Changes in the Values of Retention Forces in CEKA Attachments

Primjene vrijednosti retencijskih sila CEKA ankera

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Summary

Retention of a partial denture is the resistance of retaining elements to forces which endeavour to dislodge it from its base. Basic retention is obtained by means of clasps, attachments, diaphragms, telescopic crowns, magnets etc. The aim of the present study was to determine the dynamics of reduced retention forces in CEKA attachments (OL 694).

An instrument, especially constructed for the purpose, was used to measure retention forces, and the test was carried out with and without the addition of saliva.

The results of the study, which are presented graphically and in tables, and described by exponential law, show that at the commencement of the test the value of retention force in the attachment, without the addition of saliva, amounted to approximately 10.2 N, and after 1200 cycles of insertion and removal, 3.4 N. With the addition of saliva the retention force of the attachment amounted to 9.92 N at the commencement of the test and after 1200 cycles of insertion and removal, 5.12 N.

A fundamental factor which has a cardinal effect on the extent of the retention force is wear and fatigue of the material. Although in this study no significant differences in the reduction of retention forces were found than had been anticipated, it is recommended that special attention should be paid to the choice of retention technique in partial dentures.

Key words: *retention, attachments*

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Introduction

A partial denture can be physiologically correctly adapted to the foundation only on the basis of knowledge of the biostatics of the stomatognathic system. A large number of factors have an influence on whether a certain force will have the function of physiological stimulation, or whether it will lead to pathological changes in the supporting tissue. On the one hand it is the natural force, and on the other individual adaptive strength, of the supportive apparatus of the retaining tooth. Some authors have reported somatic and psychic changes, which can significantly influence the response of the bearing tissue to the effect of force. However, this depends on the ability, degree of alteration and adaptation of tissue, which is very individual. During the production of a partial denture one of the most important tasks is to secure retention on which its functional value depends (1). By correct choice of the retention elements and accurate dosing of their mechanical forces, the period of adaptation to the prosthetic work will be relatively short, and therapy successful.

The value of the retention force drops relatively rapidly for almost all means of retention (clasps, anchors, diaphragms, telescopic crowns etc.) (2). Stewart and Edwards (3) determined that the retention force of some types of attachments drops to 80% within a year. Each bony structure in the organism reconstructs and adapts to the new functional commands of the active matrix, and these changes occur in the bony parts of the upper and lower jaws. Functional adaptation occurs by apposition, i.e. resorption of bone cells (4). Retention of partial dentures is achieved mechanically with retention elements on the bearing teeth and direct adherence of the base of the denture to the mucosa.

If retention is studied from various aspects it can be seen that it depends primarily on the material of which the denture is made, and particularly its retention elements (5,6). Schafer (7) reported on his clinical experience in anchoring to extracoronary attachments, by the application of electrochemical etching of bearers.

Ogata and coworkers described measurement of the forces in a partial denture with telescopic crowns by using a specially constructed built-in wire lead in the distal part of the denture. They demonstrated not only which forces occur but also where they are carried by mastication of different foods and in different time periods (8). Akagava (9) constructed a new type of telescopic crown with a horizontal post on the outer crown and a groove on the interior crown in order to increase retention and reduce the harmful movement of partial dentures.

Material and methods

Retention forces in partial dentures and testing of their physical values are very difficult to measure in the oral cavity, and often impossible to perform. Thus, measuring is frequently carried out by use of various instruments which simulate the investigated segment of the oral cavity. In this study gradual loss of retention force was measured in Ceka attachments OL 694 KS CEKA, Antwerp.

The values of retention forces were measured on the examined samples with and without the addition of saliva. For the investigation natural saliva was replaced by artificial saliva according to Dr. Matzker. In order to examine the gradual loss of retention force, an instrument was constructed, according to which results of the experiment were obtained. Measuring was performed in the Institute for Materials, Faculty of Mechanical Engineering and Shipbuilding University of Zagreb. All samples were prepared in the Institute for Removable Dentures in the Dental Technical Laboratory of the School of Dental Medicine University of Zagreb.

The basic dimensions of the examined Ceka attachments prior to measuring are shown in Figure 1. The retention force was obtained through the

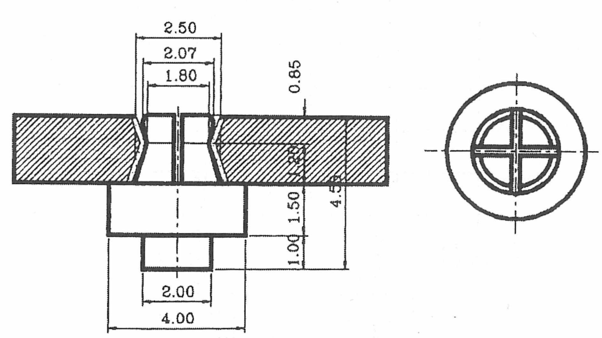

Figure 1 *Basic dimensions of the Ceka attachments, measured by a projection profile comparator*

Slika 1. *Osnovne dimenzije CEKA ankera, izmjerene projekcijskim profilnim komparatorom* conical shape of the end of the patrix and by the force of friction on the additional surfaces. Thus, the magnitude of the maximal force retention depends on the contact force on the touched surfaces, the angle of the conical incline and the coefficient of the friction on the touching surfaces. The contact force, on the other hand, depends on the extent of the maximal deformation of the patrix joint, which can be controlled by increasing or decreasing the span in the patrix joint.

By using the instrument to measure the retention force it was possible to cyclically include or exclude retention elements and to measure force continually. By adding saliva it was possible to change the conditions in which the study was performed. The measuring signals were collected with programme packet OPtiMalPlus multianalyser (LB 32). This made possible rapid and simple collection of the results of the measuring, programming and measuring procedure, recording of callibration characteristics of the sensor and later simple analysis of the measuring signals and their illustration.

Results and discussion

1. *Measuring the retention of the attachment in conditions of dry friction*

The retention forces of the Ceka attachment were measured in conditions of dry friction and with the addition of saliva. The gradual loss of retention force was examined from the initial zero values to the retention force obtained after 1200 cycles of insertion and removal of the retention element.

One cycle of joining and separating the attachment in conditions of dry friction, achieved on the measuring instrument, indicated that the force changed as shown in the diagram presented in Figure 2.

The diagram shows the following characteristic points:

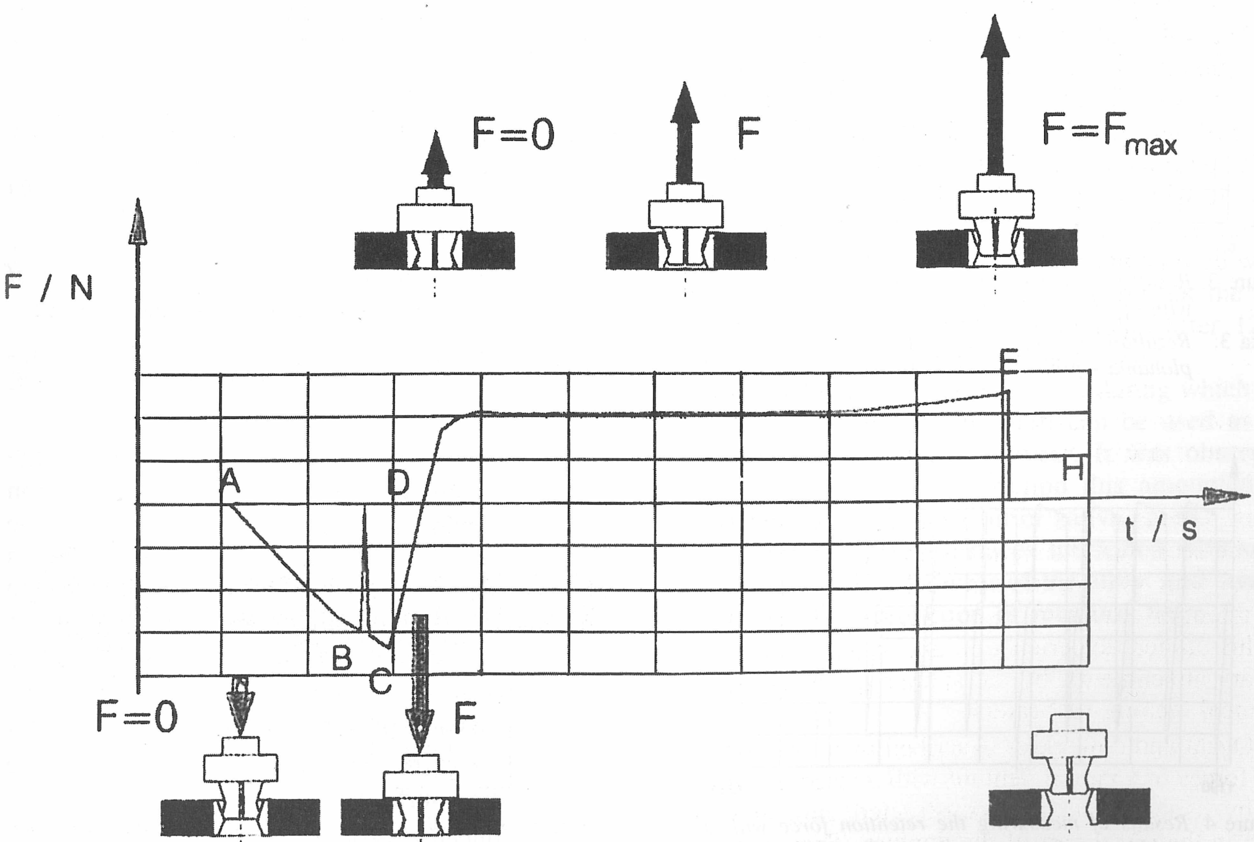

Figure 2 *Time sequence of the force of joining and separating the examined attachment*
Slika 2. *Vremenski slijed sila spajanja i rastavljanja ispitivanog ankera*

A - start of inclusion

B - moment of complete joining of the joint

C - increasing force during complete seating of the patrix joint on the matrix

D - commencement of the separation of the joint

E - maximal force of the separation immediately prior to separation of the joint elements

H - separated joint

After which the cycle is repeated. In conditions of dry friction the joints were tested with up to 1200 loading cycles. Characteristic diagrams of force are shown in Figures 3 and 4. From the presented diagrams significant changes in the retention forces can be seen. At the beginning of the test the force amounted to approximately 10.2 N, while after 1200 cycles the force had decreased to only 3.4 N.

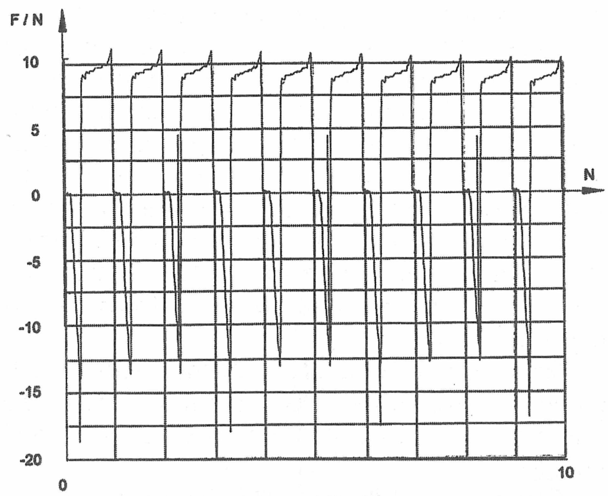

Figure 3 *Results of measuring the retention surfaces force with dry touching - first ten cycles*

Slika 3. *Rezultati mjerenja retencijske sile suhim dodirnim plohama - prvih deset ciklusa*

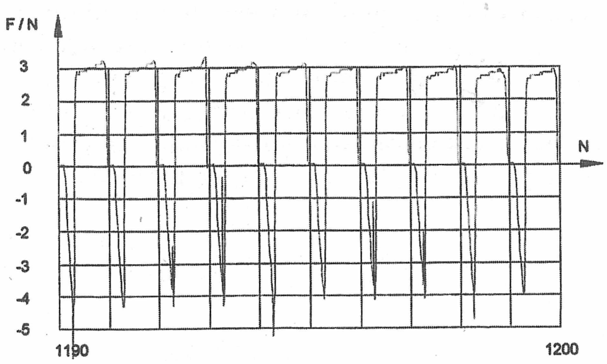

Figure 4 *Results of measuring the retention force with dry touching surfaces - loading cycles 1190-1200*

Slika 4. *Rezultati mjerenja retencijske sile suhim dodirnim plohama - ciklusi opterećenja od 1190 - 1200*

By checking the geometry of the joint, it was found that the patrix and matrix were worn. Thus, for example, the diameter of the top of the patrix was reduced from the initial 1.90 mm to 1.82 mm of the worn patrix joint. Increased roughness of the patrix surface was observed on the areas of wear. (Figure 5).

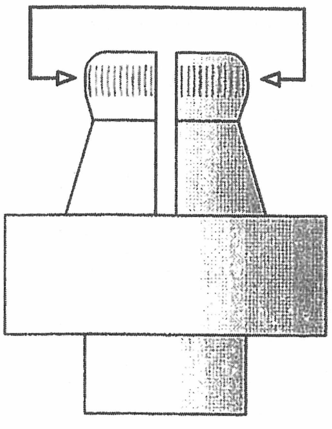

Figure 5 *Wear of the patrix after 1200 loading cycle*

Slika 5. *Istrošenost patrice nakon 1200 ciklusa opterećenja*

2. *Results of measuring the retention force of the attachment with the addition of saliva*

Investigation of retention was carried out by lubricating the touching surfaces with artificial saliva "Glandosane". Figures 6 and 7.

An indicator of the speed of wear could be the number of loading cycles at which the retention force was reduced to half the initial value. In the case of the investigated attachments, in conditions of dry friction the number of cycles amounted to 767, while with the addition of saliva the number was 2184. The reduction in retention force occurred due to:

1. Permanent plastic deformation of the patrix
2. Wear of the parts of the attachment on the sliding surfaces
3. Reduced coefficient of the friction

The conditions in which plastic deformations can occur depend on the strain involved and the

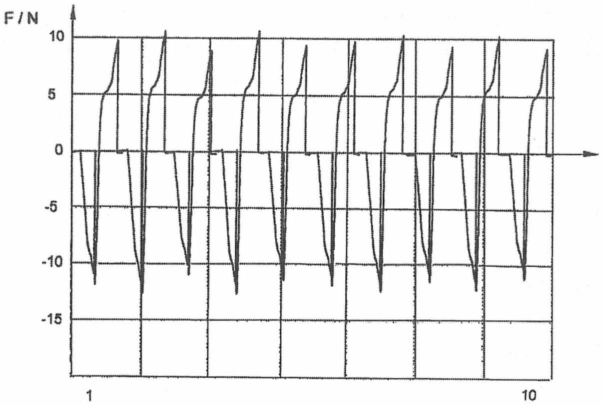

Figure 6 *Retention force with added saliva - loading cycles from 1 to 10.*

Slika 6. *Retencijska sila s nazočnosti sline - ciklusi opterećenja od 1 do 10*

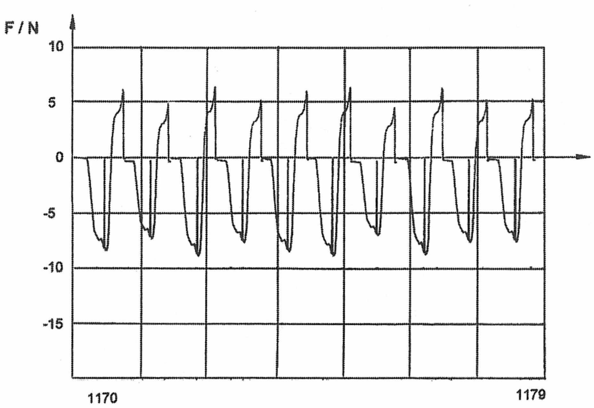

Figure 7 *Change of the retention force with added saliva - loading cycles 1170 - 1179.*

Slika 7. *Promjene retencijske sile s nasočnošću sline - ciklusi opterećenja 1170 - 1179*

characteristics of the material of which the joint is made. It is essential to know them. Reduced retention force due to wear of the parts of the attachment on the sliding surfaces during the joining and separating, depends on the contact forces, joint material, roughness of the touching surfaces of the joint and the existence or otherwise of a layer of saliva on the touching surfaces. During adhesive wear of the sliding surfaces their roughness alters and consequently the speed of wear. The speed of change of retention forces will therefore not be constant but will evolve according to exponential law.

Warren and Caputo (10) investigated and tested different types of attachments and demonstrated that they move up to 0.9 mm in a horizontal direction, which has a harmful effect on the periodontium.

Conclusion

The aim of this study was to determine the dynamics of the reduced retention force in CEKA attachments. Retention force was measured by an instrument which was especially constructed for the purpose. The basic factors which have an essential influence on the changing magnitude of retention force are wear and fatigue of the material. The value of the retention force in attachments without the addition of saliva amounted to approximately 10.2 N at the beginning of the test. After 1200 cycles of insertion and removal the force measured was 3.4 N.

The retention force of the anchor with the addition of saliva was 9.92 N at the beginning of the test and 5.12 N after 1200 cycles of insertion and removal.

Examination of the geometric joint showed wear of the top of the patrix from 1.90 mm at the beginning of the test to 1.82 mm (4%) after 1200 cycles of insertion and removal.

The number of loading cycles, during which retention force reduced by half, can be used as an indicator of the speed of wear. It was observed that in joints with dry friction this amounted to 767, and with the addition of saliva, 2184.

Contact of metal surfaces lubricated with saliva, result in reduced wear of the alloy, and consequently slower reduction of retention force.

PRIMJENE VRIJEDNOSTI RETNECIJSKIH SILA CEKA ANKERA

Sažetak

Retencija djelomične proteze jest otpor retencijskih elemenata silama koje je nastoje pomaknuti s ležišta. Osnovna retencija dobiva se s pomoću kvačica, ankera, prečki, teleskop krunica, magneta i dr. Ovim radom nastojala se utvrditi dinamika smanjenja retetncijske sile kod CEKA ankera (OL 694),

Ispitivalo se je s pomoću aparature za mjerenje retencijske sile, koja je konstruirana u tu svrhu. Ispitivanje je rađeno s nazočnošću sline i bez nje.

Rezultati istraživanja - koji su prikazanai grafički i tablicama, a opisani eksponencijslnim zakonom - pokazuju da je vrijednost retencijske sile kod etečmena bez nazočnosti sline na početku ispitivanja iznosila prosječno 10.2 N. Nakon 1200 ciklusa stavljanja i vađenja, izmjerena je sila 3,4 N. Promjena retencijske sile etečmena s nazočnošću sline iznosila je od početnih 9,92 N do 5,12 N nakon 1200 ciklusa stavljanja i vađenja.

Člmbenik koji bitno utječe na veličinu retencijske sile jest trošenje i zamor materijala. Iako u ovom istraživanju nisu vidljive velike razlike u opadanju retencijskih sila od pretpostavljenih, može se preporučiti posebna pozornost izboru načina retencije djelomične proteze.

Ključne riječi: *retencija, ankeri*

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