DIMENSIONAL STABILITY OF IMPRESSION BODY USING THE SILICONE INDEX TOOTH TRAY IMPRESSION SYSTEM

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• Abstract

Purpose : This study sought to evaluate the dimensional stability of the SITT (Silicone Index Tooth Tray) impression system and to determine whether providing space for wash impression material in SITT is a necessary step in obtaining accurate prostheses.

Materials and methods : After mounting metal dies with shoulder and chamfer margins arbitrarily, SITT was fabricated using Blu-mousse®. To test the dimensional stability of the SITT system for margin design, the shoulder margin and chamfer margin were evaluated. Furthermore, to test the effect of space for wash impression material, 0.5mm space in SITT and zero space in SITT were statistically compared.

Results :

1. There was no significant difference between the group with shoulder margin and that with chamfer margin.
2. There was no significant difference between the group with 0.5mm space and that with zero space for wash impression material.

Conclusions : Considering the limitations of this study, the dimensional stability of the SITT system did not interfere with the margin design. Space for the wash impression material was also unnecessary.

Introduction

The silicone index tooth tray (SITT) impression system is a closed mouth impression technique using silicone bite registration material. This system enables taking final impression and bite registration at the same time without a retraction cord. Note, however, that the dimensional stability of SITT is still

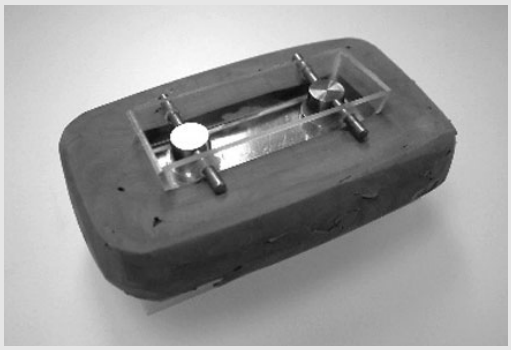

Fig. 1a

Fig. 1b

Fig. 1a. Positioning jig for the regular form of SITT 1b. Arbitrary mounting of metal die

questioned. Moreover, the additional step of removing the internal walls of the Silicone Index Tooth Tray to secure space for wash impression material is cumbersome and time-consuming.

Therefore, this study sought to evaluate the dimensional stability of the SITT impression system and to determine whether providing space for wash impression material in SITT is a necessary step in obtaining accurate prostheses.

Materials and Methods

1) Model fabrication

Prefabricated metal die (Seiki, Tokyo, Japan) was used asaprepared tooth model. A positioning jig for uniform size and location for SITT was fabricated using Extrude® heavy body (Kerr, Romulus, MI, USA), acrylic plate, and metal bar (diameter of 2mm).

The acrylic plate was fabricated such that SITT was 2mm larger than the margin of the metal die. The metal bar crossing the center of the metal die functioning as venting hole was also designed to be as high as possible to make the Fit-tester®(Tokuso, Tokyo, Japan) flow out easily at the time of impression taking (Fig. 1a).

Two metal dies with shoulder margin were fabricated into the chamfer margin with baseplate wax. A 0.5mm-thick shell made of Unifast®(GC Co., Tokyo, Japan) was also made to apply equal space for wash impression material. The margin of the shell on the shoulder metal die was designed to be located 0.5mm from the gingival wall, and that on the chamfer metal die, at the same position where the chamfer margin ended (Fig. 2).

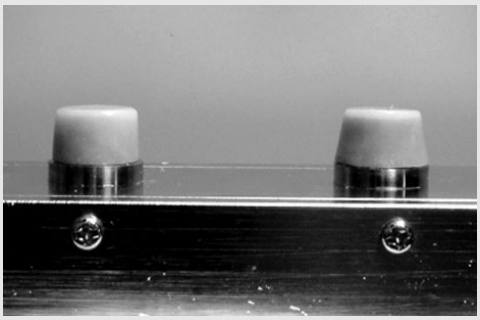

Fig. 2a

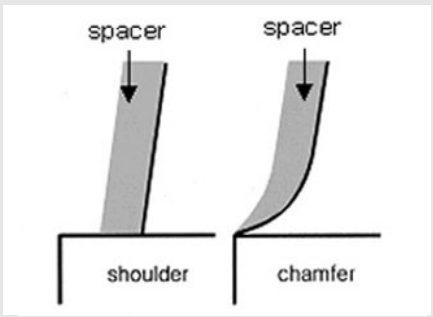

Fig. 2b

Fig. 2a. 0.5mm resin spacer 2b. Schematic drawing of spacer

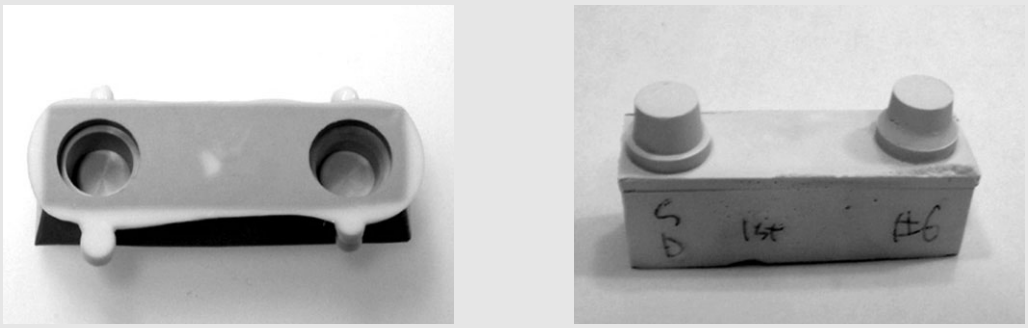

Fig. 3. SITT impression and stone model

2) Impression taking

① SITT fabrication

After locating the positioning jig on the metal die and taking an impression using elastomer syringe (3M ESPE, USA) as usual with additional silicone, Blue-mousse® (Parkell, Farmingdale, NY, USA).

The upper member of the articulator was closed with load applicator at 50N to imitate the natural bite force during the clinical procedure. Any excess impression material outside of the positioning jig was removed after the Blu-mousse® was set.

For the experimental group with spacer, the spacer was set into position on the metal die; SITT was then fabricated following the same procedures described above. A vent hole was made using a 2mm round bur through the indentation made by the metal bar on the acrylic plate.

② Wash impression taking

Fit-tester® was mixed at a ratio of 1:1 as recommended by the manufacturer and packed into SITT. Afterward, it was placed on the metal die, and the upper member of the articulator was closed with load applicator at 50N. A 12㎛ shimstock (ARTUS Corp, Eaglewood, NJ, USA) was used to verify whether SITT was placed on the right position.

③ Pickup impression taking

After Fit-tester® was set, SITT was removed. The Remnant Fit-tester® was also removed and replaced in position at 50N. Partial metal stock tray and Alginoplast® (Cavex, Haarlem, Netherlands) were used for pickup impression.

3) Stone model fabrication

Dental stone was poured right after wash impression. MG Crystal® (Maruishi, Osaka, Japan) die stone was mixed with water at a ratio of 0.24 using a vacuum mixer (Whip-mix, Louisville, KY, USA). After an hour, the stone was removed (Fig. 3).

4) Measurement

The diameter of the upper margin (8mm) and lower margin

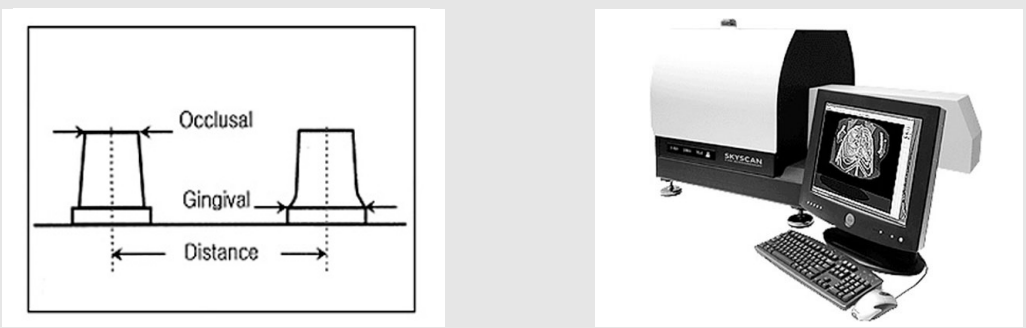

Fig. 4a Fig. 4b

Fig. 4a. Schematic drawing of the measuring point 4b. SkyScan-1076 in vivo micro CT®

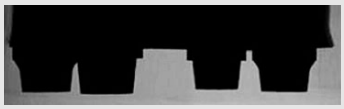

Fig. 5a

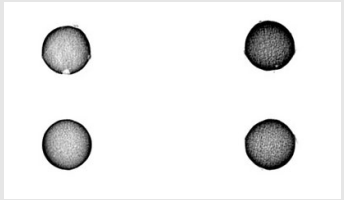

Fig. 5b

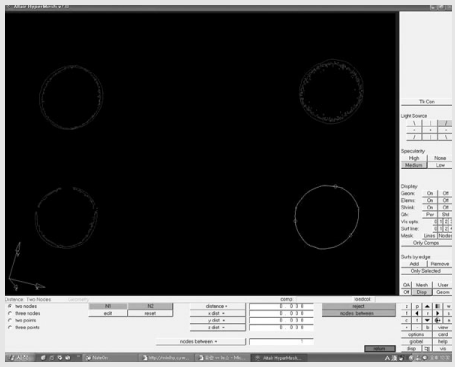

Fig. 5c

Fig. 5a. Scanned image from Skyscan micro CT®
5b. Reconstructed cross-sectional image of stone model
5c. Radius measurement with Hypermesh®

(10mm) of the metal die with shoulder margin was measured; the same procedure applied for the metal die with chamfer margin. The distance between the centers of the two casting bodies measuring 30mm was also measured (Fig. 4a).

The SkyScan-1076 high-resolution in-vivo micro-CT® (Skyscan, Aartselaar, Belgium) system was used to scan the 40stone models (Fig. 4b). Two-dimensional images were acquired using the 16bit TIFF image scanned at boxel size of 18㎛ followed by the image reconstruction process. From these images, the boundary of the circular margin was separated using Bionix® software (CANTIBio INC, Seoul, Korea); each radius of the circle and the distance between the centers of the two circles were also measured using Hypermesh® software (Altair Engineering, INC., Troy, MI, USA)(Figs. 5a, 5b, 5c).

5) Experimental group

The experimental groups were divided into the group with spacer (S) and that without spacer (NS). Two types of margins were also tested: shoulder margin (Sh) and chamfer margin (Ch). Ten stone models for each group or a total of twenty stone models were fabricated.

6) Statistical analysis

SPSS 10.0 (SPSS Inc., Chicago, USA) was used for the statistical analysis. The Wilcoxon signed ranks test was employed to test the significance of each group, with the statistical significance set at $p<0.05$ for all tests.

Results

1. There was no significant difference between the group with shoulder margin and that with chamfer margin. The groups were divided into two (NS, S), and a comparative study was performed (Table II). The Wilcoxon signed ranks test was used, although no significant differences were found ($P>.05$).
2. There was no significant difference between the group with 0.5mm space and that with zero space for wash impression material. The groups were divided into two (Sh, Ch), and a comparative study was conducted. Measurements were recorded before and after the spacer application and compared (Table I). The Wilcoxon signed ranks test was used, although no significant differences were found between groups ($P>.05$).

Discussion

There were many attempts to make an accurate impression of the margin without displacing the gingival margin using various methods such as copper bands, individual tooth tray technique, and matrix impression system.[1-7)]

The SITT impression technique using silicone bite registration material enables taking final impression and bite registration at the same time without a retraction cord even for the sub-gingival margin.[8)] Still, removing the internal walls of the silicone index tooth tray for wash impression material is very inconvenient. Furthermore, dimensional

Table I. Result of the Wilcoxon signed ranks test between GroupNSandGroupS

	Shoulder Gingival		Shoulder Occlusal		Chamfer Gingival		Chamfer Occlusal		Distance	
N	4a	6b	6a	4b	5a	4b	3a	7b	7a	3b
Mean Rank	4.75	6.00	4.50	7.00	5.80	4.00	5.67	5.43	6.00	4.33

Table II. Result of the Wilcoxon signed ranks test between Group Sh and Group Ch

	NS				S			
	Gingival		Occlusal		Gingival		Occlusal	
N	4a	6b	5a	5b	7a	3b	3a	7b
Mean Rank	4.50	6.17	6.00	5.00	5.43	5.67	5.67	5.43

a: Negative ranks NS: No spacer b: Positive ranks S: Spacer
*: Statistically significant difference

stability is still questioned.[9)]

This study was conducted to test several factors that could affect dimensional stability during the SITT procedure such as margin design and space in SITT.

The SkyScan-1076 in-vivo micro CT® used in this study can scan the image at boxel sizes of 9㎛, 18㎛, and 35㎛. A boxel size of 18㎛ was used in this study, assuming 25㎛ as the clinically acceptable misfit of prostheses. Micro CT as a non-destructive method was also used for the measurement to minimize the measuring error.[10)]

Margin design (shoulder vs. chamfer)

The shoulder and chamfer margins were compared in this study since these were two the commonly used prostheses margins.[11-12)] There was no significant difference between the two groups, however (P>.05). Thus, the margin shape can be said to have no effect on the dimensional stability of Blu-mousse® and Fit-tester.

Space for wash impression material in SITT

No significant differences were found (P>.05). Therefore, skipping the step of securing space can be said to have no clinical effect on the accuracy of the prostheses. To apply this concept clinically, however, the clinician should be careful in selecting the wash impression with low viscosity. In addition, the vent hole made on SITT should be located on top with minimum diameter of 1mm.[9)]

The SITT impression technique has several advantages. For one, variable impression materials can be used to take pickup impression. In many cases, alginate is used considering the cost and for convenience. In the procedure for pickup impression, SITT was removed after the wash impression to remove excess impression material. Afterward, it was relocated to the model, and stone was placed.[13)] These steps are necessary when using the SITT impression technique because the irreversible hydrocolloid such as alginate has no chemical bonding with SITT. Therefore, SITT should be removed once from the tooth to prevent the separation between SITT and pickup impression materials during the clinical trials.[14-16)] Furthermore, Fit-tester® outside of SITT should be removed, and pickup impression material should be rubbed onto SITT to create a smooth, continuous border between SITT and Alginate. Polyether, poly vinyl siloxane, and polysulfide can also be used for pickup impression. If these materials are used, abutment and tissue impression can be taken at a time.

Secondary stone pouring for individual die duplication is possible. P.T. William investigated the dimensional stability of 11 different rubber impression materials over time and concluded that all materials were stable for 24 hours from the initial setting.[13)] Furthermore, previous studies comparing the dimensional changes of two master casts made one after the other through stone pouring showed no statistical difference.[17-18)] Individual die fabrication through secondary stone pouring is beneficial to making precise prostheses since it allows lab technicians to make prostheses without sawing the master cast into pieces. Note that this might cause a laboratory error. Making the master cast and individual die with one impression using other impression techniques such as copper band impression technique, individual tooth tray technique using temporary crown resin, and matrix impression technique is impossible.

Since the SITT impression technique is a kind of closed mouth technique, there is no need to take additional bite

registration. When SITT is fabricated, it contains information on the interocclusal relation. After the master cast and individual die are fabricated if necessary, SITT excluding the pickup impression and trimming can fulfill the role of bite registration.

Based on these results, the dimensional stability of the SITT impression technique can be said to be sufficient. Moreover, there was no need to secure 0.5mm space for the wash impression material in the SITT impression technique to ensure the accuracy of the prostheses.

Given the small number of specimens used in this study, the Wilcoxon signed ranks test was used. Note, however, that there is still a possibility of statistical error caused by the small number of specimens. Thus, to verify these results, further studies involving more specimens are needed.

Further studies on comparing the SITT technique and conventional method with gingival retraction cord or SITT with different material for pickup impression such as polyether, polysulfide, etc., in terms of the accuracy of sub-gingival margin taking could be conducted.

Conclusion

The silicone index tooth tray impression technique is an effective method especially for the sub-gingival margin. This study was conducted to test the dimensional stability of the SITT impression system and to determine whether providing space for wash impression material in SITT is a necessary step in obtaining accurate prostheses.

There was no significant difference between the group with 0.5mm space and that with zero space for wash impression material.

There was no significant difference between the group with shoulder margin and that with chamfer margin.

Based on the Wilcoxon signed ranks test, several conclusions were drawn. For one, there is no need to secure 0.5mm space for the wash impression material in the SITT impression technique to ensure the accuracy of the prostheses. Furthermore, making the individual die through secondary stone pouring is the acceptable laboratory procedure.

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