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Retention and Wear Evaluation of Locator Attachment and Novaloc Attachments for Two Implant-Supported Mandibular Overdentures (In Vitro Study)

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ABSTRACT

This study aims to compare the retention and wear changes between two stud attachments "Locator" and "Novaloc" used for implant supported mandibular overdenture. Two ready-made epoxy resin models represented completely edentulous patients were prepared to receive two implant analogues in the canine area and divided randomly into two groups. The first group represented the Locator attachment with its nylon matrix and metal housing; the second one was Novaloc with its PEEK matrix. Two overdentures were constructed for each group. The pick-up proceeded as conventional method. Universal testing machine was used to measure the retention of each attachment. Chewing simulator exerted multiple cycles mimicking the insertion and removal of the overdentures at the baseline, 500 cycles, 1000 cycles, 1500 cycles and 2000 cycles. Digital microscope was used to evaluate the wear behavior of each attachment during these different cyclic loading. Regarding retention was performed by using Independent t-test which revealed that retention of group I (Locator) was significantly higher ($P<0.05$) than group II (Novaloc) at baseline, 500 cycles, 1000 cycles, 1500 cycles and 2000 cycles. Comparison between mean difference of wear (wear changes) of both groups was performed by using Independent t-test which revealed in the overall changes group I (Locator) was significantly higher than group II (Novaloc). The Locator showed higher initial retention than Novaloc. Regarding wear behavior, Novaloc showed lesser wear and changes than Locator attachment.

Keywords: Locator attachment, Novaloc attachment, Retention, Wear.

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INTRODUCTION

Edentulism limits a patient's ability to perform proper function as speaking and eating. The conventional prosthesis for the edentulous patient is the complete denture (CD). The common problem of mandibular CDs can be expressed in loss of denture retention and stability. Denture adhesive can be a rapid solution for instability of removable prostheses, but it does not eliminate the etiology.[1]

Mandibular implant overdentures (IODs), retained by two un-splinted in inter-foraminal area, is considered to be the optimum choice for completely edentulous patients who are un-satisfied with CDs. The use of "Attachments" in combination with implants were found to improve retention, support and stability of overdentures, thus extending their longevity. The selection of proper attaching mechanism depends on amount of retention needed, amount of alveolar bone, inter-arch space, status of antagonistic jaw and patient's expectation.

Resilient stud attachments become a favorable treatment option, due to their elementary procedure and simple maintenance. Functional and parafunctional loads may lead to changes of surface behavior, plastic distortion, wear and even breakage of attachment parts.

In order to ensure proper retention and the least wear behavior, several attachments are presented in the dental market. The Locator is an attachment system characterized by its dual retention as the nylon male element engages inner and outer contours of the female abutment. It was manufactured for ease of removal and insertion, as it has minimum vertical profile and a distinctive ability to pivot. These features increase its tolerance and resiliency for implant's divergence.[2]

As the success of the overdenture retention depends on the performance of an attachment that is susceptible to wear-related retention loss, new biomaterials have been introduced over the past few years to serve this purpose. Newer attachment systems are also available named "Novalock". It provides innovative characteristics such as the use of PEEK caps having variable retention forces as a substitute of metallic caps. The manufacture assumes that these features in conjunction with the amorphous diamond-like carbon (ADLC) coat material will overcome the wear and subsequently the loss of retention of the overdenture. It's designed with reduced abutment levels and various cuff heights to accommodate different gingival anatomies.[3]

Continuous researching is performed to enhance the retention and resistance of wear of different type of attachments, as they are the golden key of implant supported over-denture success. The question that may arise: Will there be a difference in retention and wear behavior provided by the Locator attachment and that provided by the recent attachment the Novaloc during one year follow up?

MATERIALS AND METHOD

This is an in vitro study comparing the retention and wear behavior of two unsplinted stud attachments (Locator versus Novaloc).

Epoxy Resin Model Preparation:

The study was performed on epoxy resin acrylic models (kemapoxy 150JM, chemical for modern building international Egypt) representing a completely edentulous mandibular arch. Mandibular trial denture bases with wax occlusion block were constructed on the epoxy resin models. Setting of acrylic teeth was arranged and adjusted according to the compensatory curves. (figure 1) Duplication of the whole assembly of epoxy resin model and the trial denture base with waxed up acrylic teeth using silicone duplicating material.

Plateauing of the epoxy resin cast of the anterior area (from the canine of right side till the canine of the left side) in order to create a diameter of 5 mm using straight hand piece (Nsk E-Type Reduction Nosecone Straight Hand piece). All surfaces were smoothed with fine sandpaper. The sample size included 2 identical experimental models (1model / group).

Surgical stent and analogues insertion:

The trial denture base with the teeth set up acted as a surgical stent for accuracy. The acrylic teeth determined the optimum area for drilling (canines' area) on epoxy resin cast. Both canines and their underlying trail denture base were removed, taking in consideration the inter-implant distance was 20 mm (each was 10 mm from the midline). This distance was measured by digital caliber. (Figure 2)

Epoxy resin model was marked at canine area then drilled by tungsten carbide bur (laboratory tungsten carbide bur (H79G; Brasseler USA)) to create an osteotomy to receive two root form implant analogs (RC (regular cross fit), bone level implant analog, Titanium, L:12mm, D:3.8mm, Straumann; Switzerland) with the diameter and length (3.8 x 12mm). The parallelism between the two osteotomies was checked by the aiding of the paralleling tools. Using a dental surveyor (Ney Dental Intl Surveyor) the surveyor table was set to zero position (0 degree) so mandibular cast was parallel to the floor. The implants were inserted bilaterally in the canine regions parallel to each other and perpendicular to the residual ridge with the aid of the dental surveyor. (figure 3) The implant analogues were fixed to the models using flow mix of self-cured acrylic resin and flushed with ridge.

Overdenture processing:

Four mandibular trial denture bases with wax occlusion rims were constructed from the duplicated mold. The conventional steps of complete denture construction were then followed by flasking and wax elimination. After finishing and polishing, the two identical and fitted complete dentures were ready for pick up steps. (figure 1)

Attachments placement and pick-up :

According to the type of the attachments, the experimental models were divided into two equal groups. The first group included the models with 'Locator attachment' while the second group included the models with the 'Novaloc attachment'.

Locator Group:

Model 1, represented implants analogue with Locator attachment (figure 4)

Two zest anchor locator attachments (Regular neck , Titanium alloy , 3mm collar height, Straumann, Switzerland) were screwed to the mandibular overdentures by the screw driver then under torque of 35 N using torque wrench. A white block out spacer ring was placed around each abutment. Then, a metal denture cap with a black processing male was placed onto each abutment and was pressed down to ensure engagement of the abutment. (figure 5)

Using a fissure bur, the two holes (vents) were made in the lingual surface of the denture corresponding to the position of the attachments to create sufficient space for the acrylic resin during the pick-up procedure.

Cold-cure acrylic resin was mixed according to the manufacturer's instructions and placed in the fitting surface at the vents site when it was at the dough stage. The overdenture was seated over the caps and was left until the material set. Finishing and polishing of the acrylic resin was done. (The black processing male was removed and substituted by the pink nylon cap (the pink nylon cap is with light retention of 3 lbs retention force) using the locator core tool. (figure 8)

Novaloc group :

Model 2, represented implants analogue with Novaloc attachments. (figure 6)

Screw the two Novaloc (Regular neck, cough height 3mm, Titanium , Straumann, Switzerland) tightly into the implant analogs using the Straumann Screwdriver. Then torque the Novaloc to 35 Ncm using the torque wrench. The Novaloc processing Spacer was placed around each abutment. Then, a peek denture cap was placed onto each abutment and was pressed down to ensure engagement of the abutment. (Figure 7) The pick up procedures were done as same as for the Locator group. (figure 8)

Figure 1:Finished complete denture on epoxy resin cast

Figure 2:surgical stent with removed canines for drilling

Figure 3: analogues insertion by dental surveyor

Figure 4: Locator attachment model

Figure 5: Locator attachment with metal housing and nylon caps

Figure 6: Novaloc attachment

Figure 7: Novaloc attachment with PEEK housing and caps

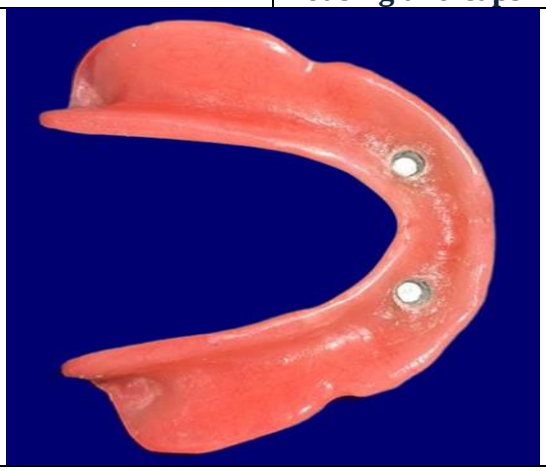

Figure 8: Picked up attachments within the finished and polished denture.

Retention assessment:

Geographic center:

The assessment of denture retention is most accurate done by pulling the denture in vertical direction from its geographic center. Stone is poured in the silicone mold in order to obtain an edentulous stone cast. Three lines were drawn on the duplicate cast and extended to the land area of the cast to aid in determining the geographic center of the lower denture. A wrought wire hook is attached to the denture by self-cure acrylic resin perpendicular to the geographic center.

Retention Measurements by universal testing machine:

Successive dislodging forces were applied using a universal testing machine (Model Ach-09075dc-T, Ad-Tech Technology Co., Ltd.) running at 5 mm/min with a load cell of 5 kN. The retention force was determined for the sample at baseline and after; 500, 1000, 1500 and 2000 cycles. The samples were submitted to fatigue and tensile strength tests using a servo-hydraulic universal testing machine, by gripping the vertical arm of resin bar by Jacob's chuck of upper compartment of materials testing machine. Data recorded by computer software (bluehill lite: instron instrument)

Wear Assessment

In order to perform the wear test, through removal and insertion cycling, a programmable logic-controlled equipment using the newly developed four stations multimodal Dual-axis ROBOTA (Model Ach-09075dc-T, Ad-Tech Technology Co., Ltd., Germany) chewing simulator was used. This device allows simulation of the vertical and horizontal movements simultaneously in the thermodynamic condition. The models were mounted and fixed to the lower part of the chewing simulator. Each denture was then placed on the corresponding abutment and fixed to the upper part of machine with triple orthodontic wire (0.5 mm).

The test conditions were maintained at room temperature (25 ± 2 ◦C). All the samples will be tested under standard conditions. Removal and insertion cycling was carried out for 500, 1000, 1500 and 2000 cycles (corresponding to 3,6,9 and 12 months of simulated clinical insertion and removal)

Wear microscopic evaluation:

Digital microscope with a built-in camera (Scope Capture Digital Microscope, Guangdong, China) photographed the attachment samples. This microscope was connected with an IBM compatible personal computer using a fixed magnification of 120×. Images were cropped to 350 x 400 pixels and then analyzed using WSXM software. The area, diameter and the perimeter of the attachment caps were captured at the base line and after selected loading cycles. The changes were measured digitally by the software.

RESULTS AND DISCUSSION

Retention Results

Comparison between group I & II:

Comparison between group I (Locator) & group II (Novalock) regarding retention was performed by using Independent t-test which revealed that retention of group I (Locator) was significantly higher (P<0.05) than group II (Novaloc) at baseline, 500 cycles,1000 cycles, 1500 cycles and 2000 cycles as presented in ***table (1)***

Table 1: Comparison between group I & II regarding retention:

	Retention				
	locator		Nova		p-value
	M	SD	M	SD	
Baseline	16.43	0.86	14.318	1.464	0.03*
500 cycles	15.69	1.24	11.756	1.173	0.002*
1000cycles	13.57	0.89	8.412	1.300	0.0003*
1500 cycles	12.34	0.85	7.070	1.682	0.0003*
2000 cycles	9.36	0.50	6.594	1.765	0.01*

M; *mean* *SD: standard deviation* *P; probability level (significant < 0.05).*

Wear results:

Statistical changes

Comparison between mean difference of wear (wear changes) of both groups was performed by using Independent t-test which revealed that locator was significantly higher than group II (Novaloc) regarding all intervals except (baseline\ 500 cycles) interval was significantly lower. Also, in (baseline \ 2000 cycles) interval (overall changes) group I (Locator) was significantly higher than group II (Novaloc) as presented in (figure 9, 10)

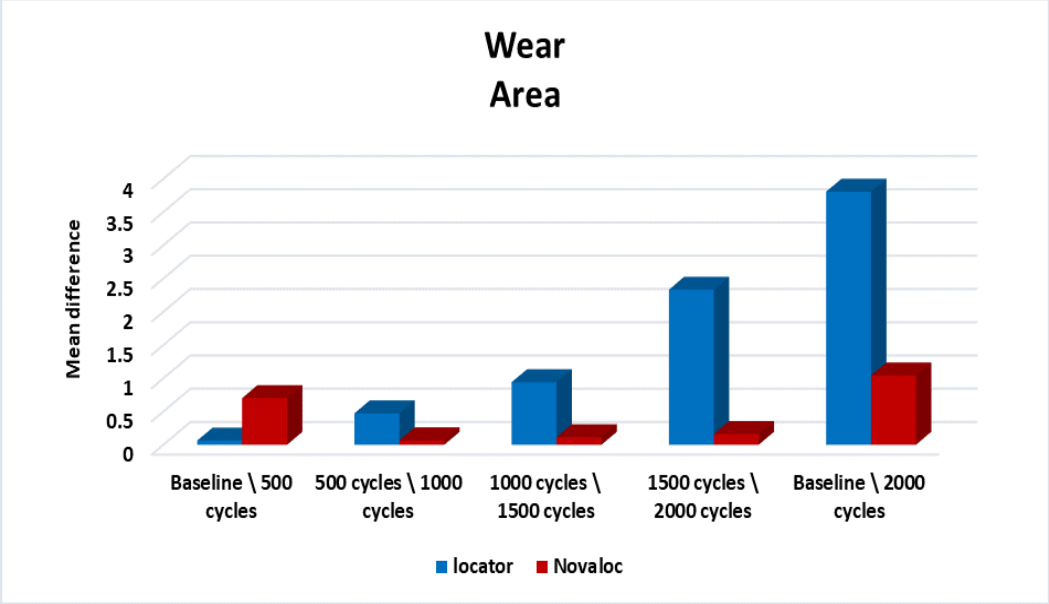

Figure 9: Mean difference of wear area of both groups

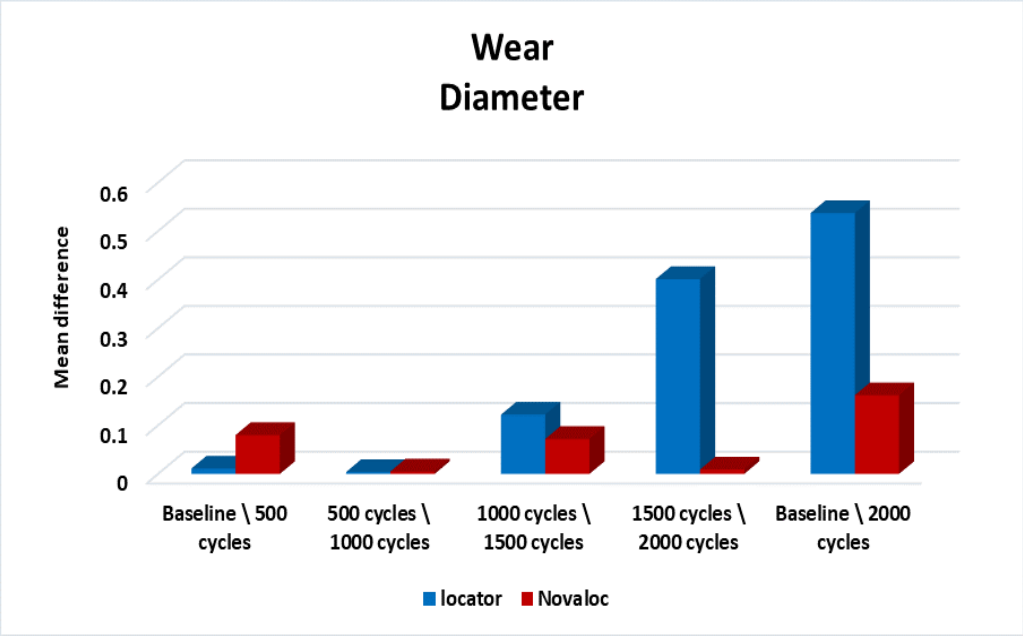

Figure 10: Mean difference of wear diameter of both groups

Microscopic Description

The Digital microscope images showed the morphological appearance and changes of the two attachment systems before and after the cyclic insertion–removal. Shots were taken at the preplanned intervals: Baseline, 500 cycles, 1000 cycles, 1500 cycles and 2000 cycles.

The present study tested the wear of attachments by subjecting them to in vitro simulations of chewing processes to estimate their stability under clinical conditions. In vitro testing is a straightforward research methodology. It was chosen in this study as its ability to perform more detailed analyses and can easily predict the clinical outcomes in the patient mouth.

Analogues were selected as12 mm length and 3.8 mm diameter. The 12 mm length was adequate length to obtain optimum stress distribution around the implants surface. Plateauing of the acrylic cast is done to reach a proper width of 6 mm in order to easily insert the analogues, leaving 1 mm for each buccal and lingual surfaces of the analogues.

The analogues were inserted bilaterally in the canine regions parallel to each other and perpendicular to the residual ridge with the aid of dental surveyor to ensure parallelism. The use of the dental surveyor was previously proven its efficacy. It was found that this method allows accurate and quick identification the undercut areas related to overdenture attachments. The surveyor can be used for careful adjustment to allow optimal seating of the attachments. [4,5]

The Locator system has been chosen in this study due to its reduced size, its retention capacity over time, and its better tolerance of angulation between implants than provided by other systems.[6] The nylon inserts selected for the present study were of pink color (light retention) of 3 lbs (13.35 N) retention. ELsyad et.al [7] reported that the pink insert had the highest axial, anterior, and posterior retention with parallel and slightly inclined implants.

While the comparator group presented as an innovative attachment known as Novaloc Retentive System (Insitut Straumann AG, Basel, Switzerland). It is a resilient holder and allows hinge movement. With the extractor and inserter kit, the PEEK holder can be removed from the slot without stress or pressure and a new one is inserted **(8)**. Light retention (white) inserts were chosen in this study to enable adequate and comparable retention with the Locator group.

It has been documented that the measurement of denture retention is more accurate done by pulling the denture in vertical direction from its geographic center. A wrought wire is hooked at this center. The hook was checked several times before starting the trial as it must be inserted passively without exerting any force to avoid false readings. [9,10]

The specimens were submitted to fatigue and tensile strength tests using Instron servo-hydraulic universal testing machine. This machine is well proved by literature as reliable and reproduceable tool to replicate the vertical separation of the denture from the mouth **(11)**. The tested overdentures were subjected to 2000 cycles of insertion and removal which simulate, nearly, one year. This time simulation was calculated by assuming that the patient removes and inserts his denture four times by day: once after each meal for cleaning and once before sleeping. [12]

ROBOTA chewing simulator operated on servo-motor was used in this study to simulate denture insertion and removal from the patient mouth. This simulator was previously used in several studies. Alagwany a et.al and El-Baz R et.al have documented that ROBOTA is an effective simulator and it reports valid results. [13,14]

Using digital light microscope (Celestron, LLC., Torrance, CA, USA), all attachments had been perceived using the same object lens distance and the same magnification. The microscope presented a good resolution and accurate measurements of the traced wear planes of the attachments **(15).** The digital microscope was used for wear detection of different materials as well as natural teeth.[15,16]

In this study, there was a statistically significant decrease in the retention of Locator group as retention at baseline was (16.43 ± 0.86), then decreased gradually to (9.36 ± 0.50). This could be explained the continuous wear of the nylon cap due to repeated insertion and removal of the chewing simulator. This was with the agreement with a study stated that the loss of attachment retention, with a metal-to-polymer friction, mainly resulted from the deformation of the polymeric matrix.

The authors found that the rate of retention loss was higher in attachment types containing plastic or nylon components than those totally made of metal. **(17)** Several studies reported similar results and showed that with the design of dual retention, Locator attachments may suggest controlled lateral movement so that the overdenture stability can be increased. The increased retention of pink inserts may be obtained from the friction between the inner and outer flanges, which comes from the dimensional mismatch between the slightly larger insert and smaller diameter of the inner ring of the Locator abutment. [18,19,20]

Regarding the comparator group of Novaloc, there was a statistically significant decrease in retention as the retention at baseline was (14.3 ± 1.4) then decreased gradually to (6.5 ± 1.7) after 2000 cycles. This decrease could be explained as the main retainer part placed on the abutment is in the form of a non-coalescing ring. The small gap left between the patrix and the matrix allows it to expand without tension or severe friction, thus significantly extending its service life.[8]

The Digital microscope examination of the nylon inserts of Locator attachments in this study revealed changes in the surface characteristics upon completion of 2000 insertion and removal cycles. Regarding area, diameter and perimeter showed a minimum amount of wear changes (mean difference ± standard deviation) till it reached the highest amount of wear at (1500 cycles\2000 cycles) interval. This could be due to the insertion and removal actions which would lead to loss of direct and friction contact between male and female part of the Locator which was the common finding to Stephens et al.'s study. [21]

Regarding the comparator Novaloc group, due to its combination of a polyetheretherketone (PEEK) matrix and the amorphous diamond-like carbon (ADLC)-coated cylindrical patrix. The abrasion-resistant surfaces (ADLC) of these abutments are intended to have a positive effect on the wear behavior.[22] In addition, the design of the inserts can also have an influence on the behavior of the attachment system. Systems with an incomplete ring design with a slot as Novaloc will probably featuring differently from those featuring a design with a full ring as Locator. This slot expands when connecting the matrix and the patrix and might act as a buffer, which reduces the deterioration of the matrix surface resulting in a reduced wear of the material. [23,24]

Comparison between mean difference of wear (wear changes) of both groups was performed revealed that in (baseline \ 2000 cycles) interval (overall changes) group I (Locator) was significantly higher than group II (Novaloc). That could be explained as the matrix of Locator systems was made up of synthetic polymer. Therefore, the deviation of the mean difference values of the retentive force and the retention loss were distinctly marked. The degradation of the nylon used in locator attachments would lead to a significant wear rate during repeated insertion and removal of the implant attachment system. [25]

CONCLUSION

With respect to the limitations of this study, it can be concluded that: Both the Locator and Novaloc attachment systems had a significant retention decrease and weared by time. This means that Novaloc has a retention force value considered sufficient for clinical use. The Locator system had a significantly higher initial retention value compared to the Novaloc attachments. The rate of wear in overdenture attachments was higher in Locator attachment which comprised plastic (nylon) parts within their components, rather than those of Novaloc with its PEEK inserts.

REFERENCES

1. Feine JS, Carlsson GE, Awad MA. Mandibular Two-Implant Overentures as First-Choice Standard of Care for Edentulous Patients. Report on McGill Consensus Statement on Overdentures. Int J Oral Maxillofac Implants. 2002:601-2.
2. Fajri L, Abdelkou A, Ismaili Z, Merzouk N. Attachement locator® en prothèse amovible complète stabilisée sur implants: description et mise en oeuvre pratique. African Journal of Dentistry & Implantology. 2020 Jan 27(16).
3. Maniewicz S, Badoud I, Herrmann FR, Chebib N, Ammann P, Schimmel M, Müller F, Srinivasan M. In vitro retention force changes during cyclic dislodging of three novel attachment systems for implant overdentures with different implant angulations. Clinical oral implants research. 2020 Apr;31(4):315-27.

4. Elshenawy EA, Alam-Eldein AM, Abd Elfatah FA. Cast accuracy obtained from different impression techniques at different implant angulations (in vitro study). International journal of implant dentistry. 2018 Dec;4(1):1-9.
5. Loney RW, Lee CJ, Michaud PL, Cook TJ. Use of a dental surveyor to ensure optimal seating of implant overdenture attachments. The Journal of Prosthetic Dentistry. 2019 Mar 1;121(3):381-3.
6. ELsyad MA, Dayekh MA, Khalifa AK. Locator versus bar attachment effect on the retention and stability of implant-retained maxillary overdenture: An in vitro study. Journal of Prosthodontics. 2019 Feb;28(2):e627-36.
7. ELsyad MA, Emera RM, Ashmawy TM. Effect of distal implant inclination on dislodging forces of different locator attachments used for mandibular overdentures: an in vitro study. Journal of Prosthodontics. 2019 Feb;28(2):e666-74.
8. Koçak Büyükdere AY. Implant Destekli Hareketli Protezler. Dental and Medical Journal-Review. 2021;3(1).
9. Badra HS, Radi IA, Aboulela A. The effect of ultra-suction system on the retention of mandibular complete denture. DENTAL JOURNAL. 2010 Jan;56(101):109.
10. Mustafa AZ. Effect of the lingual ledge of neutral zone impression on the retention and stability of mandibular complete denture in elders with atrophied alveolar ridge. Tanta Dental Journal. 2015 Jun 1;12(2):111-8.
11. Fromentin O, Lassauzay C, Abi Nader S, Feine J, de Albuquerque Junior RF. Testing the retention of attachments for implant overdentures–validation of an original force measurement system. Journal of Oral Rehabilitation. 2010 Jan;37(1):54-62
12. Choi JW, Bae JH, Jeong CM, Huh JB. Retention and wear behaviors of two implant overdenture stud-type attachments at different implant angulations. The Journal of prosthetic dentistry. 2017 May 1;117(5):628-35.
13. Alagwany A, Diab Fatoh MA, Helal MA, Mahmoud II. Wear Resistance Evaluation of the Thermoplastic Acetal Resin Denture Base Material–An In Vitro Study. Journal of Clinical Research in Dentistry. 2019;2(2):1-5.
14. El-Baz R, Fayad M, Abas M, Shoieb A, Gad M, Helal MA. Comparative study of some mechanical properties of cobalt chromium and polyether ether ketone thermoplastic removable partial denture clasps: an In-vitro Study. Brazilian Dental Science. 2020 Jun 30;23(3):6-p.
15. Ibrahim NM, El-basty R, Katamish H. Clinical Evaluation of Wear Behavior of Human Enamel and Chipping of Veneered Zirconia against Monolithic Zirconia (Randomized Controlled Clinical Trial). Brazilian Dental Science. 2020 Sep 30;23(4):11p-.

16. Habib SR, Ansari AS, Alqahtani M, Alshiddi IF, Alqahtani AS, Hassan SH. Analysis of enamel and material wear by digital microscope: an in-vitro study. Brazilian Oral Research. 2020 Jan 10;33.
17. Hedzelek W, Rzatowski S, Czarnecka B. Evaluation of the retentive characteristics of semi-precision extracoronal attachments. J oral rehabilitation. 2011 Jun;38(6):462-8.
18. Alsabeeha N, Atieh M, Swain MV, Payne AG. Attachment systems for mandibular single-implant overdentures: an in vitro retention force investigation on different designs. International Journal of Prosthodontics. 2010 Mar 1;23(2).
19. Kleis WK, Kämmerer PW, Hartmann S, Al-Nawas B, Wagner W. A comparison of three different attachment systems for mandibular two-implant overdentures: One-year report. Clinical implant dentistry and related research. 2010 Sep;12(3):209-
20. Gonuldas F, Tokar E, Ozturk C. Evaluation of the retention characteristics of various stud attachment systems for implant retained overdenture. Acta of bioengineering and biomechanics. 2018;20(4).
21. Stephens GJ, di Vitale N, O'Sullivan E, McDonald A. The influence of interimplant divergence on the retention characteristics of locator attachments, a laboratory study. Journal of Prosthodontics. 2014 Aug;23(6):467-75.
22. Yue Q, Yilmaz B, Abou-Ayash S, Zimmermann P, Brägger U, Schimmel M. Use of an attachment system with angulated abutments and polyetheretherketone inserts to retain a maxillary overdenture: A clinical report. The journal of prosthetic dentistry. 2020 Aug 1;124(2):129-34.
23. Passia N, Wichmann N, Taylor T, Wille S, Kern M. Retention and wear of attachments for implant overdentures. Clinical Oral Implants Research.2019 Sep;30:123-.
24. Srinivasan M, Kalberer N, Maniewicz S, Müller F. Implant overdentures retained by self-aligning stud-type attachments: A clinical report. The Journal of prosthetic dentistry. 2020 Jan 1;123(1):6-14.
25. Chiu LP, Vitale ND, Petridis H, McDonald A. The effect of different water temperatures on retention loss and material degradation of locator attachments. Journal of Prosthodontics. 2017 Aug;26(6):537-44.