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Microscopic evaluation of implant platform adaptation with UCLA-type abutments: in vitro study

Avaliação microscópica da adaptação da plataforma do implante com pilares protéticos do padrão UCLA: estudo in vitro

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Resumo

Introdução: O ajuste entre a prótese e o implante é fundamental para determinar a longevidade do tratamento e manutenção do osso periimplantar. **Objetivo:** Avaliar o desajuste vertical entre diferentes infraestruturas metálicas e plataforma dos implantes, a fim de fornecer informação, para auxiliar na escolha do metal a ser utilizado. **Material e método:** O estudo utilizou componentes do tipo UCLA (N=40), com antirrotacional, foram divididos da seguinte forma: componentes usinados em titânio (n=10), componentes fundidos em titânio (n=10), níquel-cromo-titânio-molibdênio (n=10) e em níquel-cromo (n=10). Após o torque, as amostras foram analisados em estereomicroscópio. Para caracterização em MEV, foram utilizadas as amostras mais representativas, com maior e menor desajuste vertical. **Resultado:** Os dados foram analisados por média e desvio padrão e submetidos ao teste ANOVA ONE way, onde os grupos foram estatisticamente diferentes (p=<0,05), seguido do teste TUKEY. **Conclusão:** A escolha do infraestrutura influencia no valor do desajuste vertical, sendo que o grupo usinado em Ti apresentou o menor valor de desajuste, e o grupo fundido em Ni Cr o grupo com maior valor de desajuste vertical.

Descritores: Prótese dentária; implante dentário.

Abstract

Introduction: The fit between abutment and implant is crucial to determine the longevity of implant-supported prostheses and the maintenance of peri-implant bones. **Objective:** To evaluate the vertical misfit between different abutments in order to provide information to assist abutment selection. **Material and method:** UCLA components (N=40) with anti-rotational system were divided as follows: components usinated in titanium (n=10) and plastic components cast proportionally in titanium (n=10), nickel-chromium-titanium-molybdenum (n=10) and nickel-chromium (n=10) alloys. All components were submitted to stereomicroscope analysis and were randomly selected for characterization by SEM. **Result**: Data were analyzed using mean and standard deviation and subjected to ANOVA-one way, where the groups proved to statistically different (p=<0.05), followed by Tukey's test. **Conclusion:** The selection of material influences the value of vertical misfit. The group machined in Ti showed the lowest value while the group cast in Ni Cr showed the highest value of vertical misfit.

Descriptors: Dental prosthesis; dental implant.

INTRODUCTION

Longevity of implant prostheses mainly depends on passive seating and accurate fit of the base of the implant and of the pillar abutment[1], factors desired by every professional who performs prosthesis implants. Passive seating results in proper dissipation of tension, as the lack of adaptation may lead to screw fracture[2,3]. Complications such as fracture or loss of function of screws and prosthesis are regularly associated with non-compliance with the aforementioned requirements. There are no clinical longitudinal studies demonstrating that the loss of screws can be attributed to misfit at abutment-implant interface[4]. The abutment-implant misfit does not influence the loss of screw torque[5,6], but the advance in this misfit results in increasingly higher stress over prosthetic structures, abutment screws and peri-implant bone tissue[7].

A prefabricated plastic cylinder named UCLA pillar has been designed with the purpose of correcting interocclusal situations where space is insufficient for receiving conventional prosthetic components[8]. The UCLA pillar adapts to implant module edges[9] so as to emerge directly on the soft tissues, improving the aesthetics associated with the correction of angulation problems.

Regardless the method used to obtain the metallic infrastructure of implant supported prostheses, totally passive prosthetic structures do not exist until present[10], and this can cause problems such as loosening or fracture of prosthetic screws[11] in the case of oral spaces.

The purpose of our study was to compare the accuracy of fit between metal infrastructures usinated in titanium, cast in titanium, nickel-titanium-chromium-molybdenum and in nickel-chromium, in order to help professionals in the choice of material for prosthesis preparation.

MATERIAL AND METHOD

The study used UCLA type components (AS Technology) with anti-rotation (N = 40), divided as follows: titanium usinated components (UT) (n = 10), plastic components cast in: titanium (CT) (n = 10); nickel-chromium-titanium-molybdenum (FNC MT) (n = 10) and nickel-chromium (FNC) (n = 10).

The use of the respective covers followed the recommendations of the manufacturer with mechanical tooling (4 Multivac, Degussa AG - Hanau - Germany). Plastic hoods were gently stroked in the inner portion and the remaining cover was used to fill the ring, with moderate vibration.

For casting commercially pure titanium ingots, material was processed in a Rematitan-Dentaurum machine. A conventional centrifuge, whose heat source was a gas-oxygen blowtorch, was used for both, nickel-chromium-molybdenum-titanium and nickel-chromium.

After obtaining the infrastructure, all items were blasted with aluminum oxide 50um as recommended by the manufacturer.

A usinated stainless steel hexagonal platform with a central hole (Figure 1) was used and an implant of 15 × 4.1 mm and 0.7 mm in height of the external hexagon was adapted to it. The implant was fixed by a perpendicular side screw that prevents movement.

Figure 1. Hexagonal Platform usinated in stainless steel.

After fixing the implant, each metal infrastructure was individually installed with a 20 N cm torque using a manual torque wrench (Figure 2). Specimens were subjected to analysis under stereomicroscope (Discovery V20, Zeiss, Germany) at 100x magnification. Ten measurements of the infrastructure/implant interface were made on each side of the hexagonal base. Six hundred measurements were obtained for each group, and thus a total of 3600 results were collected. To avoid discrepancies, a single examiner was trained to collect this data.

The scale used was micrometers. UTHSCSA IMAGE TOOL software was used to treat the images obtained. One specimen of the most discrepant groups was selected for preparation of the representative picture (Figure 3) in a scanning electron microscope (Inspect S50, FEI Company, Brno, Czech Republic).

For statistical analysis, the mean of measurements of each group (mean in μm) was calculated. Descriptive statistics consisted of calculating the mean and standard deviation, followed by analysis of variance ANOVA 1 factor and Tukey test.

RESULT

Table 1 shows values in μm, means and standard deviations of the vertical discrepancy between the prosthetic infrastructure and the implant interface. Results were submitted to analysis of variance ANOVA ($p<0.05$) and Tukey test.

DISCUSSION

The relationship of passive seating between module edges and the prosthesis is critical for longevity of the treatment[3,9]. It is clear from the very conception that the adjustment between cast prosthetic components and the implant interface presents less passive seating and, consequently, lower accuracy of fit when compared to usinated components[12]. It is noteworthy that laboratory steps can lead to misfits in such interface when UCLA type pillars are used[13]. We believe that the term calcinable does not apply correctly in this case because this term means something that can turn into lime by the action of heat.

The vast majority of prosthetic components is machined or usinated in order to ensure tight contact, although there is always a machining tolerance between the connected structures. Machined or usinated tolerance has been defined as the difference of horizontal

Table 1. Means and standard deviation for all groups

Groups	N	Mean	Sta. Dev.	Tukey's Test
Ni Cr	10	24.80	3.31	A
Ni Cr Mo Ti	10	24.39	1.0	A
Ti	10	16	7.0	B
Usinated Ti	10	10.09	3.74	C

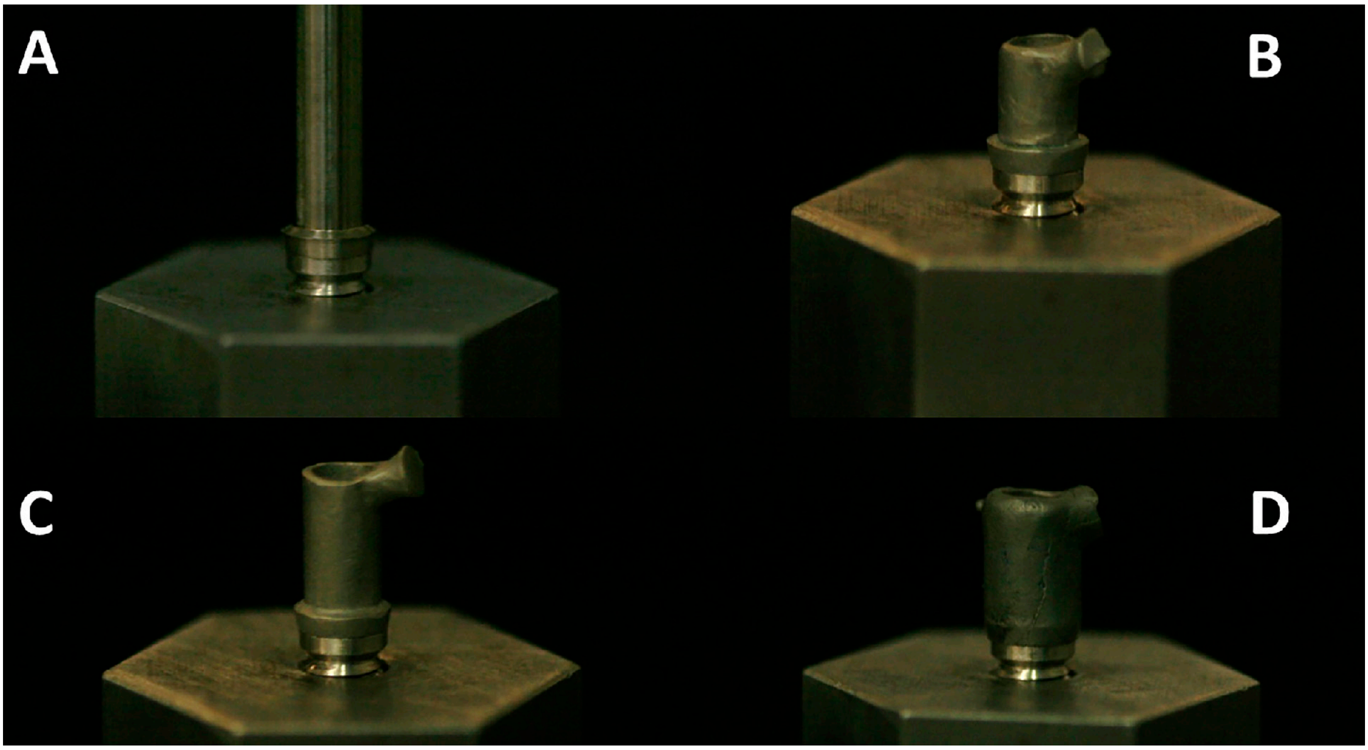

Figure 2. Components attached to the hexagonal platform in stainless steel. From left to right and top to bottom: **(A)** U-Ti Group - usinated in titanium; **(B)** F-NiCrTi Group - fused in nickel-chromium-titanium-molybdenum; **(C)** F-NiCr Group - fused in nickel-chromium; **(D)** F-Ti Group – fused in titanium.

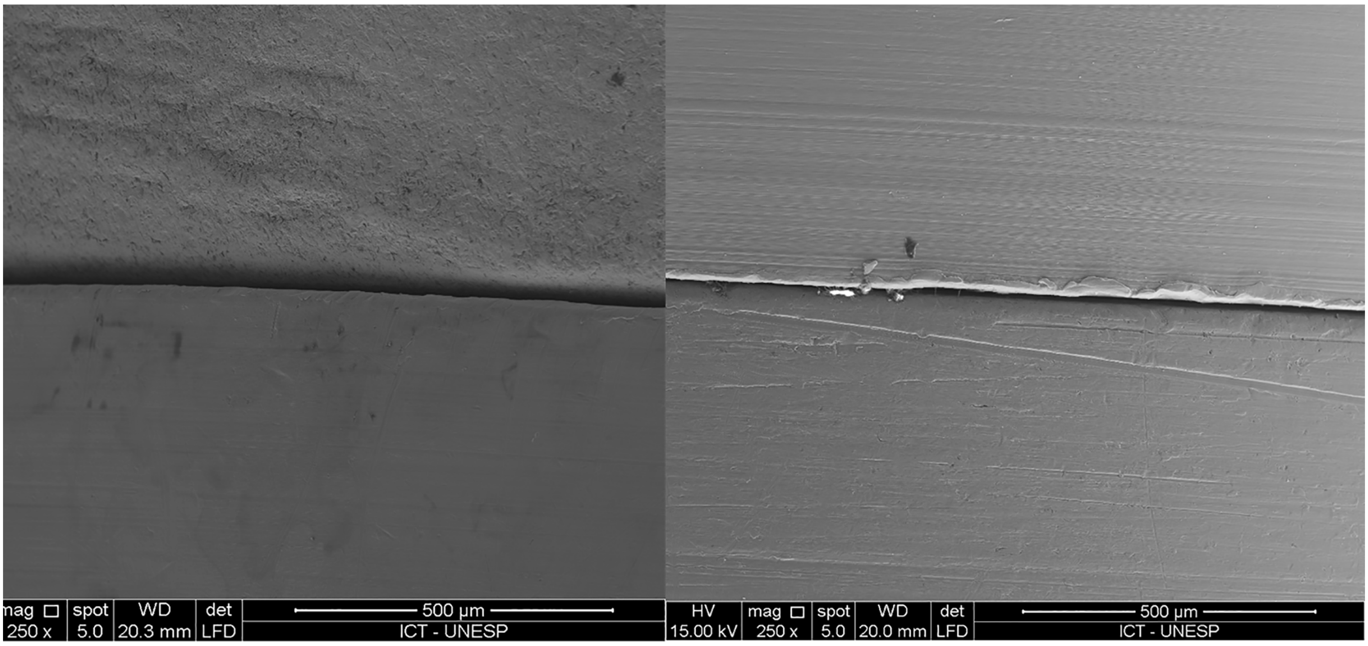

Figure 3. Scanning electron microscopy image, left image: base of the implant and metal pillar fused in NiCr, right picture: base of the implant and abutment in usinated titanium.

movement between components when they are in position with their respective screws[14].

Two factors may contribute to this tolerance: dimensional discrepancy (how much the machined component may vary from its “exact” sizing) and surface roughness (how much the machined component affects the accuracy of contact between surfaces). Proper seating of prosthetic components seems to influence the mechanical performance of the whole set[15]. Therefore, there is a concern regarding the quality of machined components and the degree of tolerance. Some professionals prudently require that implants and abutments belong to the same manufacturer in order to avoid combinations.

The choice for alternative alloys is explained by the high commercial value and, especially, because this is the safest option to be used in university outpatient units.

Lack of passivity due to marginal misfit may lead the system to become overloaded. If the maximum resistance of the screw is reached, fracture may happen[11]. The maximum misfit level accepted for an implant-retained fixed prosthesis is 150 μm[16,17]. Solá-Ruíz et al.[18] tested twenty-five different commercial combinations between implant/prosthetic infrastructure and obtained a total of 600 measurements of vertical misfit, but seating was observed to be within clinically acceptable limits in all cases, as it was also the case in our study.

The number of measurements obtained in the present study should be highlighted, as it represents a unique differential factor in relation to other researches[17-20].

CONCLUSION

The choice of material for the preparation of the metallic infrastructure influences the value of vertical misfit, and the group machined in Ti showed the lowest value while the group cast in Ni Cr showed the highest value of vertical misfit.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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