MARGINAL FIT ANALYSIS OF PREMACHINED AND CASTABLE UCLA ABUTMENTS

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ABSTRACT
This study evaluated the fit between implants and premachined and castable UCLA abutments. All plastic specimens were cast using the conventional technique in accordance with the manufacturer’s instructions. Five specimens of each experimental group were measured for vertical and horizontal gaps by scanning electronic microscopy (Phillips XL 30 model, Holland). Gold UCLA (vertical gap: 2.15 µm, horizontal gap: 11.30 µm) and castable rotational UCLA (vertical gap: 14.91 µm, horizontal gap: 59.41 µm) groups showed the lowest and highest mean values, respectively (Neodent, Curitiba, Parana, Brazil). In general, the castable UCLA abutments showed poorer marginal fit than the premachined abutments.

Key words: dental implants, abutments, marginal fit.

ANÁLISE DA ADAPTAÇÃO MARGINAL DE PILARES UCLA FUNDIDOS E USINADOS

RESUMEN
Este estudio evalúo la adaptación entre implantes y pilares UCLA usinados y fundidos. Todos los corpos de prueba de plástico fueron fundidos usando técnica de fundición convencional de acuerdo con el fabricante. Cinco corpos de prueba fueron evaluados en relación a la desadaptación vertical y horizontal utilizando un Microscopio Eletrónico de Varredura. Os grupos UCLA Ouro (desadaptação vertical: 2.15 µm, horizontal: 11.30 µm) e UCLA rotacional fundido (desadaptação vertical: 14.91 µm, horizontal: 59.41 µm) mostraram as médias mais baixas e mais altas, respectivamente. De uma maneira geral, os pilares UCLA fundidos mostraram adaptação menor do que os pilares UCLA usinados.

Palavras-chave: implantes dentários, pilares, adaptação marginal.

INTRODUCTION
Castable abutments were introduced as an alternative to the premachined abutments to allow prosthetic restoration of poorly fitting fixtures with little interocclusal space, as well as to simplify restoration. In 1988, Beumer and Lewis developed a castable abutment, which would be connected directly to the implant, after casting. However when this castable abutment is cast, distortions inherent to the casting process occur. These distortions can cause a greater crown misfit, leading to peri-implantitis1,2.

To reduce the distortion in abutment casting, UCLA type abutments were developed with premachined bases of noble or semi-noble alloys. These abutments are overcast with a metal alloy compatible with that of the abutment base, thus not altering the premachined base3. Therefore, marginal fit could be improved, since the passive fit of prosthetic components on implants is affected by the material and its manufacturing process4. Moreover, the imprecise fit of combined components could influence the prognosis of implant success, as lack of precise and passive fit can generate stresses that may lead to mechanical and biological complications, such as loss of screws, loosening, and eventually, implant fractures5,6. When fit is close to ideal, it generates greater stability of the screwed denture system, maintaining the torque and fit for a longer time, preventing early loss of preload, guaranteeing not only the micromechanical stability of the system but also peri-implant tissue health and osseointegration7-10.

The concept of fit in implant supported prosthesis is a controversial subject. There is still no consensus about the acceptable value of vertical gap and...
horizontal discrepancy, and the best method for verifying this misfit and its clinical implication\textsuperscript{11}. In the literature an acceptable standard for misfit with values around 10 micrometers is mentioned\textsuperscript{1}. For clinical evaluation of marginal gaps, radiography is the most used method; however, this analysis may lead to a very subjective interpretation due to the difficulties involved in obtaining a standard image\textsuperscript{12}. Therefore, the aim of the present study was to evaluate the vertical and horizontal marginal fit of premachined and castable UCLA type abutments on implants of the same system, using scanning electron microscopy (SEM). This study uses a null hypothesis: the use of premachined or castable UCLA type abutments does not modify the marginal gap measurements.

MATERIALS AND METHODS
For this study implants and abutments of a commercial implant system (Neodent, Curitiba, Parana, Brazil), with external hexagon 3.75 mm in diameter and platform of 4.1mm were used. For each experimental group five specimens of each type of abutment were used: UCLA castable abutments, rotational, UCLA castable abutments, rotational with internal rectification, UCLA castable abutments, anti-rotation, UCLA premachined titanium abutments, UCLA type abutments with premachined Tilite base, UCLA Noble abutments, and custom-made stub type abutments. The castable abutments were cast by the conventional lost-wax technique\textsuperscript{13} in Nickel-Chrome (Verabond II, AALBA Dent Inc, Cordelia, CA, USA) in accordance with the manufacturer’s recommendations. After casting, the specimens were cleaned internally; followed by airborne particle abrasion with aluminum oxide granulation of 100 micrometers under pressure of 5 kg/cm\textsuperscript{2}, protecting the abutment cervicals with implant analogs. All the components were cleaned ultrasonically in an acetone bath before marginal fit assessment.

Marginal fit measurement
Marginal fit was evaluated by measuring the vertical gap and horizontal discrepancy (in micrometers) between implant and abutment, using SEM (Phillips XL 30 model, Holland)\textsuperscript{14} (Fig. 1).

The UCLA abutment was connected to the implant with a titanium screw under torque of 10N\textsuperscript{15} with a manual torque meter (Neodent S.A., Curitiba, Paraná, Brazil). The vertical gap of each set was measured at three points: two points at the extremity and one central point. Four opposite implant faces were assessed and marked to obtain 12 standard measurements. Horizontal discrepancy was measured at two points of each of the four faces evaluated, originating eight measurements per component evaluated. Arithmetic means of the vertical gap and horizontal discrepancy values were obtained for each specimen.

The group of UCLA cast rotational abutments was analyzed first, soon after they were cast, and conventionally finished. Next, the internal surfaces of the abutments were rectified. Standardized rotational movements were made six times with a rectifier appliance (Conexão Sistemas de Próteses, São Paulo, SP, Brazil), alternating 10 clockwise movements with 10 anticlockwise movements. After rectification, the abutments were again connected to the implant to measure marginal fit.

The vertical gap and horizontal discrepancy data in micrometers were evaluated by the ANOVA and Tukey tests at a 5% level of significance.

RESULTS
Comparison of the mean vertical gap and horizontal discrepancy values among the experimental groups is shown in Table 1 and Fig. 2. The highest values were found in the group of UCLA type castable abutments, both for vertical gap and horizontal discrepancy. Rectification of the rotational castable abutment reduced the vertical gap, but not the horizontal discrepancy. The lowest vertical gap and horizontal discrepancy values were observed with UCLA Gold and UCLA Tilite abutments. (Table 1, 2 and 3, Fig. 2).
DISCUSSION
The success and popularity of the implant system designed by Brånemark\textsuperscript{16-19}, encouraged the appearance of alternative implant systems, which are compatible and interchangeable with the original Brånemark system\textsuperscript{19}. These implants and components are an attractive clinical alternative, as they have a lower cost, a larger range of restorative options and components are readily available commercially. With regard to the UCLA type abutments, alterations were introduced in the technical laboratory protocol of the castable UCLA pillars with premachined bases of noble or semi-noble alloys to improve fit between the implant and abutment.

This study showed that the experimental groups presented significant differences in vertical gap and horizontal discrepancy. The components with premachined bases, UCLA Noble, UCLA Tilite, Custom-made Stub and UCLA Titanium, presented better fit with regard to vertical gap, corroborating previous findings\textsuperscript{21}. The Custom-made Stub and UCLA Titanium groups did not differ, but presented worse fit than the UCLA Noble and Tilite groups.

The cast UCLA castable abutments presented the highest vertical gap and horizontal discrepancy values. Components whose complete structure is exposed
to the casting process tend to be more technique-laboratory sensitive: casting shrinkage, inclusion technique, casting method, type of lining used and type of dental alloy used. The internal rectification procedure was shown to improve the fit of completely castable components. However, the UCLA Noble and Tilite components were shown to be a superior alternative with regard to the pattern of fit.

The better fit of the UCLA Titanium component in comparison with the completely castable groups is noteworthy, as the main indication of the UCLA Titanium component is for the provisional stage of implant work, while the completely castable components are indicated for definitive work. Noble alloy-based materials thus showed that not only do they provide better fit of components on implants, but as a result of this superior compatibility, they also maintain the long term integrity of peri-implant tissues and osseointegration

The in vitro nature of this study precludes the extrapolation of results directly to the clinical field. It is therefore suggested that future longitudinal clinical studies be conducted on these components to confirm their clinical applicability, material longevity and health of the peri-implant tissue.

**CONCLUSION**

Within the limitations of this study, it could be concluded that:

1. The null hypothesis was rejected;
2. The components with premachined bases presented better fit than the cast components;
3. Internal rectification of the cast abutments produced a partial improvement in the fit of components;
4. The UCLA Tilite component showed fit values close to those of UCLA Noble, demonstrating that it was an alternative that promotes a more favorable connection in comparison with the completely castable components, whose compatibility and pattern of fit were shown to be inferior.

**REFERENCES**

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5. The components with premachined bases presented better fit than the cast components, whose compatibility and pattern of fit were shown to be inferior.