EVALUATION OF A TWO-STEP POURING TECHNIQUE FOR IMPLANT-SUPPORTED PROSTHESES IMPRESSION

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ABSTRACT

The aim of this study was to evaluate the efficacy of a pouring technique for implant-supported prostheses impressions. A metallic matrix (control group) with two implants positioned at 90 and 65 degrees was fabricated. The matrix was submitted to the direct transfer impression technique. In group CP (conventional pouring - n=10), casts were obtained by the conventional pouring technique. In group EP (experimental pouring - n=10), the analogs were embraced with latex tubes before the first pouring and then submitted to a second pouring. Vertical misfit and implants/analogs inclinations were evaluated. Data were analyzed by analysis of variance and Tukey's test (p<.05). Results demonstrated significant difference (p<.05) between control and experimental groups for misfit measurement in perpendicular implant/analog and between control group and group EP in leaning implant/analog. Considering inclination, there were significant differences (p<.05) between control and experimental groups for leaning analogs. Independently of the pouring technique, perpendicular implants produced more accurate casts.

Key words: dental implantation, implant-supported dental prosthesis, prosthodontics.

AVALIAÇÃO DE UMA TÉCNICA DE VAZAMENTO EM DOIS TEMPOS PARA MOLDAGENS DE PRÓTESES SOBRE IMPLANTE

RESUMO

O objetivo do estudo foi avaliar a eficácia de uma técnica de vazamento para moldagens de próteses sobre implante. Uma matriz metálica (grupo controle) contendo dois implantes posicionados a 90° e 65° de inclinação foi confeccionada. A matriz foi submetida à técnica de moldagem de transferência direta. No grupo CP (vazamento convencional – n=10), os modelos foram obtidos através da técnica de vazamento convencional. No grupo EP (vazamento experimental – n=10), os análogos dos implantes foram revestidos por tubos de látex anteriormente ao primeiro vazamento e, então, submetidos a um segundo vazamento. A desadaptação vertical e a inclinação dos implantes/análogos foram avaliadas. Os dados foram submetidos à Análise de Variância e teste de Tukey (p<.05). Os resultados demonstraram diferença significante (p<.05) entre os grupos controle e experimentais para a mensuração da desadaptação no implante/análogo perpendicular e entre os grupos controle e EP em relação ao implante/análogo inclinado. Considerando a inclinação, houve diferenças (p<.05) entre os grupos controle e experimentais em relação a implante/análogos inclinados. Independentemente da técnica de vazamento, implantes perpendiculares geraram modelos mais precisos.

Palavras chave: implante dentário, prótese dentária fixada por implante, prótese.

INTRODUCTION

The introduction of osseointegrated implants allowed restoration of single or multiple dental elements, as well as increased retention and stability of partial and complete removable dentures. In addition to effective patient home care, such as appropriate oral hygiene[1], the long term success of dental implants treatment also depends on the passive fit between prosthesis and implant to allow correct distribution of forces without damaging support structures[2-4]. Considering clinical and laboratorial practice, complete passive fit depends on innumerable aspects, such as physical properties of materials, professional experience and knowledge of techniques. Another important aspect is the biological behavior of each patient that may contribute to avoid treatment failure, since the extent of stress supported by structures without suffering damage is not measurable[5].

So, accurate transferring of implant position as well as localization and arrangement in the master cast employing the direct transfer impression technique with splinted impression copings are necessary. This technique results in a more accurate cast than other impression techniques[6-9]. Impression material dimensional stability also influences master cast accuracy[10,11]. Assunção et al.[12] demonstrated great efficacy of polyether and addition silicone as impression materials and observed that implant inclination influences master cast accuracy. However, few studies have investigated the influence of plaster expansion on master cast accuracy[13-15]. Within this context, the purpose of this study was to evaluate the efficacy of the two-step pouring technique to obtain an implant prosthesis master cast.

MATERIAL AND METHODS

A metallic matrix similar to a medium toothless jaw was fabricated with two implants of 3.75 X 10.0 cm (Master; Conexão Systems of Prosthesis, Sao Paulo, SP, Brazil) positioned at 90 and 65 degrees in relation to the alveolar edge surface (Fig. 1).

The matrix was submitted to the direct transfer impression technique with splinted impression squared copings through a dental floss scaffold covered by autopolymerizing acrylic resin (Duralay; Reliance Dental MFG Company, Worth, IL, USA), using individual open trays made with autopolymerizing acrylic resin (Jet; Dental Articles Clássico Ltd., Sao Paulo, SP, Brazil) and polyether (Impregum Soft; 3M ESPE, Seefeld, Germany) as impression material.

All impression procedures were carried out in a controlled temperature (23ºC ± 2ºC) and humidity (50% ± 10%) environment and the impression material was set in a stove at 37ºC ± 2ºC. After setting, the screws of the copings were removed with a screwdriver, and the impression/matrix set was separated with the help of a device screwed at the base of the metal matrix.

The impressions were submitted to pouring techniques according to the experimental groups (n=10). In group CP, the analogs were adapted and screwed into the copings. Sixty minutes later, dental stone type IV (Durone; Dentsply Ind. and Com. Ltd., Petropolis, RJ, Brazil) was manipulated with a vacuum machine (Turbomix; EDG Equipments and Controls Ltd., Sao Paulo, SP, Brazil), with a powder/water ratio of 60 g/12 ml and then poured under constant vibration into the impression.

In group EP, the analogs were placed into natural latex surgical tubing (Auriflex Ind. and Com. Ltd., Sao Roque, SP, Brazil), before being adapted and screwed into the copings. Sixty minutes later, dental stone type IV (Durone; Dentsply Ind. and Com. Ltd., Petropolis, RJ, Brazil) was manipulated with a vacuum machine (Turbomix; EDG Equipments and Controls Ltd., Sao Paulo, SP, Brazil), with a powder/water ratio of 60 g/12 ml and then poured under constant vibration into the impression (Fig. 2). After sixty minutes, the latex tubes were removed and the space was filled with dental stone type IV with a powder/water ratio of 30 g/7 ml (Fig. 3).

After setting (60 minutes later), the impression was separated from the cast in both groups (CP and EP) to obtain the matrix replicas. The control group was characterized by the measurements corresponding to the metallic matrix (Group M).

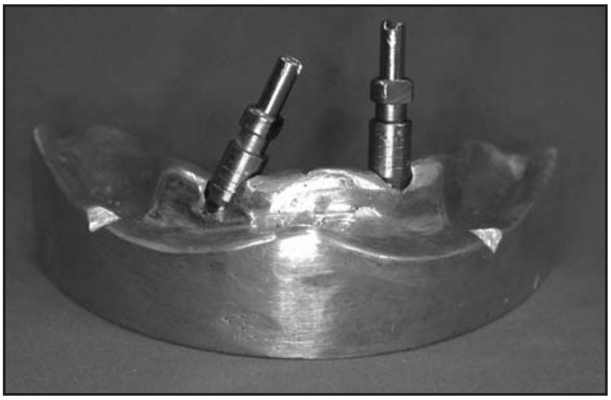

Fig. 1: Metallic matrix with two implants positioned at 65° and 90° in relation to the alveolar edge surface with square impression copings.

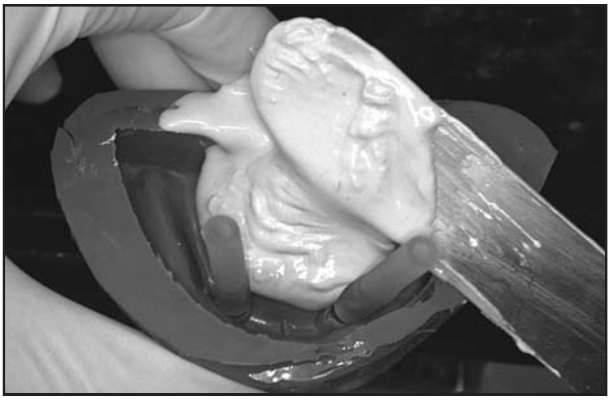

Fig. 2: Initial dental stone pouring with latex tube in position - group EP.

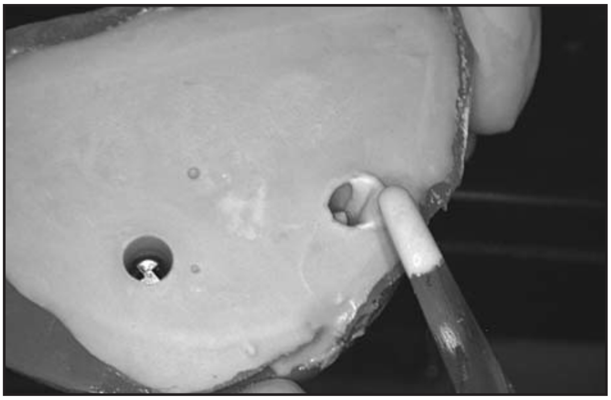

Fig. 3: Final dental stone pouring into the space created by the latex tube - group EP.

Vertical misfit measurement between the framework and the implants/analogs:

A framework in nickel/chrome alloy (CNG prosthetics solutions, Sao Paulo, SP, Brazil) presenting clinical passive fit to the metallic matrix was adapted to each

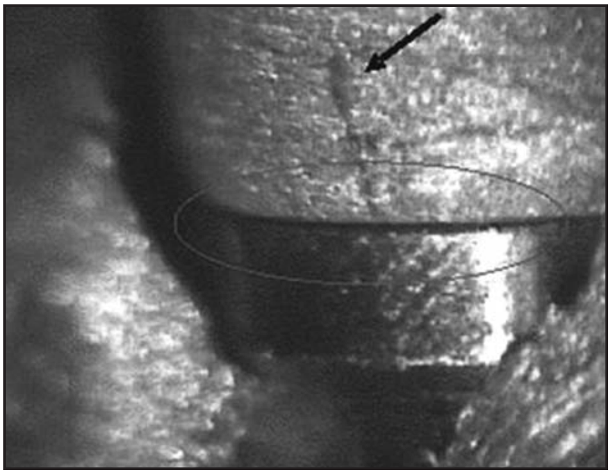

Fig. 4: Vertical misfit measurement between superstructure and metallic matrix circled in red. The arrow indicates the index made to standardize the measurements.

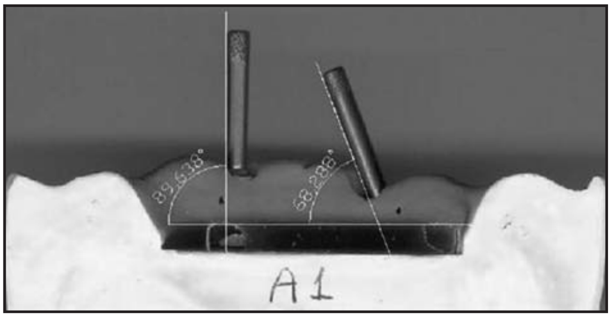

Fig. 5: Implants/analogs inclination measurement by a software program (AutoCAD 2005).

replica and to the metallic matrix with a titanium screw tightened by a 10N/cm torque driver (Conexão Systems of Prosthesis, Sao Paulo, SP, Brazil). First, the framework was attached to the perpendicular analog to perform the misfit measurement in both analogs (perpendicular and leaning) and then attached to the leaning analog for the same evaluation.

The gap created between the framework and each implant/analog, in µm, was analyzed by LEICA QWin software (Leica Imaging Systems Ltd., Cambridge, UK) that received the images from a video camera (TK-C1380; JVC, Japan) coupled to a LEICA microscope (LEICA, Germany) (Fig. 4). Each measurement performed in each implant/analog was repeated three times.

Implants/analogs inclination measurement: The metallic matrix and the replicas, adapted to coping screws, were scanned (HP scanjet 2400, Hewlett-Packard Company, Palo Alto, CA, USA) and the images were transferred on line to the image analysis software (AutoCAD 2005, Autodesk Inc., San Rafael, CA, USA). The implant/analog inclinations were determined in relation to the upper edge of a glass plate fixed on the scanner lens to standardize the position of the replicas and the matrix, using the dimension angular tool (Fig. 5). Each implant/analog inclination measurement was repeated three times.

RESULTS

After measurement of vertical misfit between the framework and the implants/analogs, analysis of the data by ANOVA demonstrated significant differences among groups (p=0.00001), among readings performed in each implant/analog (p=0.00028) and among retention screw localizations (p=0.00743), both with individual analysis and considering interactions among these factors (Table 1).

Tukey's test revealed significant differences between control (group M) and experimental (groups CP and EP) groups. No significant difference was observed between the experimental groups (Table 2).

However, there was no significant difference among the three groups (groups CP, EP and M) when the readings were performed in the same implants/analogs that received the retention screw.

Tukey's test showed significant differences among the three groups (groups CP, EP and M) when the reading

Table 1: ANOVA for vertical misfit.

Source	*df*	Sum of squares	Mean square	F	P
Groups	2	56118.5100	28059.2550	17.3034	.00001
Reading site	1	26347.8825	26347.8825	16.2481	.00028
Screw site	1	12069.0952	12069.0952	7.4427	.00743
Group*Reading	2	43603.9071	21801.9535	13.4447	.00005
Group*Screw	2	14230.9937	7115.4968	4.3879	.01451
Reading*Screw	1	29026.5632	29026.5632	17.9000	.00017
Gr*Read*Scr	2	16379.4411	8189.7205	5.0504	.00816
Residue	108	175132.7541	1621.5996		
Total	*119*	*372909.1468*			

was performed in the perpendicular implant/analog with the retention screw in the leaning implant/analog (Table 3).

However, when the reading was performed in the leaning implant/analog with the retention screw in the perpendicular implant/analog, Tukey's test revealed significant difference between EP and M groups and no significant difference with the CP group (Table 4).

Considering implants/analogs inclination measurement, ANOVA revealed significant difference (p=0.00010) among the groups for leaning implant/analog readings (Table 5) but no statistically significant difference among the groups (p=0.73619) for perpendicular implant/analog readings.

Tukey's test revealed significant difference between control (group M) and experimental groups (groups CP and EP), and no significant difference between the experimental groups (Table 6).

DISCUSSION

The plaster expansion that occurs following plaster setting can result in analog movement inside impression, followed by prosthetic misfit. Within this context, this study evaluated a two-step plaster pouring technique that involves placing analogs in latex tubes to create a reduced space around the analogs and reduce the expansion effect. Similarly, Mc Cartney and Pearson[14] described a technique to create space around the analogs with silicone, allowing the correction of the position of the analogs after evaluation of superstructure fit.

The measurement of the vertical misfit between implants/analogs and the framework showed similar means for the different groups when the misfit was evaluated at the same implant/analog that received the retention screw. This result suggests that screw tightening, regardless of the pouring technique, disguises the misfit between the superstructure and the implant. This may result in tension that damages the treatment's long-term success. The control group revealed gaps between the framework and the implants when the reading was carried out at the implant that did not receive the retention screw, suggesting that the passive fit shown by macroscopic examination may be false.

None of the pouring techniques resulted in casts with vertical fit similar to that of a metallic matrix when the retention screw was in the leaning analog and the reading was carried out in the perpendicular analog (Table 3). This difference is probably associated to the plaster expansion effect, which was more evident with the conventional technique. Similar findings were reported by Vigolo and Millstein[13], and Wee et al.[15]

Table 2: Tukey's test for vertical misfit means, regardless of retention screw site and reading site.

Group	Means	5% *
Group CP	67.3143	a
Group EP	49.9377	a
Group M	15.2903	b

* Means followed by the same letter in the next column do not differ statistically (p>.05).

Table 3: Tukey's test for vertical misfit means when reading was performed in perpendicular implant/ analog with retention screw in leaning implant/ analog.

Group	Means	5% *
Group CP	162.5000	a
Group EP	75.4920	b
Group M	15.7480	c

* Means followed by the same letter in the next column do not differ statistically (p>.05).

Table 4: Tukey's test for vertical misfit means when reading was performed in leaning implant/analog with retention screw in perpendicular implant/ analog.

Group	Means	5% *
Group CP	61.0300	a
Group EP	28.6760	ab
Group M	14.9550	b

* Means followed by the same letter in the next column do not differ statistically (p>.05).

Table 5: ANOVA for implants/analogs inclination considering the leaning implant/analog reading.

Source	*df*	Sum of squares	Mean square	F	P
Groups	2	3.4721	1.7361	15.9304	.00010
Residue	27	2.9424	0.1090		
Total	29	6.4145			

Table 6: Tukey's test for inclination means for leaning implant/analog readings.

Group	Means	5% *
Group CP	69.9290	a
Group EP	69.2300	b
Group M	69.1870	b

* Means followed by the same letter in the next column do not differ statistically (p>.05).

who prefixed the positions of the analogs to avoid distortion caused by plaster expansion. However, when the retention screw was in the perpendicular analog and the reading was performed in the leaning analog, only the casts obtained by the two-step pouring technique were different from the metallic matrix. Larger alterations in the inclination of the leaning analogs were observed in this group. For this technique, the interval required between the first and the second pouring was longer. Two hours elapsed between the impression/matrix separation and the pouring of plaster around the analogs. During this time, the analogs may have moved inside the impression.

Although the technique may be easily carried out, the latex tube around the analogs represents a visual barrier during the adaptation of the analogs to the copings that must be overcome by the operator.

Considering the inclination measurement for leaning analogs, none of the experimental groups were similar to the control group (Table 6). This finding is in agreement with Assunção et al.[12] who showed that perpendicular implants generate more accurate casts. Thus, data suggest that cast accuracy depends not only on the pouring technique, but also on implant inclination, and further investigation of clinical methods is required to evaluate the fit between implants and superstructure.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

- Both experimental groups exhibited similar results to the control group when vertical misfit was evaluated in the analogs that received the retention screw.
- Both experimental groups revealed significant differences with the control group when the vertical misfit was measured in the analogs that did not receive the retention screw, except for group CP when the reading was performed in the leaning analog and the retention screw was in the perpendicular analog.
- Perpendicular implants produced more accurate casts than leaning implants, regardless of the pouring technique.

ACKNOWLEDGMENT

This study was supported by Foundation of Support to Research from State of São Paulo (FAPESP – 05/54518-4)/Brazil.

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