest half, which is the densest 50% of observations.

technique, ie, the impressions were taken with a tray loaded with the regular-body material while the light-body material was applied around the teeth or implants.[5] In most cases, commercially available full-arch stock trays (Algilock, Hager & Werken) were used.

The application times t_1, t_2, and t_3 are defined in Fig 1. In addition, the total application time was calculated as $t_1 + t_2 + t_3$. The application times t_1, t_2, and t_3 were measured with a stopwatch by the same experienced clinician who was not involved in the patients' treatment. Care was taken to silently observe the impression taking without interfering with the clinical routine. Informed consent was obtained from all patients.

Application times were summarized by means and confidence intervals of means. The nonparametric Kruskal-Wallis test was used to characterize relations between the total application time and the clinicians or the total number of teeth/implants per impression. Statistical significance was declared as $P < .05$. All calculations were completed using JMP 8.0.1 software (SAS Institute). Application times were related to wettability data[4] of type 3 polyether and PVS impression materials.

Results

Figure 2 visualizes the frequency distribution of the impressions grouped by ascending, equidistant ranges of the total application time. The clinician significantly influenced total application time ($P < .05$). The results qualitatively indicate that older, more experienced clinicians and those who were familiar with the tested impression material took longer impression

Table 1 Means and Confidence Intervals (CIs) of the Respective Application Times

	t_1 (s)	t_2 (s)	t_3 (s)	$t_1 + t_2 + t_3$ (s)
Mean	5.8	42.0	3.4	51.2
Lower CI	2.9	38.3	3.3	46.9
Upper CI	8.7	45.6	3.6	55.5

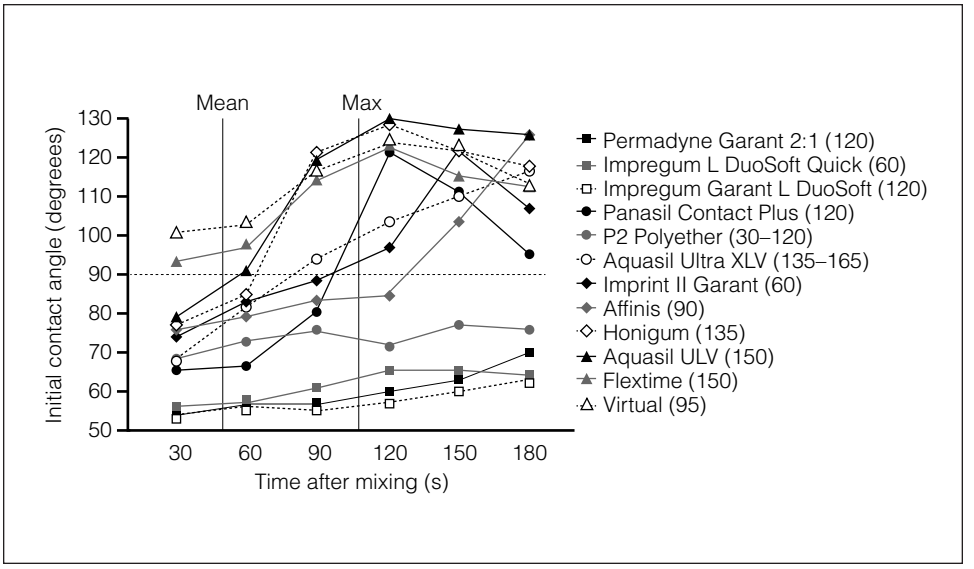

Fig 3 Initial contact angles of type 3 polyether and PVS impression materials from 30 to 180 seconds after mixing, according to Rupp et al.[4] The manufacturer-given working times (in seconds) are given after each trade name. The timeline at 51 seconds indicates the mean total application time, and the "Max" timeline indicates the longest total application time of 106 seconds observed within this study. The horizontal line at the 90-degree contact angle separates hydrophilic (< 90 degrees) from hydrophobic (> 90 degrees) material surfaces.

times compared to their younger colleagues. In contrast, the influence of the number of registered teeth/implants on the time needed to take the impression was not statistically significant. Therefore, the measured application times were parameterized regarding the complete data set without analyzing groups encompassing different numbers of abutments (Table 1). As a result, the mean total application time was 51.2 seconds. The length of confidence intervals < 10 seconds indicates sufficient precision regarding the remarkable spread of measured application times from 11 to 106 seconds. Several PVS materials have shown decreasing hydrophilicity within the observed range of application times (Fig 3).[4]

Discussion

This study reports results on the amount of time needed for clinicians to take impressions applying the single-step/double-mix technique. Of interest to the clinician is the available time in which a tray with the regular-body impression material has to be loaded, the light-body material has to be applied around the abutments, and the impression material has to be in its final position before the desirable flow qualities of the material decrease and the setting of the material begins. In this respect, the highest observed total application time of 106 seconds needed to take an impression was below the respective working times of 120 seconds for the light-body and 165 seconds for the regular-body materials. However, prolonged application times needed in clinical practice already covered the time of decreasing hydrophilicity of several PVS materials. Further studies might clarify if prolonged application times needed by clinicians will have an impact on the outcome quality of the impression itself or of the definitive restoration.

Until now, physicochemical in vitro investigations on unset impression materials were done at various time points within their working times.[1,3,4] Future investigations can now be adjusted to the estimated application times. Thus, the overall clinical relevance of such data may be increased by focusing on the clinically relevant time period. The experience and

operator skill of the clinician are known to be responsible for the quality of impression results.[6] However, whether the degree of clinical experience plays a decisive role in the time needed is speculative. It is possible that more experienced clinicians know how to take advantage of the setting properties of the impression material with regard to the time and accuracy of applying the low-viscosity material around the teeth or implants, whereas younger colleagues tend to hurry because they are afraid of not taking the impression fast enough. There are certain clinical conditions that potentially influence the application time. These include the type of margin of the preparation (subgingival, supragingival), the type of teeth (adjacent teeth, teeth spread out in the complete dental arch, di-/convergent teeth, parallel standing teeth), and the clinical accessibility or the compliance of the patient. However, these variables were not the focus of this study.

Conclusions

The authors suggest using the study result of the mean application time in future in vitro studies on physicochemical properties of unset impression materials to enhance their respective clinical relevance. All measured total application times lay within the working times of the applied impression materials. However, since PVS materials can partly lose their hydrophilic properties over time after mixing, observed prolonged application times give reason to assume the possibility of declined wettability at the time point of impression taking.

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Literature Abstract

Tooth preparation for rest seats for cobalt-chromium removable partial dentures completed by general dental practitioners

The aim of this study was to examine occlusal and cingulum rest seat preparations made by general dental practitioners for cobalt-chromium removable partial dentures. Sixty-eight master casts produced by a commercial dental laboratory from impressions made by 45 general dental practitioners were examined over a period of 5 months. The criteria for the ideal rest seat were: *(1)* a minimum of 1 mm but less than ⅓ of the tooth width in the buccolingual plane, *(2)* a minimum of 2 mm and between ⅓ and ½ of the tooth width in the mesiodistal plane, and *(3)* an occlusal clearance of between 1.03 and 1.5 mm when opposed by natural teeth. Any rest seats that fell outside these criteria would be categorized as either underprepared or overprepared, as appropriate. The depth of reduction of the rest seat was measured using a Williams probe. Thirty-three (48%) of 68 casts did not have prescriptions or designs and were excluded from the study. Eighty-one rests were prescribed for the remaining 35 casts. Only 4 prepared cingulum rest seats of 5 maxillary canines were obvious; 10 (23%) of 43 premolar occlusal rests had obvious rest seats prepared, while 33 (77%) had no preparation; and 10 (30%) of 33 molar occlusal rests had obvious rest seats prepared, while 23 (70%) did not. Six rests with no preparation were opposed by natural dentition, and the mean interocclusal clearance was 0.97 mm. Eighteen (75%) of 24 prepared rest seats did not meet the predetermined criteria. Twenty-one of the 57 prescribed rests did not have any preparation and were opposed by natural teeth; 11 (52%) of these had insufficient occlusal clearance and did not meet the predetermined criteria as well. In all, 70% of prescribed rests (57 of 81) did not have an obvious tooth preparation, and 49% (33 of 68) of prostheses did not include any rests in the prescription and were fabricated without rests. It is indeed alarming to note that a high percentage of removable partial dentures either had no rests or had poorly designed rests. The authors rightly emphasize that the responsibility for denture design and prescription is with the clinician, and poor design instructions will force the technician to make decisions that may have implications for future disease progression. They further recommend that there should be emphasis placed on importance of denture design in continuing education courses for dentists and dental technicians.

Rice JA, Lynch CD, McAndrew R, Milward PJ. *J Oral Rehabil* 2011;38: 72–78. **References:** 27. **Reprints:** Dr Christopher D. Lynch, School of Dentistry, Cardiff University, Heath Park, Cardiff CF14 4XY, United Kingdom. Email: lynchcd@cardiff.ac.uk—*Elvin W.J. Leong, Singapore*