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Original article

Comparison of the accuracy for three dental impression techniques and index: An in vitro study

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Abstract

Objectives: This in vitro study compared the dimensional accuracy of stone index (I) and three impression techniques: tapered impression copings (T), squared impression copings (S) and modified squared impression copings (MS) for implant-supported prostheses.
Methods: A master cast, with four parallel implant abutment analogs and a passive framework, were fabricated. Vinyl polysiloxane impression material was used for all impressions with two metal stock trays (open and closed tray). Four groups (I, T, S and MS) were tested ($n = 5$). A metallic framework was seated on each of the casts, one abutment screw was tightened, and the gap between the analog of implant and the framework was measured with a stereomicroscope. The groups' measurements (80 gap values) were analyzed using software (LeicaQWin – Leica Imaging Systems Ltd.) that received the images of a video camera coupled to a Leica stereomicroscope at 100× magnification. The results were statistically analyzed with Kruskal–Wallis One Way ANOVA on Ranks test followed by Dunn's Method, 0.05.
Results: The mean values of abutment/framework interface gaps were: Master Cast = 32 μm (SD 2); Group I = 45 μm (SD 3); Group T = 78 μm (SD 25); Group S = 134 μm (SD 30); Group MS = 143 μm (SD 27). No significant difference was detected among Index and Master Cast ($P = .05$).
Conclusion: Under the limitations of this study, it could be suggested that a more accurate working cast is possible using tapered impression copings techniques and stone index.

Keywords: Dental implant; Impression technique; Transfer coping; Impression material

1. Introduction

One of the main interests in implant-supported prosthesis is the production of structures that show passive fit when connected with multiples implants. This standard of fit is required because of the unique quality of the implant–bone relationship [1]. The natural tooth can move up to 100 μm within its periodontal ligament, thus compensating for a certain degree of misfit of a fixed partial denture, whereas an osseointegrated implant has extremely limited movement in the range of 10 μm [2]. The lack of intrusion movement of the implant allows the forces introduced into an implant-supported restoration to produce a misfit in the prosthesis. If these forces are not relieved, problems such as screw loosening screw fracture implant fracture, and occlusal inaccuracy may arise. Thus, this lack of flexibility of the implants should be compensated for the correct fit between the prosthetic components obtained by the production of an accurate impression [3].

An accurate impression affects the accuracy of the definitive cast, and this is essential to fabricating prosthesis with a good fit. A successful working cast is dependent on the type of impression material and implants transfer technique [4–6]. Dullabh and Sykes [7] reported that two of main factors that appear to be significant for passive fit are: impression material

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and the impression technique [7]. In accordance with McCabe and Store [8], dimensional alterations occur for various reasons: loss of alcohol in the condensation of silicones, loss of volatile substantiate in the polysulfide and water absorption in polyether [8]. Vinyl polysiloxane impression material transfers the spatial orientation of implants with equal precision when compared with polyether materials. This occurs because the vinyl polysiloxane presents lower modulus of elasticity and reduces the permanent deformation caused by stress between the impression material and the copings [9].

Implant transference techniques have a decisive influence in the manufacturing of casts and the optimal functioning of the prosthesis. Several studies investigated the variables affecting the accuracy of transfer procedures in implant prosthodontics. Among then, it is possible detach: Pick-up technique or transfer techniques, the use of different impression materials, splinting or surface treatment of transfer copings, the relative implant angulations, the die material accuracy, and master cast manufacturing [1,6,7,9,10].

There is still no consensus among researchers in regards to the best impression techniques for implants. Thus, the aim of the present study was analyzed the accuracy of three different impression techniques: tapered, square and modified squared impression coping with the master cast (control group) for prosthesis implant-supported and determines which of the techniques offer greater passivity with greater clinical viability. At the same time, this study compared the results of these techniques with the index because the index is considered to be the best technique to reproduce the positioning of the implants. For this, all the procedures were done using manual mixing and conventional pouring to simulate routine clinical situations. The null hypothesis was that there would be no significant difference in the accuracy of casts generated with different impression techniques.

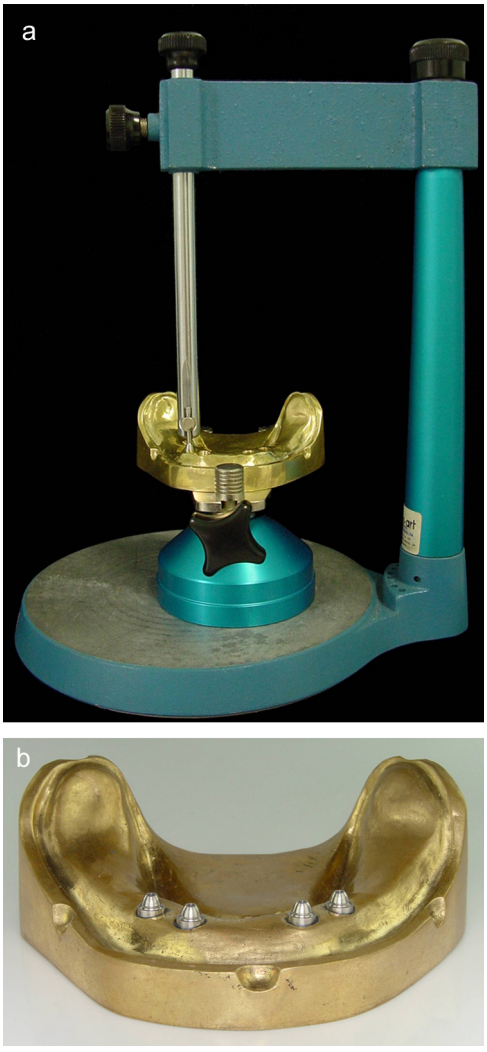

Fig. 1. Installation of the four parallel implant analogs with Duraley resin on master cast: (a) delineator confirming the parallelism between the implants analogs; (b) analogs fixed with Duraley resin.

2. Materials and methods

2.1. Obtaining the master cast

A brass mandibular edentulous cast was fabricated to simulate a clinically relevant situation (*Master Cast – control group*). Four parallel abutment analogs (Micro-Unit Abutment; Conexão Sistema de Prótese, São Paulo, São Paulo – Brazil) were installed with Duralay resin to make their removal possible after making the framework (Fig. 1a and b). A framework was compost of titanium cylinders and 2 mm diameter titanium bars (Conexão; Conexão Prosthesis Systems, São Paulo, São Paulo – Brazil) using a laser welding technique for allowing passive fit between the prosthetics components. After fabrication of the framework, the Duralay resin and the original analogs were removed and discarded. Four new analogs were screwed to the framework with the aid of a calibrated torque wrench (Conexão; Conexão Prothesis Systems Ltd., São Paulo, São Paulo – Brazil) limited to 10 N cm and then embedded into the master cast holes with epoxy resin GY 1109/943 (Huntsman Química Brasil Ltda, São Paulo, São Paulo – Brasil) [10–13]. The framework was removed from the master cast only after the polymerization of the epoxy resin was complete. As a result, the discrepancies due to the welding procedure were eliminated almost entirely and a metal master cast with a passively fitting framework was produced [10–15].

2.2. Study variables

For this study, four groups with sample size of five casts for each group ($n = 5$) were evaluated:

- Index

  Group I: In*dex group* – Squared Splinted Impression Copings. The splinting process was initiated by placing light-polymerized composite resin (Z100; 3 M ESPE) around the squared copings (Conexão; Conexão Prosthesis Systems, São Paulo, São Paulo – Brazil). Performed composite resin bars with a cross-sectional diameter of approximately 3 mm were fabricated by the injection of composite resin into a drinking straw [17]. Appropriate