

Effect of a Laboratory Surfactant on Compatibility of Type IV Dental Stones with Addition-Cured Silicone Impression Materials.

Christopher Jeremy Tredwin*, Michael Nesbit†, Rajeev Butta‡ and David R Moles§

Abstract - This study compared the effect of a surfactant on surface detail reproduction between combinations of addition-cured silicone impression materials and type IV stones. Six hundred impressions were made of a ruled test block using; Examix™-NDS, Doric-Es Flo-Light, Panasil® Contact Plus, Extrude Wash and President Plus Jet. Half of the impressions were treated with a surfactant (Aurofilm). Impressions were poured with type IV dental stones; Silky Rock, Fuji Rock, Suprastone and Vel-Mix and the 20µ line was scored. A laboratory surfactant (Aurofilm) significantly reduced ($P<0.01$) compatibility with; (i) Examix™-NDS and Suprastone, (ii) Examix™-NDS and Velmix, (iii) Extrude Wash and Fuji Rock.

KEY WORDS: Addition-cured silicone, dental stone, surfactant, compatibility.

INTRODUCTION

The fit and ultimate success of a cast dental restoration is dependent upon the accuracy and completeness of the die reproduction¹. Polyvinyl siloxane impression materials have been found to be the most stable impression materials². A serious problem with the use of silicone elastomeric impression materials is that their low surface energy renders them difficult to wet with gypsum slurries³. This poor wetting leads to air entrapment at the surface of the casts and dies⁴. The detail reproduction potential of a material is influenced by several factors, such as wettability, viscosity, and compatibility with gypsum⁵. Surfactants applied to an impression may reduce the number of voids in such dies⁶. However, the effect of such surfactants on the compatibility of addition-cured silicones with type IV dental stone is unknown.

The null hypothesis of the current study is that there is no significant difference between the compatibility among addition cured silicones with and without the use of a laboratory surfactant and type IV dental stone.

MATERIAL AND METHODS

The impression materials, type IV dental stones and dedicated laboratory surfactant tested in this study are listed in Table 1. The experimental methodology was carried out in accordance with ADA specification 19.

One hundred and twenty impressions were made of an ADA test block at 34°C using each of the five impression materials in a random order. Room temperature and humidity were controlled between 21°C and 23°C and be-

tween 30 and 40%, respectively. Subsequently half of the impressions were treated with a dedicated alcohol based laboratory surfactant, Aurofilm, and air-dried as per manufacturer instructions. All impressions were left for one hour before pouring. Following vacuum mixing in proportions according to manufacturer instructions and using the ADA test apparatus, the impressions were randomly allocated and poured using vibration, slight angulation and a slow flow technique with the four type IV stones. This gave fifteen of each impression material type, with and without surfactant, and in combination with each of the four type IV stone types.

Under a microscope at twelve times magnification using standardised low angle (20 degrees) illumination, two independent examiners examined the entire 20µ (micron) line on both the impression material and their partner stone and scored them for reproducibility. This was undertaken for all samples in a random order. The criteria used to score the reproducibility were adapted from a previous experiment⁷ and can be seen in table 2. A score of 4 represented perfect reproducibility of the original line on the ADA test block, which is a sharp V shape, a score of 3 represents slight loss of clarity with the V shape becoming rounded, a score of 2 indicates that part of the line was not recorded, and a score of 1 indicates that the line was not reproduced at all.

Both examiners repeated the scoring for each sample on different days. The lowest score obtained from the two examiners was used to give the final figure score. Randomisation throughout the experiment was achieved using a computer generated random number list. The Kappa statistic was used to assess inter- and intra- examiner agreement. The Kruskal Wallis test was used to assess whether there was any evidence of differences in the median scores between groups.

* BDS, BSc, MSc, MFDS RCS (Eng), FDS (Rest Dent) RCS, FHEA

† MSc, FHEA

‡ BDS, MSc

§ PhD, BDS, MSc, MSc (Hons), DDPH RCS(Eng), MIHPE, FHEA

RESULTS

The Kappa statistic revealed good agreement between the examiners on scoring of the samples (Kappa = 0.79). Intra-examiner agreement was also good, with examiner 1 (RB) Kappa = 0.80, examiner 2 (CJT) Kappa = 0.79.

All of the impression materials used in this study were able to fully reproduce (score 4) the 20 μ line. This was not the case in the resultant stone dies that were poured. This is in line with the results obtained in a previous study ⁸.

Table 3 shows the median quality scores obtained without the use of laboratory surfactant for the type IV dental stones related to the impression material from which they were poured, while table 4 shows the same combinations and results when a laboratory surfactant (Aurofilm) was used. These data are illustrated graphically in Figure 1.

Use of Kruskal Wallis statistical testing revealed significant differences ($P < 0.01$) between the compatibility of the following combination of addition-cured silicone impression materials and type IV dental stones with and without the

Table 1. Product, batch number, expiry date and manufacturer of light bodied addition cured silicones, type IV dental stones and laboratory surfactant used in this study.

Product	Batch Number	Expiry Date	Manufacturer
Examix™-NDS	0210081	10/2004	GC, America, IL, USA
Doric-Es Flo-Light	510641	03/2005	Davis, Schottlander & Davis, England
Panasil Contact Plus	30401	01/2006	Kettenback GmbH and Co. KG, Germany
Extrude Wash	2-1112	04/2004	sdsKerr, USA
President Plus Jet	MC533	02/2005	Coltene AG, Switzerland
Silky Rock	018503008	02/2006	WhipMix Co., Louisville, USA
Fugi Rock	030127	01/2006	GC, Europe
Suprastone	3-1071	03/2005	sdsKerr, Italy
Vel-Mix	2-2127	05/2004	SdsKerr, Italy
Aurofilm	1.72	12/2004	Bego, Bremen, Germany

Table 2. The scoring criteria used in this study

Criteria	Score
Line fully reproduced with fine margins	4
Line fully reproduced with rounded margins	3
Line not fully reproduced	2
Line not reproduced at all	1

Table 3. The median quality scores obtained without the use of laboratory surfactant for the type IV dental stones related to the impression material from which they were poured.

Stone Type		Impression Material				
		Examix NDS	Doric-Es Flo-Light	Panasil Contact Plus	Extrude Wash	President Plus Jet
Stone Type	Silky Rock	2	2	2	2	3
	Fugi Rock	3	3	3	4	3
	Suprastone	4	4	4	4	4
	Vel-mix	3	3	2	2	3

Table 4. The median quality scores obtained with the use of laboratory surfactant (Aurofilm) for the type IV dental stones related to the impression material from which they were poured.

Stone Type		Impression Material				
		Examix NDS	Doric-Es Flo-Light	Panasil Contact Plus	Extrude Wash	President Plus Jet
Stone Type	Silky Rock	2	2	2	2	2
	Fugi Rock	3	3	3	3*	3
	Suprastone	2*	4	4	4	4
	Vel-mix	2*	2	2	3	3

* Denotes significant difference from corresponding values in Table 3 ($p < 0.01$).

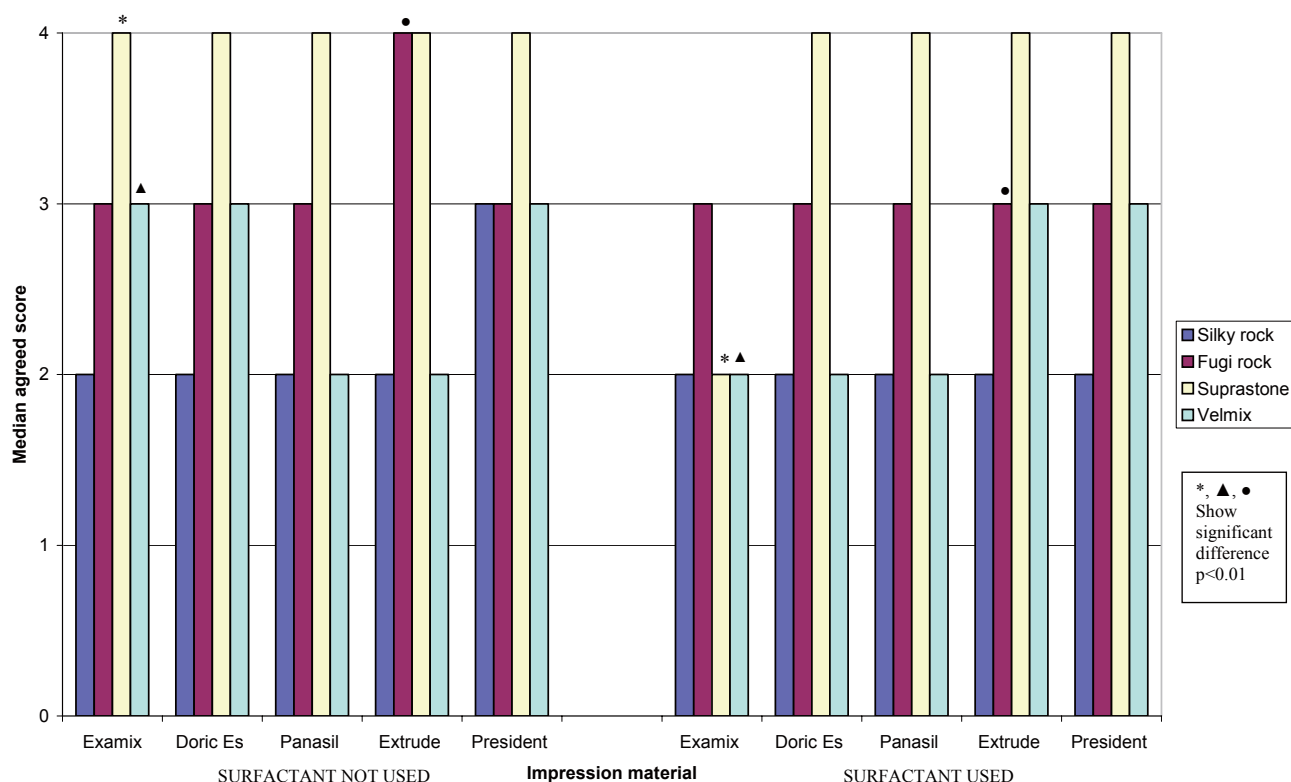


Figure 1. Bar graph to show median quality scores obtained.

use of laboratory surfactant. These differences were seen with the following combinations; (i) Examix™-NDS and Suprastone, (ii) Examix™-NDS and Velmix, (iii) Extrude Wash and Fuji Rock.

DISCUSSION

The null hypothesis that there was no significant difference between the compatibility of the addition-cured silicone impression brands and the four type IV dental stones with and without the use of a laboratory surfactant was rejected.

The international standard for dental elastomeric impression materials⁹, states that a type III (light body) impression material must reproduce a line 0.002mm (20µm) in width. Thus this line on an ADA block was chosen for investigation in this study. A previous study has explored the methodology employed and the compatibility of the addition-cured silicone impression materials and type IV dental stones used in this study⁸. The purpose of this study was solely to explore the effect of use a laboratory surfactant on compatibility of these impression materials and type IV stones.

A serious problem with the use of silicone elastomeric impression materials is that their low surface energy renders them difficult to wet with gypsum slurries³. This poor wetting leads to air entrapment at the surface of the casts and dies⁴. The detail reproduction potential of a material is influenced by several factors, such as wettability, viscosity, and compatibility with gypsum⁵, this study chose to investigate one of these variables i.e. compatibility. Laboratory surfactants applied to an impression may reduce the number of voids in such dies, and thus are recommended

for use prior to the pouring of addition-cured silicones and type IV dental stones in the laboratory⁶. An alcohol based topical laboratory surfactant - Aurofilm was selected for investigation in this study as it is commonly used on addition-cured silicone impression materials in the dental laboratory prior to pouring with type IV dental stones.

The results of this study showed that in seventeen of the combinations of addition-cured silicone impression materials and type IV dental stones used, the use of a laboratory surfactant did not make any significant difference to the stones ability to reproduce the 20 micron line of the test block. However, in three of the combinations namely; (i) Examix™-NDS and Suprastone, (ii) Examix™-NDS and Velmix, (iii) Extrude Wash and Fuji Rock, significant differences were found with the use of a laboratory surfactant. The use of the laboratory surfactant had in these three cases made compatibility worse i.e. the 20 micron line had been reproduced with less clarity after the topical laboratory surfactant had been applied. Clinically this is important as loss of surface detail can lead to an inaccurate die and a poor fitting casting¹. How much the clinical effect will be with the loss of surface detail seen with these three combinations requires further investigation.

CONCLUSION

Within the limitations of this study the following conclusion can be drawn:

- With certain combinations of addition-cured silicone impression material and type IV dental stones the use of a topical laboratory surfactant may adversely affect surface detail reproduction.

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MANUFACTURERS DETAILS

- ISO 1563 Dental Test Suite, Ravenfield Designs Ltd. Russel St. Heywood Lancs.
- Water Bath, no. 67/3694/157, Baird and Tatlock (London) Limited.
- Examix™-ND, GC, America Inc., IL, U.S.A. Lot:0210081. Expiry:2004-10.
- Doric-Es Flo-Light, Davis Schottlander and Davis Ltd, Herts, England. Made in Germany. Lot: 510641. Expiry:2005-03.
- Panasil® Contact Plus, Kettenback GmbH and Co. KG, Eschenburg, Germany. Lot: 30401. Expiry:2006-01.
- Extrude® Wash, sdsKerr, U.S.A. Lot: 2-1112. Expiry:2004-04.
- President Plus Jet, Coltène AG, Switzerland. Lot:MC533. Expiry :2005-03.
- Silky Rock, Violet, WhipMix® Corporation, Louisville, Kentucky, U.S.A. Lot: 018503008. Expiry:2006-02.
- Fuji Rock, Topaz Beige, GC Europe N.V. Lot: 030127. Expiry:2006-01.
- Suprastone, Green, ultrahard die stone, sdsKerr, Italy. Lot: 3-1071. Expiry:2005-03.
- Vel-Mix, crown and bridge die stone, sdsKerr, Italy. Lot: 2-2127. Expiry:2004-05.
- Surfactant: Aurofilm, Bego, Bremen, Germany. Lot: 1.72. Expiry:2004-12.

ADDRESS FOR CORRESPONDENCE

Christopher Jeremy Tredwin , Clinical Lecturer in Fixed and Removable Prosthodontics, Unit of Prosthodontics, UCL Eastman Dental Institute, University College London, 256 Grays Inn Road, London, WC1X 8LD.

Email: c.tredwin@eastman.ucl.ac.uk

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