Short Communication

In Vitro Wear of Different Material Combinations of Intracoronal Precision Attachments

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Purpose: This study examined the retentive forces of intracoronal precision attachments after wear cycling. ***Materials and Methods:*** Three material combinations of an intracoronal cylindric T-attachment were tested. A total of 10,000 separating and joining movements were performed, and retentive forces were measured. ***Results:*** Components made of gold alloy performed significantly better (P = .002) than other materials. The average proportional loss of retention was 90% for titanium and 47% for gold alloy components. ***Conclusion:*** Cyclic loading of metal precision attachment components results in loss of retention, which can be fully compensated by reactivating internal screws in the patrices. Machined, high-noble gold alloys show less wear than other materials. *Int J Prosthodont 2006;19:330–332.*

Attachment systems provide conventional treatment options for patients with a remaining anterior dentition and unilateral or bilateral edentulism.[1,2] While functional loads are dispersed in a favorable manner for the abutment teeth,[1,3] wear-induced loss of retention of matching attachment components plays a major role in the longevity of these restorations.

This study examined retentive forces of intracoronal precision attachments after wear cycling.[4] It was hypothesized that material properties have a direct influence on retentive forces after simulated wear. Another crucial aspect considered was the fabrication technique. It was presumed that prefabricated components would perform considerably better than cast components because of their homogenous surfaces.

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Materials and Methods

Three material combinations of the Duolock attachment system (ZL-Microdent) were investigated. The Duolock system includes an intracoronal, adjustable T-bar attachment with an activating screw in the patrix. Five sets of the 3 material combinations were examined in 6 test series each: *(1)* titanium matrix (Ti)/Ti patrix, *(2)* platinum-gold matrix (Pt-Au)/Au-Pt patrix (Au-Pt), *(3)* platinum-iridium matrix (Pt-Ir)/palladium-silver patrix (Pd-Ag). All components were prefabricated except for the Pt-Ir matrix, which had to be cast since no prefabricated components are available.

Initial retentive forces were set to 7 N (according to the manufacturer's recommendations) for the first 5 cycles and 14 N for the sixth cycle through adjustment of the internal activation screws. Retentive forces of 14 N were used for the final cycle to assess the influence of overactivation of a precision attachment. Manual tightening in clinical settings can result in such phenomena since no devices are available to measure retentive forces. A total of 10,000 separating and joining movements were executed by a computer-controlled stepper-motor in an axial direction under a spray of artificial saliva (37°C; 3 mL/min). A force sensor measured within 0.02 N the force required to join and separate the 2 attachment components. Surface characteristics of the attachment systems were evaluated with a scanning electron microscope (SEM) before and after the tests. Descriptive statistics, multivariate analyses of variance, and nonlinear regression analysis were computed.

Results

The greatest loss of retentive forces was measured for the material combination Ti matrix/Ti patrix (Fig 1). Even though the initial frictional forces could be regained by activation of the setscrew (7.71 ± 044 N), a significant decrease was observed after every test cycle (0.78 ± 0.07 N; average loss of retention: 90%). The Pt-Au matrix/Au-Pt patrix system performed considerably better (mean initial values: 7.48 ± 0.22 N; mean final values: 3.82 ± 2.21 N; average loss of retention: 47%). Multivariate analyses of variance revealed a significant difference between the Ti/Ti and Pt-Au/Au-Pt attachment systems ($P = .002$). Final retention values increased after each cycle (Fig 2).

Highly inhomogeneous results were observed for the Pt-Ir matrix/Pd-Ag patrix systems. The amplitude and inconsistency of measured values made it impossible to draw a distinct conclusion about this attachment type (Fig 3).

SEM images revealed distinct signs of wear for all 3 groups.

Discussion

The material properties of metal alloys have a considerable effect on the retentive forces of precision attachments.[4] Based on the current findings, titanium precision attachments cannot be recommended. This may be a result of the corrosion resistance and formation of an oxide layer of titanium, which results in the continuous wear of matching components and subsequent loss of retention. Sliding of opposing gold alloy parts leads to an increase in the size of the matching surfaces after small particles are abraded. This explains the increasing retentive values after each test series.[5] Retentive forces of Pt-Ir matrix/Pd-Ag patrix were uncontrollable throughout the study, which may be harmful to the abutment teeth. SEM analysis revealed insufficient surfaces prior to testing, due to the necessary casting procedures.

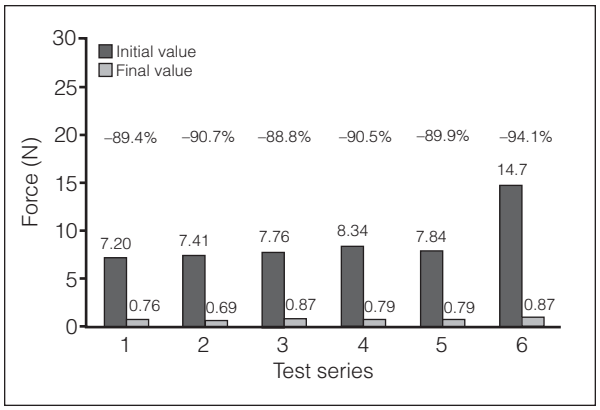

Fig 1 Mean separating and joining forces of the Ti matrix/Ti patrix precision attachments. The retentive forces before and after 10,000 cycles for each of the 6 test series are shown, along with the proportional loss.

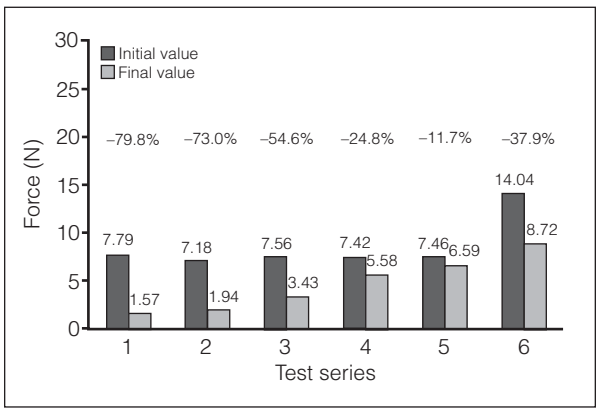

Fig 2 Mean separating and joining forces of Pt-Au matrix/Au-Pt patrix precision attachments. The retentive forces before and after 10,000 cycles for each of the 6 test series are shown, along with the proportional loss.

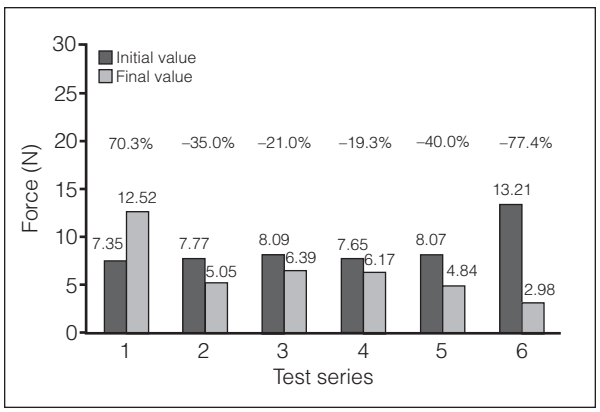

Fig 3 Mean separating and joining forces of Pt-Ir matrix/Pd-Ag patrix precision attachments. The retentive forces before and after 10,000 cycles for each of the 6 test series are shown, along with the proportional loss.

Conclusions

- Cyclic loading of metal precision attachment components results in loss of retention. This wear can be fully compensated by reactivating internal screws in the patrices.
- High-noble gold alloys are the material combination of choice. Pt-Ir/Pd-Ag systems should not be applied because of extreme wear of the surfaces and uncontrollable retentive forces. A major drawback of titanium components is an irresistible decrease of retentive forces that can only be compensated by repeated activation of the setscrews.
- Machined precision attachments show superior wear behavior in comparison to cast systems.
- Further research is necessary to evaluate the impact of frequent reactivation following delivery and the long-term effect of retentive mechanisms such as plastic inserts.

References

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Literature Abstract

Indirect latex glove contamination and its inhibitory effect on vinyl polysiloxane polymerization

The purpose of this study was to evaluate latex glove contact contamination and then evaluated for inhibition of polymerization of vinyl polysiloxane. The influence of cleansing procedures was also investigated. Four experimental groups (n = 8) were prepared: *(1)* clean vinyl gloves (control), *(2)* clean gingival retraction cords (control), *(3)* vinyl gloves contacted latex gloves, and *(4)* gingival retraction cord contacted latex gloves. Microscopic evaluation of the appearance and characterization of the contaminated surfaces were performed. Three cleansing protocols were evaluated for cleaning vinyl glove surfaces contaminated by latex contact: *(1)* brushing with water, *(2)* brushing with soap/rinsing with water, *(3)* cleansing with rubbing alcohol. For each cleansing protocol, vinyl polysiloxane impression material was mixed and dispensed in direct contact with the glove specimens from each of the cleaning protocols. The impression material specimens were allowed to polymerize and subjectively evaluated for the degree of polymerization by experienced dental faculty members. Results showed that transfer of residual elemental sulfur and sulfur-chloride compounds to vinyl gloves and retraction cord was demonstrated after contact with latex gloves. The sulfur and sulfur-chloride compounds were identified as the contamination that resulted in polymerization inhibition of the tested impression material. All the tested cleansing procedures did not remove polymerization inhibition. Elemental sulfur remained on all tested surfaces after the cleansing procedures. The polymerization inhibition observed appeared related to the transfer of the identified sulfur compounds.

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