Stomatologija, Baltic Dental and Maxillofacial Journal, 13: 15-8, 2011

Accuracy of the second pour casts using dual-arch trays

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SUMMARY

Objective. To compare, in vitro, the accuracy between dental stone casts obtained from the first and the second pour using metallic (Smart) and plastic (Triple Tray) dual-arch trays.

Material and Methods. The impressions were taken using Flexitime® vinyl polysiloxane from a typodont model with a mandibular right first molar prepared for a full crown. Ten impressions were made with each tray and poured using type IV die stone. After 1 hour, the casts were removed from the impressions and, 1-hour later, second pours were completed. The mesio-distal and the buccal-lingual widths at the gingival margin of the prepared tooth on the cast were measured in a perfil projector. The results were submitted to Student's t-test (α=0.05) using SPSS version 10.0.

Results. There was a statistically significant difference between the first and second pours using the plastic tray in the mesio-distal width.

Conclusion. It could be suggested that a repeated pour is more accurate using a metallic tray.

Key words: impressions, elastomers, silicone, dual-arch tray.

INTRODUCTION

The dual-arch impression technique was first described by Wilson and Werrin [1], in 1983, and it is also known as the double-arch technique. It is a closed-mouth impression technique which utilizes a special tray to register an impression of the opposing segments of the dentition while simultaneously records the interocclusal relationship. The patient closes into a tray in which a thin piece of fabric or mesh divides the tray into maxillary and mandibular compartments. Once taken, the impression is poured and mounted in an articulator, usually a simple hinge-typo model.

The dual-arch technique is indicated for single crown, inlay, or onlay restorations. The patient must be able to close reproducibly into intercuspal position without interferences, and the opposing teeth must have intact occlusal surfaces [2].

This technique has gained wide popularity due to the advantages, such as time saving procedure for the dentist and patient, patient feels more comfortable and it is cost effective (savings of the impression material) [3,4]. However, some disadvantages are related to this technique. Basically, the absence of contralateral teeth and the inherent possibility of the incorporating non-centric interferences during the fabrication of the casting [3].

An in vitro investigation reported dual-arch impressions to be as accurate as impressions registered using complete-arch custom acrylic resin tray [3]. However, some studies showed that the metallic dual-arch tray tends to be more accurate [5-7].

The accuracy of dual-arch trays as well as the dimensional stability of the impressions used for repeated pours are of clinical significance. A second pour is useful in a variety of situations and it provides latitude for the laboratory error. Although the use of dual-arch impressions has been widely accepted by private practicing dentists, there is a lack of information about the accuracy of the multiple pours using dual-arch trays. So, an important issue to be investigated is the accuracy of the second pour of dual-arch impressions.

The purpose of this study was to compare the

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accuracy between gypsum casts obtained from the first and the second pour using metallic and plastic dual-arch trays. The null hypothesis is that there is no difference between the first and the second pored casts using either plastic or metallic trays.

MATERIALS AND METHODS

A typodont (Ultra System®, Vila Mariana, SP, Brazil) with complete maxillary and mandibular arches was used to simulate the clinical conditions. The mandibular right first molar was prepared for a full-ceramic crown. Plastic (Triple Tray® – DFL, Jacarepaguá, RJ, Brazil) and metallic (Smart® – SS-White, São Paulo, SP, Brazil) dual-arch trays were employed with Flexitime® (Heraues-Kulzer GmbH & Co. KG, Germany) vinyl polysiloxane impression material. Ten impressions were made with both trays and the putty/wash one-step technique was applied. The manufacture's recommended tray adhesive material has been applied to the inner surfaces of the tray. The light-body material was injected around and over the prepared molar. Both sides of the tray were filled with the heavy-body material, then the tray was placed over the posterior mandibular teeth, and the maxillary and mandibular arches were closed until the unprepared teeth touched. All impressions were made by the same operator in a climate controlled room with the temperatures of 23±2° C. The impression material was allowed to set for 10 minutes before it was removed from the typodont. The impressions were stored for 1 hour, and then the mandibular side of the impression was poured using a Type IV dental stone (Durone® – Dentsply, Petrópolis, RJ, Brazil). After 1 hour, the casts were removed from the impressions. The impressions were cleaned with a jet air and immediately poured again using the same Type IV stone. The gypsum was allowed to set for 1 hour and then removed from the impressions.

The prepared tooth was separated from the cast to facilitate the measure in a V16 perfil projector (Nikon®, Tokio, Japan). The mesio-distal and the buccal-lingual width at the gingival margin were measured 5 times and the mean values were recorded. After data collection, Kolmogorov–Smirnov normality test was applied. To compare the first and second pours for each tray, Student's t-test (α=0.05) was applied. Statistical analyses were performed using SPSS version 10.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

The mean values of the mesio-distal and buccal-lingual widths at the gingival margin are shown in Table 1 and Table 2, respectively. The Student's t-test showed a significant difference between the first and second pours only for the plastic tray in the mesio-distal width ($p<0.05$). There was no difference between the first and second pours for the plastic tray in the buccal-lingual width and for the metallic tray in the mesio-distal and buccal-lingual widths.

DISCUSSION

An accurate impression will result in a precise fitting cast restorations, and this is one of the factors that determines the restoration`s longevity [8]. In terms of clinical relevance, multiple pours of impressions are useful in a variety of situations as supplemental casts for the internal adjustment of cast restorations and for the pre-clinical adjustment of the proximal contacts using an unsectioned cast. Multiple pour provides latitude for laboratory error. However, a repeat pour should not influence the accuracy.

In the present study, the null hypothesis was not confirmed, since there was a significant difference between the first and second pour for the plastic dual-arch tray in the mesio-distal width. The higher in-

Table 1. Comparison between first and second pours in the mesio-distal width

Tray	N	Mean (mm)	Difference (mm)	SD	P
Metallic					
1º pour	10	10.0426	0.010	0.0161	0.09
2º pour	10	10.0320		0.0222	
Plastic					
1º pour	10	10.0431	0.026	0.0165	0.01*
2º pour	10	10.0166		0.0212	

Table 2. Comparison between first and second pours in the buccal-lingual width

Tray	N	Mean (mm)	Difference (mm)	SD	P
Metallic					
1º pour	10	8.8762	0.013	0.0423	0.39
2º pour	10	8.8623		0.0231	
Plastic					
1º pour	10	8.8596	0.015	0.0245	0.32
2º pour	10	8.8750		0.0267	

accuracy between the pours was obtained for the plastic tray (26 μm). One possible explanation is the higher flexibility of the dual-arch plastic tray. The plastic tray may be distorted by the weight of the stone when the impression is poured, as well as when the stone cast is being removed. This problem could be minimized by the usage of the metallic dual-arch tray due to the more rigid support at the borders.

Another question is if a 26 μm difference between first and second pours is clinically relevant. However, as an imprecise fitting restoration is a sum of small distortions that occur during clinical and laboratory processes [7,8], a higher distortion due to the tray can contribute to this imprecise fitting

Although distortion of an impression is a 3-dimensional problem, only the mesio-distal and buccal-lingual dimensions of the gingival margin were measured. According to Wassel and Ibbetson [9], larger variations occur in gingival margin distortions than in occlusal width distortions. Additionally, the gingival margins are related to the adaptation of the restoration.

In relation to the impression material, dual-arch impression trays are routinely employed with vinyl polysiloxane impression material. This material has been reported to be the most accurate and dimensionally stable [10-13]. Different viscosities are available (heavy, media and wash). Usually, the putty/wash one-step technique, which the material polymerizes in one stage, is applied with dual-arch trays. Johnson and Craig [14] investigated the accuracy of second pours of vinyl polysiloxane impressions reporting them to be as accurate as the initial pours. Although vinyl polysiloxane is a dimensional stable impression material, results of this study indicate that the material, per se, some distortion may occur. This is in accordance with the study of Petersen and Asmussem [15] who studied the distortion of the elastomers Express (3M), Mirro (Kerr), Permagnum (Espe), President (Coltene), Provil (Bayer), Refrosil (Detrey), Permadyne (Espe), and concluded that all materials had different degrees of distortion. In the present study, the distortion between the first and second pour cast was smaller for the metallic trays (10 μm to 13 μm) in comparison to the plastic trays (15 μm to 26 μm). So, it seems that lack of rigid support would predispose a greater distortion when the impression is poured twice.

The present study did not evaluate the accuracy between the cast generated from metallic and plastic dual-arch trays with the master model, and there are conflict results about this subject. In the study of Davis and Schwartz [3], the metallic dual-arch tray provided less percentage of the change from the master model in comparison to the plastic dual-arch tray. According to the study of Breeding and Dixon [5], the plastic trays produced tooth replicas that were larger than the tooth (95 and 166 μm), and the metal trays produced replicas that were smaller (-24 and -36 μm). As for clinical implications, the authors concluded that with the dual-arch impression technique, the metallic tray is more likely than the plastic tray to generate full-coverage castings with acceptable marginal integrity. Carvalho et al. [6] verified that the plastic dual-arch trays can provide inaccuracies of 30 μm to 70 μm at the gingival margin between the master model and the first stone cast, and the maximum of 20 μm for metallic dual-arch tray, and concluded that metallic dual-arch trays have more stability and tend to be more accurate than plastic dual-arch trays. However, Davis et al. [16] compared the marginal fit of castings made with custom acrylic trays and metallic or plastic dual-arch impressions trays, and concluded that excellent marginal adaptation was achieved with all three impression trays. In the study of Ceyhan et al. [17] the plastic dual-arch trays produced the least distorted working dies, and the metallic and plastic dual-arch, and complete-arch custom trays produced dies that were within clinical standards to make clinically successful impressions of a single tooth implant abutment preparation.

In terms of clinical relevance, it is difficult to know exactly which magnitude of the distortion could influence significantly the final adaptation of the restoration. However, it seems to be a consensus that a low distortion is necessary to obtain good adaptations . So, when a repeated pour is done, the metallic dual-arch tray seems to provide casts with lower distortion.

CONCLUSION

Under the limitations of the current study, the results suggest that a more accurate repeated pour can be made with the metallic dual-arch tray.

REFERENCES

1. Wilson G, Werrin SR. Double arch impressions for simplified restorative dentistry. *J Prosthet Dent* 1983;49:198-202.
2. Barzilay AYI, Myers M.L. The dual-arch impression. *Quintessence Int* 1987;18:293-5.
3. Davis RD, Schwartz RS. Dual-arch and custom tray accuracy. *Am J Dent* 1991;4:89-92.

4. Burke FJ, Crisp RJ. A practice-based assessment of the handling of a fast-setting polyvinyl soloxane impression material used with the dual-arch tray technique. *Quintessence Int* 2001;32:805-10.
5. Breeding LC, Dixon DL. Accuracy of casts generated from dual-arch impressions. *J Prosthet Dent* 2000;84:403-7.
6. Carvalho GL, Tavares JG, Lang AR, Spohr AM. Avaliação da precisão de moldeiras de dupla arcada. (Evaluation of the accuracy of dual-arch trays). *Rev ABO Nacional* 2004;12:170-3.
7. Cox JR, Brandt RL, Hughes HJ. A clinical pilot study of the dimensional accuracy of double arch and complete arch impressions. *J Prosthet Dent* 2002;87:510-15.
8. Holm C, Tidehag P, Tillberg A, Molin M. Longevity and quality of FPDs: a retrospective study of restoration 30, 20, and 10 years after insertion. *Int J Prosthodont* 2003;16:283-9.
9. Wassell RW, Ibbetson RJ. The accuracy of polyvinyl soloxane impressions made with standard and reinforced stock trays. *J Prosthet Dent* 1991;65:748-57.
10. Piwowarczyk A, Ottl P, Buchler A, Lauer HC, Hoffmann A. In vitro study on the dimensional accuracy of selected materials for monophase elastic impression making. *Int J Prosthodont* 2002;15:168-74.
11. Thongthammachat S, Moore BK, Barco MT 2nd, Hovijitra S, Brown DT, Andres CJ. Dimensional accuracy of dental casts: influence of tray material, impression material, and time. *Int J Prosthodont* 2002;11:98-108.
12. Endo T, Finger WJ. Dimensinal accuracy of a new polyether impression material. *Quintessence Int* 2006;37:47-51.
13. Faria ACL, Rodrigues RCS, Macedo AN, Mattos MGC, Ribeiro RF. Accuracy of stone casts obtained by different impression materials. *Braz Oral Res* 2008;22:293-8.
14. Johnson GH, Craig RS. Accuracy of four types of rubber impression materials compared with time of pour and a repeat pour of models. *J Prosthet Dent* 1985;53:484-90.
15. Petersen GF, Asmussen E. Distortion of impression materials used in the double-mix technique. *Scand J Dent Res* 1991;99:343-8.
16. Davis R, Schwartz R, Hilton T. Marginal adaptation of castings made with dual-arch and custom trays. *Am J Dent* 1992;5:253-4.
17. Ceyhan JA, Johnson GH, Lepe X, Phillips KM. A clinical study comparing the three-dimensional accuracy of a working die generated from two dual-arch trays and a complete-arch custom tray. *J Prosthet Dent* 2003;90:228-34.

Received: 01 09 2010
Accepted for publishing: 30 03 2011