
原 著

Retentive Force on Telescope Conical Crowns on Palladium Metal Alloy

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Summary : The retentive force in telescope conical crowns is affected by several factors.

The purpose of this study was to evaluate the retentive force of outer crowns fabricating two crowns on 3 different Water/Powder ratio on Palladium 12% gold alloy. We also tested the influence on retention of the seating force. Trying to recreate the occlusal force, before each test a metal ingot was placed over the outer and inner crown die. The tests were made with 3 weights 1kg, 2kg, 5kg. The results showed that the seating force has a direct effect on retention. No considerable retentive difference was exhibited between the W/P ratios. It has been reported that the existence of a small gap between occlusal surface of the inner crown and the outer increases the retentive force. After the all the crowns were tested, we polished the occlusal surface of the inner crown with a silicone point by free hand for 10 seconds creating a small gap between the crowns. The same outer crowns were tested following the same method and criteria for the first tests above described. The results showed a remarkable increase on the retentive force. Comparing the results of the tests made before and after occlusal polishing of the inner crown, we observe that all the second tested crowns showed a lower retentive force. This happened because after the first crown were tested; the inner crown may suffer micro deformations creating loose friction for the second crown.

キーワード : テレスコープ冠, コーススクローネ, 維持力

Keywords: Telescope System, Conical Crowns, Retentive Force

I. Introduction

Removable dentures supported by telescope double crown system have been successfully used for many years in dentistry.

Telescope crowns have proven more effective retention than any other direct retainers. Their degree of retention can be planned to suit different situations by modifying the taper angle degree of the crown design.

Proper functioning of this type of dentures is largely dependent on precision in the clinical practice, laboratory and materials.

Ensuring proper retentive force is indispensable for normal functioning of conical crown dentures.

The retentive force should be neither too strong to not damage the periodontium or nor too weak, to prevent uncontrolled loss of retention during mastication.

One of the main advantages of telescopic retainers is that, being pericoronal devices, they transmit the occlusal forces in the direction of the long axes of the abutment teeth. This has proven to be the least damaging application force.

The purpose of this study is to evaluate the retentive force and characteristics of telescopic conical crowns by casting the outer crown on different Water/Powder Investment ratio and the influence of the seating force applied on them, recreating the occlusal force.

Using a separation tensile machine the retentive force created during the separation was analyzed.

A group of 2 crowns were made on each Water/Powder ratio 30%, 32%, 35%, the 2 crowns of each group were tested and afterwards, the occlusal surface of the inner crown was polished for 10 seconds and the same 2 crowns were tested once again to prove if this gap between the crowns could affect the fit of the inner crown and have a retentive effect on the crowns.

All crowns were tested with the three seating forces 1kg, 2kg and 5kg.

The crowns were made over the same inner crown.

II. Method

1. Fabrication of the Inner Crown

1) Abutment tooth

The inner crown was made on the mandibular first molar of a study model.

2) Wax pattern

①Wax up method

On the mandibular first molar the inner crown was elaborate using the cone wax up technique. Green GC Medium Inlay wax (melting point of 57.2°C) was used to create the natural and functional anatomy on the inner Crown. GC-Sep was used between the model and wax pattern.

②Outer Form

After the crown wax up was finished, using the GC Conometer on a taper angle of 6°, the crown was smoothly cutted with the conometer knife to create the conical shape of the conic crown. (Fig.1 A)

3) Casting and Polishing

The crown was casted using IDEAVEST FIT Investment (GC Corporation, Tokyo) on 30% W/P ratio on a KDF Super Cascom Vacuum Pressure Casting Machine with the use of Palladium Alloy 12% Gold (Castwell GC Corporation, Tokyo). The casted inner crown then was cleaned with ultrasonic cleaner

using rouge cleaner-low alkaline solution (I-dent, Japan).

The crown then was transferred to a metal base to work on the milling machine. It was polished on Heraeus Milling machine using a 6°-tapered bur (Meisinger, Germany) with polishing milling wax. The occlusal surface was polished with brown silicone point (Shofu Company) by free hand technique until get the smoothness and brightness desired. (Fig. 1 B, Fig.2 A, 2 B, 2 C).

2. Fabrication of the Outer Crown

1) Wax Pattern

①Wax up

Outers crowns were elaborated on the polished metal inner crown with self-curing Resin Pattern (GC Corporation) using brush technique to be able to regulate the powder-liquid and have a good consistence and fluidity to avoid significant shrinkage. The patterns were submerged on warm water (40°C) for one minute, immediately after the build up was done.

②Investing and Casting procedure

This procedure was repeated for all crowns

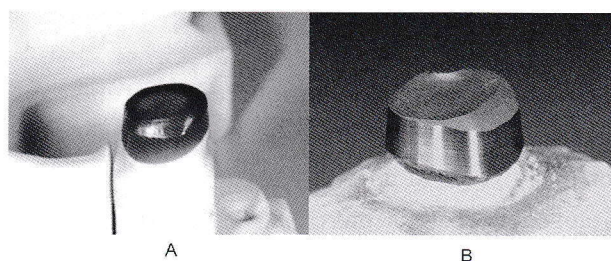


Fig. 1 A. Wax crown after being cut with 6° knife (GC Conometer)
B. Crown texture during the polish procedure with milling wax and 6° taper bur

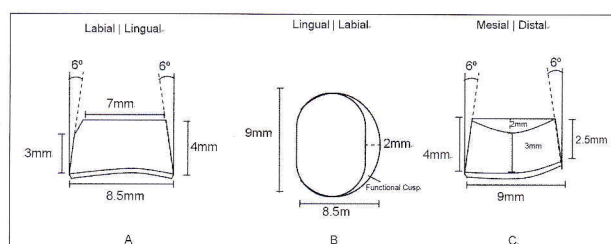


Fig. 2 A. inner crown proximal view B. Occlusal view
C. Labial view of inner crown

elaborated, each crown was invested with the corresponding Water/Powder ratio (30%, 32%, 35%).

The crowns were sprued with a direct sprue on the occlusal surface using GC Ready Casting Wax with a diameter of 2mm and melting point of 60°C.

The invested rings were placed on KDF burnout furnace for 40 minutes at a temperature of 730°C. The cast procedure was made in a KDF Supercascom Vacuum Pressure Casting Machine with ceramic crucible using Castwell M.C. Palladium Gold12% alloy casted at a temperature of 930°C.

Casted rings were cooled to room temperature, divested and cleaned with ultrasonic cleaner using rouge cleaner-low alkaline solution (I-dent, Japan).

③ Measuring attachment on the occlusal surface

An O-shaped hook was fixed to the top of the crowns by laser welding (Fig.3). Through this O-shaped hook the tensile machine could make the separation procedure possible.

Over the occlusal surface of outer crowns, a resin pattern table was made for an easier seating procedure for metal ingots thus, creating the seating force (Fig. 4 A).

III. Measuring procedure

The test consisted on evaluate the retentive force of the 2 crowns casted on each Water/Powder ratio (30%, 32%, 35%). The two crowns elaborated with the 30% W/P ratio were tested as the sequence described below.

After the test was done the next two crowns with the other W/P ratios (32% and 35%) were elaborated and tested on the same sequence established.

1) Measurement sequence criteria:

- A) Two outer crowns were casted on 30% W/P ratio

B) The first crown and second crown were tested on the same inner crown with a seating force of 1kg and measures were taken

C) The crowns were removed and this time the 2Kg ingot was seated in place and retentive force was measured. The same sequence was followed for the 5kg of seating force.

D) The first crown and second crown on 32% W/P were casted and tests were made following the sequence described above. The outer crowns casted on 35% W/P were tested with the same procedure.

E) After the tests were finished the occlusal surface of the inner crown was polished and the crowns casted on 30%W/P were tested on again following the same the seating force ingots order (1kg, 2kg and



Fig. 3 Resin table and the O-shaped hook made for and easier seating in and separating procedure.

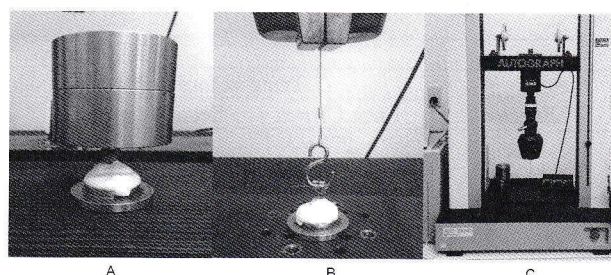


Fig.4 A. Metal ingots seated in place over the outer crown B. Inner and outer crown seated in place under the autograph C. The autograph automatically starts the test were the cross head went up until the crowns were separate.

5kg).

F) The 32% W/P crowns were seated in place on the polished inner crown and tested again with the 3 seating forces.

G) Finally the crowns casted with 35% W/P were tested following the same sequence for the previous crowns.

2) Sequence test procedure

Each crown was tested on three different seating force using 3 metal ingots 1kg, 2kg and 5kg following this sequence:

- The outer crown was placed over the inner crown then the metal ingot was seated over it for one minute (Fig. 4 A)
- After one minute the die was inserted and aligned to the cross-head. Once the die was in place the autograph's hook was placed through the O-shaped hook (Fig. 4 B).
- Then the software automatically started the separating process. (Fig. 4 C)

After each test the inner and outer crowns were cleaned with alcohol to avoid any residue could affect the fit on and sealed between crowns.

The retentive force test was performed on AGS-10kND (Shimadzu, Japan) with a separating speed of 1000mm/min.

3) After polishing Occlusal Surface

In this study we decide to polish the occlusal surface of the inner crown was to observe if this variable could improve the retentive force effect over the outer crown.

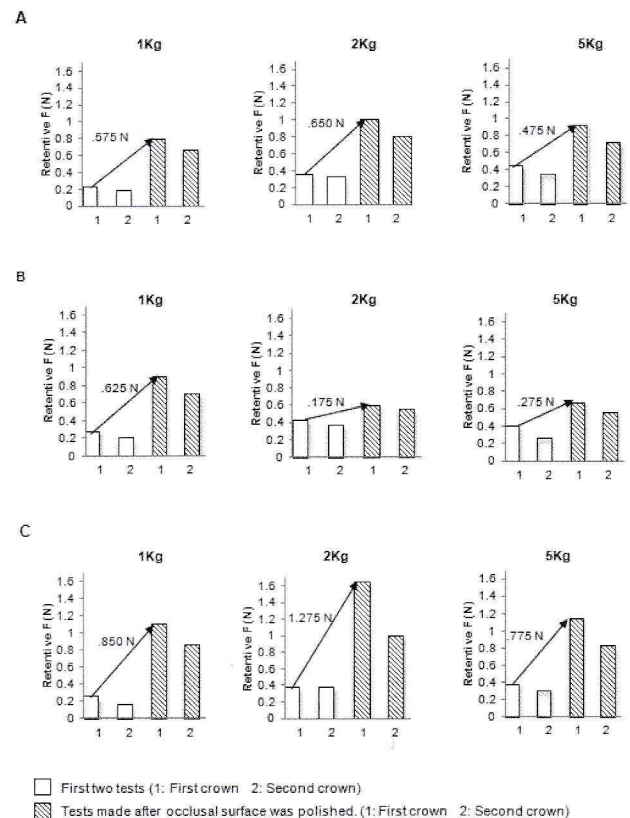


Fig. 5 Data obtained from crowns invested with A: W/P 30% B: W/P 32% C: W/P 35%

Table 1. Retentive Force of tested crowns

A. Crown casted with 30% W/P ratio						
Seating Force	Tests before occlusal polishing			Tests after occlusal polishing		
	First Crown	Second Crown	Difference	First Crown	Second Crown	Difference
1Kg	.225	.175	.050	.800	.670	.130
2Kg	.350	.320	.030	1.000	.800	.200
5Kg	.450	.350	.100	.925	.720	.205
B. Crown casted with 32% W/P ratio						
Seating Force	Tests before occlusal polishing			Tests after occlusal polishing		
	First Crown	Second Crown	Difference	First Crown	Second Crown	Difference
1Kg	.275	.200	.075	.900	.700	.200
2Kg	.425	.375	.050	.600	.550	.050
5Kg	.400	.250	.150	.675	.550	.125
C. Crown casted with 35% W/P ratio						
Seating Force	Tests before occlusal polishing			Tests after occlusal polishing		
	First Crown	Second Crown	Difference	First Crown	Second Crown	Difference
1Kg	.250	.150	.100	1.100	.850	.250
2Kg	.375	.375	0.0	1.650	1.000	.650
5Kg	.375	.300	.075	1.150	.825	.325

The occlusal surface of the inner crown was polished for 10 seconds with a brown silicone point(Shofu company, Japan) by free hand using a hand piece engine at 10,000 r.p.m.

Retentive force was measured by the same method and sequence as the one followed for the crowns before occlusal polishing.

IV. Results

The retentive forces measured are shown in the Table 1 and in the Fig. 5.

The results characteristics are as follows.

- 1). Before occlusal polishing on the inner crown.
 1. Comparing the data obtained we can observe that the ingots creating the seating force have a direct influence on the retentive force. As the seating force was increased the higher retentive force was obtained.
 2. No considerable difference was observed between the retentive forces registered on the crowns casted on 30%, 32% and 35% W/P. All ratios showed a similar retentive force.
 3. On this study all the first crowns on each W/P ratio exhibited a higher retentive force compared with the retentive force of the second crowns.
- 2). After occlusal polishing on the inner crown.
 1. The retentive force showed a great increase after the occlusal surface of the inner crown was polished. The highest increase observed was of 1.275N on the 35%W/P 2kg test. The lowest increase registered was of .175N on the 32% 2kg test.
 2. The first crown of each W/P exhibited a higher retentive force than the second crown. Same as it happened on the tests before occlusal polishing.
 3. After the occlusal surface of the inner crown was polished, the difference of retentive force between the three W/P ratios became clearer. The crown made

on 35% tested with 2kg of seating force exhibited 1.050N higher than the retentive force created by the crown casted on 32% tested on 2Kg.

V. Discussion

The second crown always registered a lower retentive force compared with the first crown. The decrease of the retentive force shows us that the fit and perfect friction between outer and inner crowns is very important and difficult to get.

After the first crown was tested, the walls of the inner crown may suffer micro deformations because of the friction. The second crown walls will have a loose friction, because of the micro deformations on the surface of the inner crown made by the first crown, as consequence the second crown didn't register a retentive force as strong as the first crown.

Occlusal surface polishing

In cases when conical crowns have a perfect fit on the inner crown, and the entire crown is in perfect contact with inner crown, they show low level of retentive force. However creating a small gap on the occlusal surface of the inner crown, as we did in this study, the same crowns showed significant higher retentive force. This happens because with the small gap between the crowns and the seating force recreating the occlusal force makes the outer crown to suffer a little deformation so it can go deeper on the inner crown and by consequence an increase on the walls friction creating higher retention.

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