ABSTRACT

Introduction: Non-metallic alternatives are being explored to check for alternatives in the double-crown-retained maxillary overdentures on implants. Hence in the present study we aim to evaluate the change in the retention of metallic and non-metallic combinations for double-crown-retained maxillary overdentures on implants.

Material and Methods: We tested zirconia abutments/PEEK framework (ZP), PEEK abutments/PEEK frame-work (PP), titanium abutments/PEEK framework (TP), titanium abutments/CoCr framework (TC), and titanium abutments/gold copings/cobalt-chromium framework as the control group (TG) with wet condition using a chewing simulator initially, and then at 100, 200, 500, 1,000, 2,000, 3,000, 5,000, 8,000, and 10,000 insertion/separation cycles and compared.

Results: The change in the retention after 10,000 cycles was not statistically significant within groups ZP and TG. For groups PP and TP, there was a slight increase in retention with partial significance. The retention of group TC showed fluctuation with a partially significant decrease in retention.

Conclusions: The use of novel metallic and non-metallic combinations in the construction of double-crown-retained maxillary overdentures on implants resulted in acceptable levels of retention and might be recommended for clinical application.

Key words: Retained Maxillary Overdentures, Double Crown, Implants

I. INTRODUCTION

Double-crown attachments have the benefit of giving good retention and stability with satisfactory mastication and acceptable phonetics. In spite these advantages, double-crown-retained removable prosthesis making is laborious, technically sensitive, and expensive and there is a likelihood of losing retention over time due to the mechanical wear of the abutments and copings [1].
The retention of double-crown-retained prostheses varies according to different crown tapers, heights, used materials and the friction among the axial walls of the inner and outer crowns [2]. Zirconia is a non-corrosive metal, its color take after the color of teeth, and it has superior biocompatibility compared to gold. In a clinical study, the 3-year survival of zirconia/electroplated double-crown retained removable prostheses was alike to cast cobalt-chromium/electroplated double-crown retained removable prostheses [1,3].

Polyetheretherketone (PEEK) is a semi-crystalline thermoplastic polymer with good mechanical charachters. PEEK implant abutments showed equal or lower values of biofilm formation compared to abutments made of zirconia or titanium [4]. The alternative materials for double-crowns include other metals such as base metal alloys and titanium. Non-metallic alternatives comprise zirconia, polyoxymethelyene (POM), polyetheretherketone (PEEK) or polyetherketoneketone (PEKK). Though, information on the retention durability for these alternative materials for double crowns is not existing [5]. Hence in the present study we aim to evaluate the change in the retention of metallic and non-metallic combinations for double-crown-retained maxillary overdentures on implants.

II. MATERIALS AND METHODS

We conducted an invitro study, using the cylindrical bases that were arranged in an arch simulating the jaw. We used 4 implants, 12 mm in length, 3.5 mm in diameter for the lateral incisors, and 4 mm in diameter for the premolars Retentive holes were prepared within the PVC bases by a round bur before inserting the BisGMA.

We compared 10 specimens Group ZP; zirconia abutments/PEEK framework (ZP), PEEK abutments/PEEK frame-work (PP), titanium abutments/PEEK framework (TP), titanium abutments/CoCr framework (TC), and titanium abutments/gold copings/cobalt-chromium framework as the control group (TG). The abutments were designed as conical crowns with 1° taper.

A universal testing machine was used to measure the retention of the PEEK frame-works for each testing group.

In the chewing simulator device all samples were exposed to 10,000 insertion/separation cycles. The data was tabularized and statistically analyzed after 0, 100, 200, 300, 400, 500, 1000, 2000, 3000, 5000, 8000, 10,000 cycles and the retention of the specimens were analyzed. The observations that obtained were compared keeping the $p \leq 0.05$ as Statistical significant.

III. RESULTS

We observed that after 10,000 insertion/separation cycles, the median retention ranged from 10.3 to 35.0 N. The retention forces after 10,000 insertion/separation cycles was not statistically significant within ZP and TG groups ($p > 0.05$). However, within groups PP and TP there was a slight initial increase in retention, which was partially significant at the first 1000 cycles ($p \leq 0.05$). Only within group TC, the retention showed fluctuation at the beginning, followed by partially significant continuous decrease of retention. Table 1

Hence, the median retention force of group ZP was significantly higher than that of groups PP, TP and TG.

Table 1: Comparison of the various groups.
IV. DISCUSSION

In the current study, the production and the finishing process were standardized as much as possible. Furthermore, the PEEK frameworks were tested in the universal testing machine to ensure similarity of the initial retention value among the eight specimens of each test group.

A direct relationship between the retention of the prosthesis and the patient satisfaction was reported [10]. The electroformed control group (TG) showed lower retention than the other groups. This difference could be attributed to the production process, as the direct construction of gold crowns by the electroforming process established an optimal fitting [6]. Likewise, the electroforming process achieves a smooth internal coping surface and does not require any manual adjustment. PEEK retention was higher than that of the TG group. Furthermore, secondary cast crowns (telescopic and conical) mainly adhere through friction and wedging, whereas galvanic crowns basically adhere by hydraulic adhesion [10]. It can be recognized that the variation in the values is not only material dependent, but also strongly influenced by the manufacturing techniques [8]. An upsurge in the retention force was noticed to be dependent on the increase of the preload force of the double crowns with secondary cast crowns. Though, this effect was not observed for the double crowns with electroformed secondary crowns at preloads between 10 and 300 N [1-5]. All these factors may explain the difference in retention force between the control group TG and the other test groups in the present study.

The degree of wear may either decrease or increase as a result of the relative movement between the surfaces of the copings based on whether the elevated areas of the material are abraded and leveled, or other areas are broke. The following change of the retentive forces may decrease, remain unchanged, or even increase, as the surfaces at the wear tracks may interlock leading to an increase in the retentive force. Supplementary wear may occur and the firmly wedged contact would be replaced by a gap and the retentive force is abridged. Despite the fact that the manually produced copings were constructed by the same operator using identical methods, the behavior of the retentive force may still be unpredictable depending on the effect of wear [10]. A reduction in the retention force due to metal abrasion over long-term use was not observed in any of the specimens. Hence, the difference in material mechanical adaptation, finishing of the primary crowns, construction of the secondary crowns, different physical properties and wear of the different materials could clarify; the observed slight upsurge in retention in groups PP and TP, as well as the slight decrease observed in group TC, and the observed higher level of retention of group ZP in comparison to other groups. PEEK double crowns showed capable results compared to zirconia, titanium and electroformed gold materials. PEEK could be efficiently used as primary, secondary, or for both crowns. Nonetheless, these results should be measured as basic initial testing of the PEEK material in combination with approved materials, such as CoCr, ZrO2, and electroformed crowns [4].

V. CONCLUSION

Within the limitations of this laboratory study, the use of metallic and non-metallic combinations in the construction of double-crown-retained maxillary overdentures resulted in acceptable and reliable levels of
retention, which might be suitable for clinical application. Long-term clinical studies are required to support the use of PEEK for double crowns.

REFERENCES

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