DOI: https://doi.org/10.2298/SARH190923025M
UDC: 615.461:616.314-77

ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

Retention force of overdenture retained with telescopic crowns – a comparison of polyether ether ketone and zirconia ceramic telescopic crowns

Aleksandra Milić-Lemić[1], Stefan Sredojević[2], Katarina Radović[1], Dejan Stamenković[1], Biljana Miličić[3], Aleksandra Popovac[1], Ivica Stančić[1]

[1]University of Belgrade, School of Dental Medicine, Clinic for Prosthodontics, Belgrade, Serbia;
[2]University of Belgrade, School of Dental Medicine, Clinic for Periodontal Medicine, Belgrade, Serbia;
[3]University of Belgrade, School of Dental Medicine, Department for Biomedical statistics, Belgrade, Serbia

SUMMARY

Introduction/Objective Recently, new materials for double crowns have been introduced, such as zirconia and polyether ether ketone (PEEK). However, some characteristics of these materials, such as retentive force and duration of "settling in phase," have not been investigated sufficiently. During the "settling in phase," telescopic overdenture has not yet achieved its definitive retention force, and it can be harmful for periodontal tissue if the value is above optimal for a long period of time.

The objective was to measure the *in vitro* overall pull-off force of telescopic crowns where primary crowns were made from zirconia ceramics and a survey of the "settling in phase" duration.

Methods Forty zirconia primary telescopic crowns were produced on prepared canine teeth. Twenty secondary crowns were of PEEK and other 20 of zirconia with electroplated gold copings. The pull-off force measurements were conducted utilizing a dynamometer until a constant value was obtained.

Results The specimens of the PEEK group showed higher initial retentive force values. Settling in phase was finished between 800 and 900 cycles of separation for both groups. Comparing the value of the pull-off force between individual different cycles, a statistically significant reduction was recorded up to the 800th cycle, while between the 800th and the 900th cycle there was no difference.

Conclusions The settling in phase was finished between 800 and 900 cycles of separation in both groups. Final retentive force values for both tested telescopic groups were in the optimal range which is 5–9 N per one telescopic crown.

Keywords: telescopic crowns; PEEK; zirconia ceramics; retentive force; CAD-CAM

INTRODUCTION

Although dental implants' placement has become a standard procedure in prosthetic rehabilitation, there are still some situations where conventional overdentures retained with double crowns are the best solutions especially in elderly patients, having in mind some diseases such as osteoporosis, their economic situation and number, and the position of leftover teeth [1, 2]. They are indicated in cases where there are few leftover teeth (2–4) with good biological value, preferably distributed on both sides of the dental arch [3]. Double crowns consist of two main parts: a primary or male part permanently fixed to an abutment tooth or implant, and a congruent secondary or female part, rigidly connected to a removable partial denture. A cylindrical structure known as a telescopic crown is often used for double crowns and is characterized by equivalent gingival and occlusal circumference; therefore, no taper is employed [4]. Double crown systems offer more advantages than other types of attachments such as cross-arch stabilization of the abutment teeth, axial loading of the teeth, good retention, longevity, and are therefore suitable for elderly people, giving them oral comfort and self-confidence [5, 6]. Commonly, double crowns are made of metal alloys, precious and non-precious, making a homogenous or heterogeneous friction pair. During decades of use, gold alloys have proved to be the best solution in terms of creating clinically acceptable values of retention force, longevity, and biocompatibility [2, 4]. However, despite these many advantages of double crowns, they have been repressed from use mainly due to high prices of the gold alloy. Consequently, dental technicians have less experience in double crown production and avoid doing them.

Double crowns have undergone changes recently, in terms of the material selection, manufacturing technique, and design concepts, mainly in order to increase the level of precision through digitalization and consequently their performance. Modern systems of double crowns are based on zirconia ceramics (ZrO_2) and polyether ether ketone (PEEK). Ceramic materials combined with electroplated gold provide numerous advantages such as small plaque susceptibility, absence of marginal

Received • Примљено:
September 23, 2019
Revised • Ревизија:
April 29, 2020
Accepted • Прихваћено:
April 30, 2020
Online first: May 6, 2020

Correspondence to:
Aleksandra POPOVAC
School of Dental Medicine
Dr Subotića 8
11000 Belgrade, Serbia
jelenkovic.aleksandra@gmail.com
aleksandra.popovac@stomf.bg.ac.rs

gingiva discoloration and important esthetic qualities [7]. Another material utilizing computer-aided design and computer-aided manufacturing (CAD/CAM) technique for manufacturing double crowns, PEEK, provides many advantages. It is a low-priced material, compared to gold alloys, it is light weight and easy to work with compared to non-precious metal alloys, titanium, and ceramics. Its insolubility distinguishes it as an excellent material for patients with allergies [8].

Precision made telescopic crowns achieve reliable and long-lasting retention, usually by friction of touching surfaces. However, during the telescopic retained overdenture initial period of use, the retentive force value is variable. The retentive force is at its highest immediately after the denture construction and progressively decreases until the end of the "settling in phase," i.e. until the retention force value becomes well established [3]. Throughout the settling-in phase, wear of the material occurs, thus only after a certain period of wear do telescopic crowns achieve their final geometric form.

The aim of the study was to measure the in-vitro overall retention force of telescopic crowns where primary crowns were fabricated from zirconia ceramics with PEEK secondary crowns, and those where primary crowns were fabricated from zirconia ceramics and gold electroplated secondary crowns were made with zirconia ceramics. Also, the intention was to evaluate the number of cycles after which the retentive force becomes steady for all mentioned telescopic crowns under simulated clinical conditions. We hypothesized that different materials of secondary crowns have an impact on: (i) the initial retentive force value and (ii) the duration of initial retentive force value reduction.

Figure 1. Polyether ether ketone (PEEK) secondary crown

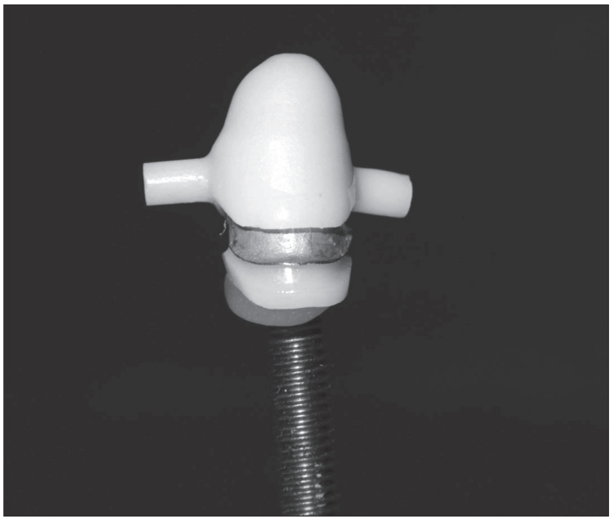

Figure 2. ZrO_2 secondary crown with electroplated gold coping

METHODS

Specimen preparation

Maxillary canine typodont resin model (KaVo Dental GmbH, Biberach an der Riss, Germany) was prepared for conventional telescopic crowns. Height of the prepared canine was 5 mm with 2 mm occlusal reduction, with a 1-mm-thick 360°-rounded shoulder margin. Afterwards, impressions of the resin model including the prepared tooth were obtained utilizing standard metal trays and additional silicone material (Zhermack SpA, Badia Polesine, Italy). According to 40 silicone impressions, 40 master casts were fabricated in dental stone type IV (Fuji Rock, GC, Leuven, Belgium) and were subsequently used for fabricating ZrO_2 primary crowns.

Primary and secondary crowns fabrication

All 40 primary crowns (40 master casts with prepared canine teeth) were fabricated from zirconia blocks (ZENOSTAR, 98 mm, Wieland Dental, Pforzheim, Germany). The stone models were scanned using an extraoral scanner (3 Shape D 800 scanner, 3Shape A/S, Copenhagen, Denmark), designed (Dental System Premium 2014, 3Shape A/S, Copenhagen Denmark) and milled in a Wieland Dental CNC milling unit. The primary crowns were polished with a special bur kit for zirconia (sets 4430 and 4431, Komet Dental Gebr. Brasseler GmbH & Co. KG, Lemgo, Germany) with water cooling using a hand piece [9].

The prepared primary crowns were afterwards divided into two groups – 20 primary crowns were randomly selected for PEEK secondary crowns (Figure 1); the rest of the 20 crowns were left for ZrO_2 secondary crowns with electroplated gold copings (Figure 2). The parameters used for PEEK secondary crowns were adjusted for breCam BioHPP blanks (Bredent, Senden, Germany, LOT: 394172), with proximal extension to enable precise separation of the crowns. Twenty PEEK secondary crowns were milled utilizing Wieland Dental CNC. The polishing procedures of the outer surfaces of peek secondary crowns were conducted under standardized condition, which implies silicone polishers (Ceragum Wheel, Bredent Medical GmbH & Co.KG, Senden, Germany) and polishing brushes (Komet Dental) with polishing paste (Abraso-Starglanz asg, Bredent, Germany); inner surfaces were not polished, in accordance with manufacturer recommendations [8].

Another 20 secondary crowns were fabricated combining electroplated gold copings and ZrO_2. The gold copings were produced in the electroforming machine (Gammat Optimo 2, Dental Gramm Technik GmbH, Ditzingen, Germany). The primary crowns were covered with thin layer of electroconductive lacquer (Conductive Silver Lacquer art. No. 910.00.049) using a special brush. Special attention was paid to producing a thin homogeneous layer. The properties of the gold solution (Ecolyt SG 200), activator (Activator SG 200), and time required were automatically calculated by the system to create a 0.2 mm thin layer of gold. Afterwards, the copings were submersed in a 40% nitric acid solution for 15 minutes to remove metallic lacquer. On the master cast with primary and secondary telescopic crowns in place, another digital scan was performed and a tertiary structure was designed (Dental System Premium) and milled (Wieland Dental CNC, Wieland Dental) from zirconia blocks (Zenostar, Wieland Dental). Afterwards, the gold copings were introduced into the ZrO_2 secondary crowns and luted using Multilink Automix adhesive (Ivoclar Vivadent AG, Liechtenstein) according to the manufacturer's directions.

Pull-off force measurement

Measurements were performed on 40 sets of telescopic crowns. The study adopted the "pull off force" as a force needed for pulling off the secondary from the primary crown. The measurements were preformed manually as complete separation of the telescopic crowns with artificial saliva substitute interposed (Biotene; GSK, Brentford, UK in physiological sodium chloride solution, ratio 1:2). The pull-off force measurements were conducted by a Bredent dynamometer (Friktionsmesgerat fmg 20) [10]. This dynamometer measures forces ranging 0–20 N. The existence of proximal extensions on the secondary telescope crowns was required for precise separation of the crowns. Measurements of the overall pull-off force were done in several steps. First, the interiors of the primary crowns were filled with autopolymerizing acrylic resin, and using the movable arm of the surveyor the dynamometer pins were immersed into the acrylic (Figure 3). Following the polymerization of the acrylic resin, adequate secondary crowns were seated over the primary crowns with finger pressure. The telescopic crown and pin assemblies were mounted onto the perforated plate of the dynamometer and fixed with an appropriate screw. The vertical post was then secured using a proper screw. The described method was performed for each of the 40 telescopic crown specimen sets. In summary, 40 specimens for each telescopic system were fabricated consisting of 20 for each material group combination.

Manual complete separation of the secondary crowns from the primary telescopic crowns in an axial direction was performed respectively at the baseline and presented the initial pull-off force. Readings of the pull-off force values were evaluated on the dynamometer scale. Insertion and separation of the telescopic crowns and adequate measurements were repeated until a constant value of the pull-off force was obtained. The final measurement refers to the pull-off force values that repeat in at least 10 consecutive readings, while the number of cycles until steady force value is achieved, represents the settling-in phase.

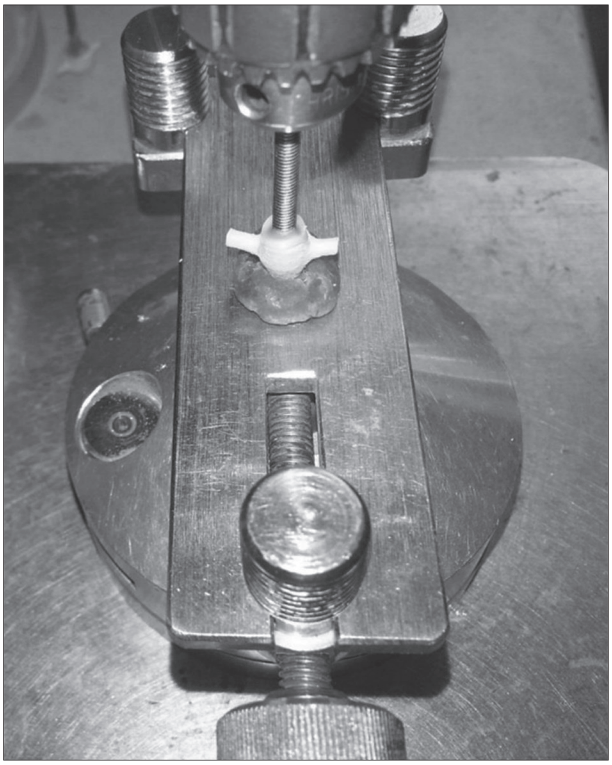

Figure 3. The dynamometer pin was immersed into the acrylic using the movable arm of the surveyor

Statistical analyses

For statistical analysis, the values of the pull-of force obtained after the first measurement (baseline) were used, as well as after each hundred measurements to the end of the settling in phase (the end of the test). Statistical analyses were performed using IBM SPSS Statistics, Version 24.0 (IBM Corp., Armonk, NY, USA). Descriptive data for all groups and variables were expressed as mean ± standard deviation, median, and interquartile range. Obtained data were tested for normal distribution by the Kolmogorov–Smirnov test. All our data was non-parametric. Quantitative non-parametric variables, between two groups, were compared by the Mann–Whitney U-test. For the comparison within a group (between different observed times), Friedman and Wilcoxon tests were performed. Logistic regression model was used to determine predictors of different groups: the PEEK group and the electroplated-gold-ZrO_2 group. All reported p-values were two-sided; the differences were considered significant when p-value was < 0.05.

RESULTS

The initial settling-in phase was finished between 800 and 900 cycles of separation, due to the fact that the 900th cycle of separation was presented as the end of the test for both groups. On average, the initial settling-in phase was finished after 892 cycles of separation in the PEEK group and 858 in the electroplated-gold-ZrO_2 group. The initial values showed the range of the pull-off force: 7.5–10.2 N for the PEEK group and 2.4–10 N for the electroplated gold-ZrO_2-group. The respective final pull-off forces were 4.1 N and 3 N. The descriptive statistics, such as mean with standard deviation, median, and interquartile range together with the result from Mann–Whitney and Friedman tests are summarized in Table 1. By comparing the values of the pull-off forces between the groups analyzed, a statistically significant difference was found at all observed times, commencing from the baseline to the 900th separation cycle. The p-values in question are also shown in Table 1.

When comparing inside the groups, a statistically significant reduction in the pull-off force value was observed in both groups. By comparing the value of this parameter between individual different cycles, a statistically significant reduction was recorded up to the 800th cycle, while between the 800th and 900th cycle there was no difference (Table 2). The percentage change in the finish value (900th separation cycle) compared to the baseline (start) did not statistically significantly differ from the observed groups (Figure 4).

Multiple regression analysis was used for identification of parameters that may predict changes in the initial retention force of different telescopic crowns: the PEEK group and the electroplated-gold-ZrO_2 group. For the assessment of univariate predictors, all values for the pull-off force and the percentage change from baseline to finish values were analyzed. When the univariate predictors were obtained, all values of the pull of force during different cycles of separation were introduced in a multivariate model. In the multivariate model, none of these factors showed statistically significant differences between the observed telescopic crowns.

DISCUSSION

Upon evaluating the obtained results regarding the first hypothesis, it could be said that both groups of investigated telescopic sets had achieved sufficient retention forces. The PEEK telescopic crown group in our study showed higher initial retentive force values (mean value of 9.3) compared to the ZrO_2 crowns (median value of 7). Also, the PEEK group showed a larger range of retention force before the end of the settling-in phase and slightly longer duration of settling-in phase compared to the ZrO_2 group. The possible explanation may be that known recommendation not to polish inner surfaces of PEEK crowns contributes to an initial high abrasiveness and consequently robust initial retentive force values. In addition to that, PEEK as a flexible material undergoes the process of better adaptation to the primary coping [9, 10, 11]. The results concerning the second hypothesis showed that final pull-off forces were 4.1 N and 3 N, respectively for each group. Phenomenon that occurs during the settling-in phase represents plastic deformation of materials with an increase of actual contact surface area resulting in tension reduction between surfaces [3, 11]. The existing tension will decrease as long as the limits of elasticity are exceeded anywhere in the contact area, whereas elasticity is specific for any given material. The results correspond to the statement that the retention mechanism of electroformed secondary crowns is based on adhesion, not on the wedge effect [5].

Table 1. Descriptive statistics values; all values for pull-off force are presented in newtons (N)

Number of test cycles $\bar{x} \pm SD$ (Med, IQR)	PEEK group	Electroplated Au-ZrO_2 group	p[a]
Baseline	9.3 ± 1.2 (9.7; 2.4)	7 ± 2.6 (7.3; 2.4)	p = 0.001*
100	7.9 ± 1.6 (7.2; 3)	6.1 ± 2.1 (64; 1.4)	p = 0.006*
200	7.1 ± 1.3 (6.4; 2.2)	5.5 ± 1.9 (5.8; 1.6)	p = 0.017*
300	6.1 ± 0.8 (6.1; 1.8)	4.6 ± 1.5 (4.8; 1)	p = 0.001*
400	5.4 ± 0.6 (5.38; 1)	4.2 ± 1.3 (4.4; 0.8)	p = 0.000*
500	4.8 ± 0.6 (4.65; 0.8)	3.7 ± 1.2 (4; 0.6)	p = 0.000*
600	4.5 ± 0.6 (4.4; 0.3)	3.5 ± 1.2 (3.6; 0.3)	p = 0.000*
700	4.3 ± 0.4 (4.4; 0.8)	3.4 ± 1.1 (3.6; 0.8)	p = 0.000*
800	4.2 ± 0.5 (4.3; 0.8)	3.1 ± 1.1 (3.2; 0.6)	p = 0.000*
900	4.1 ± 0.5 (4.3; 0.8)	3 ± 0.9 (3.2; 0.6)	p = 0.000*
p[b]	p = 0.000*	p = 0.000*	

IQR – interquartile range;
*statistically significant;
[a]Mann–Whitney U-test;
[b]Friedman test

Table 2. Statistically significance of reduction of pull-off force over time in two groups

Test cycles	PEEK group	Electroplated Au-ZrO_2 group
baseline–100	p = 0.000*	p = 0.000*
100–200	p = 0.000*	p = 0.000*
200–300	p = 0.000*	p = 0.000*
300–400	p = 0.000*	p = 0.000*
400–500	p = 0.000*	p = 0.000*
500–600	p = 0.000*	p = 0.001*
600–700	p = 0.004*	p = 0.045*
700–800	p = 0.002*	p = 0.004*
800–900	p = 0.157	p = 0.063

*Statistically significant; Wilcoxon test

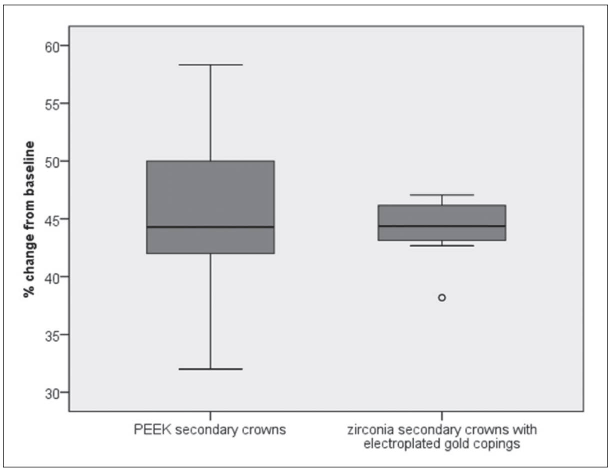

Figure 4. The percentage change from baseline to finish values

The retention of telescopic crowns in which the secondary parts are electroplated is based on the combination of capillary gap and saliva [12, 13]. Capillary gap occurs as a result of gold ion deposits on a thin layer of silver lacquer which is applied during the fabrication of the coping. Furthermore, by implementing the artificial saliva, design of the tooth preparation and chamfer design and dimensions may have an impact on adhesion between the smooth surfaces of telescopic crowns, as well as having a hydraulic effect, thus increasing the initial retentive force [10]. Also, as stated by Weigl et al. [14], double crown assemblies with electroformed secondary crowns have more stable retention forces than double-crown assemblies with cast secondary crowns [14].

The main limitation of this study is that the dynamometer pin was positioned manually, and that some errors may have occurred when reading the measured values. However, to avoid significant errors, the dynamometer pin was positioned using the surveyor arm, thus providing the vertical direction for the separation/insertion process. Under *in vivo* conditions, the insertion path of the denture in most cases is slightly different from the path used during the measurements. Also, the lubricant was interposed during the "pull-off force" measurement, although the presence of artificial saliva is a controversial subject concerning the validity of the results ranging from those that indicate the presence of saliva substitute does not alter the withdrawal force in individual withdrawal force tests to those that assert the absence of such intermediary leads to significant changes in frictional wear [15].

Double crowns have been exposed to numerous criticisms over decades of use. However, research has shown that properly planned and precisely manufactured overdenture retained with double crowns does not show a higher incidence of complications than other types of attachments. Ishida et al. [16] investigated survival and complication probabilities of the prosthesis retained with clasps and double crowns. Decementation was the most frequent cause of failure in double crowns (which is neither expensive nor complicated to solve), but other complications such as fracture of crown restoration, fracture of tooth, caries, and periodontal disease were more frequent in abutment teeth with clasps [16]. Similar conclusion was made by Hofmman et al. [17], who reported the loss of cementation for double crowns and fractures of the clasps. Schwindling et al. [18] concluded that the most frequent complications of double crown retained overdentures were decementation of primary crowns, need for denture relining, and fracture of the veneer of secondary crowns. All these complications are considered minor and low-cost, and overall survival rate was 90% after seven years. According to the most recent research, the cumulative survival rate of double crowns was higher in implants compared to tooth-supported overdentures, but still above 80% in both teeth- and implant-supported overdentures over 10 years [19]. Based on these results, it can be said that the main drawbacks of the telescopic overdenture are in the complex design and production, as well as the price of gold alloys. For this reason, the idea of introducing new materials for double crowns means a potential reduction of the production cost, but the main advantage is digitalization, which reduces the errors caused by the human factor. For example, due to CAD/CAM fabricating, casting beads, inevitable during conventional casting, were avoided [20, 21]. In addition, a recent study has shown that fully digital protocol for RPD production with clasps is possible, meaning digital impression, design with CAD software, fabrication with CAM machine, and 3D printer and assembly with adhesive material [22]. This means that soon it will be possible to produce telescopic overdenture with fully digital protocol as well.

Non-precious metal alloys are convenient because of the much lower price compared to gold alloys, but also to PEEK and ZrO_2. However, literature data and also experience in practice point out that these alloys often cannot reach sufficient retention force and therefore need additional retention elements which complicate the production process. Also, because of the existence of carbides, oxide layer creation, and high elasticity module, double crowns made of non-precious alloys are much more difficult to handle and process [23, 24, 25].

The optimal retention force value per one telescopic crown amounts to 5–9 N [3, 8, 23], which correlates with our own results. The results from Stančić and Jelenković [4] demonstrate that when a larger number of matrix–patrix components are present, as in most cases, there is an initial force stronger than optimal and the settling-in phase will last longer, thus providing the possibility of potentially harmful outcome for the periodontium over a longer interval [4]. Considering the retention force values, contrary to our results, initial retentive force in the 3.6–3.7 N range or less were reported by Özyemişci-Cebeci and Yavuzyilmaz [12] prior to applying different friction varnishes that improved retention to satisfactory 4.6 and 6 N. Güngör et al. [25], similar to our results, reported that only after the initial 800 cyclic procedures were performed, a decrease in the retentive force could be found, with no further changes afterwards. Contrary to our findings, the results of Stock et al. [8] showed a decrease of retention force in PEEK secondary crowns as soon as the first 20 cycles.

Bearing in mind the obtained results as well as the difference in the crown production cost which is approximately 2:1 in favor of PEEK, authors give mild advantage to the electroplated gold ZrO_2. However, further prospective clinical studies are needed to determine which material is more durable and has better clinical characteristics after some period of use. Nowadays, more implant-supported overdentures are retained with double crowns with good survival rate [2, 26], and researches about different computer-aided technologies for those double crowns should give precious information [19, 22].

CONCLUSION

The first hypothesis that different materials of the secondary crown have an impact on initial retentive force value has been shown as correct. The specimens of the PEEK telescopic group showed higher initial retentive force values than electroplated-gold-ZrO_2 group. The settling-in phase was finished between 800 and 900 cycles of separation in both groups; thus, material combination did not have an impact on the duration of the initial retentive force reduction. Both tested telescopic groups showed retentive force values in the optimal range.

ACKNOWLEDGEMENT

The authors are very grateful to master dental technician Nemanja Grkinić and Dental Design Studio, Belgrade, Serbia for the help in preparation of samples used in the present study, and to dental technician Gustav Bačlija (G-dent, Subotica, Serbia) for providing the galvanic device.

Conflict of interest: None declared.

REFERENCES

1. Carlsson GE. Implant and root supported overdentures: A literature review and some data on bone loss in edentulous jaws. J Adv Prosthodont. 2014;6(4):245–52.
2. Fobbe H, Rammelsberg P, Bermejo HL, Kappel S. The up-to 11-year survival and success of implants and abutment teeth under solely implant-supported and combined tooth – implant-supported double crown-retained removable dentures. Clin Oral Impl Res. 2019;30(11):1134–41.
3. Stamenković D. Stomatološka protetika-pacijalne proteze. Beograd: Interprint; 2006. pp. 337–66, 403–13.
4. Stančić I, Jelenković A. Retention of telescopic denture in elderly patients with maximum partially edentulous arch. Gerodontol. 2008;25(3):162–7.
5. Zahn T, Zahn B, Janko S, Weigl P, Gerhardt-Szép, Lauer HC. Long-term behaviour of double crown retained dentures with metal and metal-free secondary crowns and frameworks made of Vectris© on all-ceramic primary crowns: a prospective, randomized clinical trial up to 14 years. Clin Oral Invest. 2016;20(5):1087–100.
6. Stober T, Danner D, Bömicke W, Hassel AJ. Improvement of oral health-related quality-of-life by use of different kinds of double-crown-retained removable partial dentures. Acta Odontol Scand. 2015;74(1):1–6.
7. Schwindling FS, Rammelsberg P, Krisam J, Rues S. Adjustment of retention of all-ceramic double-crown attachments. Int J Comput Dent. 2017;20(4):409–21.
8. Stock V, Wagner C, Merk S, Roos M, Schmidlin P, Eichberger M, et al. Retention force of differently fabricated telescopic PEEK crowns with different tapers. Dent Mater J. 2016;35(4):594–600.
9. Stock V, Schmidlin PR, Merk S, Wagner C, Roos M, Eichberger M, et al. PEEK Primary Crowns with Cobalt-Chromium, Zirconia and Galvanic Secondary Crowns with Different Tapers – A Comparison of Retention Forces. Materials (Basel). 2016;9(3):187.
10. Linek W, Richter G, Raedel M, Walter M, Reitemeier B. In vitro analysis of the tribological behaviour of different material combinations for telescopic crowns. Metals. 2016;6(7):149.
11. Schubert O, Reitmaier J, Schweiger J, Erdelt K. Retentive force of PEEK secondary crowns on zirconia primary crowns over time. Clinical Oral Investigations. 2019;28(5):2331–8.
12. Özyemişci-Cebeci N, Yavuzyilmaz H. Comparison of the effects of friction varnish and electroforming on the retention of telescopic crowns. J Prosthet Dent. 2013;109(6):392–6.
13. Lian M, Zhao K, Feng Y, Yao Q. Prognosis of combining remaining teeth and implants in double-crown–retained removable dental prostheses: a systematic review and meta-analysis. Int J Oral Max Impl. 2018;33(2):281–97.
14. Weigl P, Hahn L, Lauer HC. Advanced biomaterials used for a new telescopic retainer for removable dentures: ceramic vs. electroplated gold copings: part I In vitro tribology effects. J Biomed Mater Res. 2000;53(4):320–36.
15. Bayer S, Stark H, Mues S, Keilig L, Schrader A, Enkling N. Retention force measurement of telescopic crowns. Clin Oral Invest. 2010;14(5):607–11.
16. Ishida K, Nogawa T, Takayama Y, Saito M, Yokoyama A. Prognosis of double crown-retained removable dental prostheses compared with clasp-retained removable dental prostheses: A retrospective study. J Prosth Res. 2017;61(3):268–75.
17. Hofmann E, Behr M, Handel G. Frequency and costs of technical failures of clasp- and double crown-retained removable partial dentures. Clin Oral Investig. 2002;6(2):104–8.
18. Schwindling FS, Dittmann B, Rammelsberg P. Double-crown retained removable dental prostheses: A retrospective study of survival and complications. J Prosthet Dent. 2014;112(3):488–93.
19. Seo JG, Cho JH. Clinical outcomes of rigid and non-rigid telescopic double-crown-retained removable dental prostheses: An analytical review. J Adv Prosthodont. 2020;12(1):38–48.
20. Obradović-Đuričić K, Medić V, Dodić S, Gavrilov D, Antonijević Đ, Zrilić M. Dilemmas in zirconia bonding: A review. Srp arh Celok Lek. 2013;141(5–6):395–401.
21. Çelik Güven M, Tuna M, Bozdağ E, Öztürk GN, Bayraktar G. Comparison of retention forces with various fabrication methods and materials in double crowns. J Adv Prosthodont. 2017;9(4):308–14.
22. Nishiyama H, Taniguchi A, Tanaka S, Baba K. Novel fully digital workflow for removable partial denture fabrication. J Prosthod Res. 2020;64(1):98–103.
23. Arnold C, Hey J, Setz JM, Boeckler AF, Schweyen R. Retention force of removable partial dentures with different double crowns. Clin Oral Invest. 2018;22(4):1641–9.
24. Turp I, Bozdağ E, Sünbüloğlu, Kahruman C, Yusufoğlu I, Bayraktar G. Retention and surface changes of zirconia primary crowns with secondary crowns of different materials. Clin Oral Invest. 2014;18(8):2023–35.
25. Güngör MA, Artunç C, Sonugelen M. Parameters affecting retentive force of conus crowns. J Oral Rehabil. 2004;31(3):271–7.
26. Rinke S, Buergers R, Ziebolz D, Roediger M. Clinical outcome of double crown-retained implant overdentures with zirconia primary crowns. J Adv Prosthodont. 2015;7(4):329–37.

Ретенциона сила протезе ретиниране телескопским крунама – поређење телескопских круна од полиетеркетона и цирконијумске керамике

Александра Милић-Лемић[1], Стефан Средојевић[2], Катарина Радовић[1], Дејан Станменковић[1], Биљана Миличић[3], Александра Поповац[1], Ивица Станчић[1]

[1]Универзитет у Београду, Стоматолошки факултет, Клиника за стоматолошку протетику, Београд, Србија;
[2]Универзитет у Београду, Стоматолошки факултет, Клиника за пародонтологију и оралну медицину, Београд, Србија;
[3]Универзитет у Београду, Стоматолошки факултет, Биомедицинска статистика, Београд, Србија

САЖЕТАК

Увод/Циљ Последњих година уведени су у праксу нови материјали за двоструке круне, као што су цирконија и полиетеретеркетон (ПЕЕК). Међутим, неке карактеристике ових материјала нису довољно испитане, као што су ретенциона сила и трајање „фазе уходавања“. „Фаза уходавања“ је иницијални период употребе телескопске протезе када финална ретенциона сила још увек није постигнута, и може имати штетни утицај на пародонтално ткиво ако су у том периоду силе превисоке и предуго трају.

Циљ је био да се измери ин витро укупна сила раздвајања телескопских круна, где су примарне круне израђене од цирконијумске керамике, и испитати трајање фазе уходавања.

Методе Четрдесет примарних телескопских круна од цирконијумске керамике је израђено на препарисаним очњацима. Двадесет секундарних круна је израђено од ПЕЕК-а, и још 20 круна од цирконије са галванизованим златом. За мерење силе раздвајања коришћен је динамометар. Спајање и раздвајање телескопских круна и мерење силе раздвајања је вршено док није добијена константна вредност.

Резултати Узорци из групе ПЕЕК показали су вишу иницијалну вредност ретенционе силе. Фаза уходавања је завршена између 800 и 900 циклуса раздвајања код обе групе. Када се упореде индивидуалне вредности силе раздвајања између различитих циклуса, статистички значајно смањење је забележено до 800. циклуса, док између 800. и 900. циклуса није било разлике.

Закључак Фаза уходавања је завршена између 800 и 900 циклуса раздвајања у обе групе. Финална ретенциона сила код обе тестиране групе показала је оптималне вредности, које износе 5–9 N по телескопској круни.

Кључне речи: телескопске круне; ПЕЕК; цирконијумска керамика; ретенциона сила; *CAD-CAM*