IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 2 Ser. 9 (February. 2019), PP 56-65
www.iosrjournals.org

Surface wear of All Zicronia, All PEEK and Zirconia-Peek Telescopic Attachments for Two Implants Retained Mandibular Complete Overdentures. In -Vitro study using scanning electron microscope.

*Radwa M. K. Emera1, Mohamed Elgamal2,Mona M.albadwei 3

1 Associate professor of removable prosthodontics, faculty of dentistry, Mansoura University
2 Lecturer of removable prosthodontics, faculty of dentistry, Mansoura University.
3. B.D.S (2006), Faculty of Dentistry, Elmerqep University, Lybia.
*Corresponding author: * Radwa Mohsen kamalEmera*

Abstract
Purpose: *This study aimed to investigate and compare wear of telescopic attachments constructed from different tooth colored materials by evaluating surface changes of both primary and secondary copings using Scanning Electron Microscope (SEM).* ***Materials and methods:*** *Three identical clear acrylic resin models of completely edentulous mandibular arch were fabricated for this study. Two implants were installed bilaterally in canine region of the models by the aid of guide template. The models were scanned to design resilient telescopic attachment using CAD/CAM technology on the 3D image of the model. According to the material used to fabricate the telescopic attachment, the models were categorized as follows: 1-st group* ***(PP)*** *whereprimary and secondary telescopic copingswere constructed from peek, 2-nd group* ***(ZZ)*** *where primary and secondary telescopic copings were constructed from zirconia, 3-rd group* ***(ZP)*** *where the primary copings were made from zirconia and secondary ones were made from PEEK. Three identical mandibular complete overdentures were constructed. The secondary telescopic copings of each group were picked up in the overdenture fitting surface. Surface changes of primary and secondary copings were evaluatedusing scanning electron microscope (SEM) at time of secondary copings pickup (T0) and after simulation of 6 monthsofoverdenture use (T6).*
Results*: Significant wear was shown within each group between T0 and T6 and between groups in both primary and secondary coping where the highest wear was found in ZP group followed by PP group and the lowest wear in ZZ group.*
Conclusions*: With respect to limitations of this study, it could be concluded that:Combining PEEK and Zro_2 materials for telescopic attachment construction may be associated with more changes in surface topography in contrast to all PEEK or all zircon telescopic attachments.*
Keywords: *Zircon-PEEK Telescopic Attachments, Implants Retained Mandibular Overdentures, wear.*

Date of Submission: 01-02-2019 Date of acceptance:18-02-2019

I. Introduction:

Treatment of completely edentulous patient with implant assisted overdenture became a common treatment modality that greatly improve the patient's quality of life, used successfully in many clinical situations, has economic advantage to the patients and provide sufficient retention to their mandibular dentures. In fact two implants placed in the interforaminal region to assist such overdentureshave been recommended as a minimum standard of care for the edentulous patient. [1]

These implant overdentures can be retained by many types of attachments either by splinting concept (bar –clip constructions with various designs and shapes) or non-splinted concept (ball type, locator, telescopic and magnetic attachments). Telescopic attachments are described as double crowns or crown and sleeve coping (CSC). Inner or primary telescopic coping is cemented to the abutment and outer or secondary coping is connected to a detachable prosthesis. Many studies recommended the use of telescopic attachments for retaining overdentures as they transmitocclusalload along the abutments long axis and provide support, guidance and protection against dislodging forces.[2]

Metal alloys were considered the most commonly used material for telescopic attachment construction, as it exhibits good physical and mechanical properties, however,the recent demands for the metal free concept in dentistry, together with the increased sensitivity and allergies of some patients, have promoted the development of new materials. [3]Additionally,recent improvement in the field of computer-aided designing

(CAD) and computer-aided manufacturing (CAM) offered easier manipulation of new materials with high quality.

Zirconia (ZrO_2) is the form of zirconium (Zr) that was used in medicine and dentistry. It excellent esthetics, biocompatibility, superior mechanical properties than metals, and wear resistance has recently supportedits use in the fabrication of frameworks, implants, and double crowns. [4]

Another promising material is the thermoplastic high-performance polymer; Polyetheretherketone (PEEK). PEEK has high hardnessand resistance to abrasion andlow water solubility. [5]Recent studies concluded that PEEK is a suitable material for fabricating double crown attachment. Therefore,these two biocompatible materials, i.e., ZrO_2 and PEEK could be combinedas a new concept in order to produce metal free telescopic attachment.[6]

One of the most common problems of attachmentsused with implant overdenture is wear occurs after period from its use which lead to retention loss. [7] Since a limited data is available regarding wear of ZrO_2 and PEEK as a telescopic attachments materials, this study was conducted to evaluate changes in surface topography of both primary and secondary copings of telescopic attachments constructed from different tooth colored material.

II. Materials and methods:

1-Fabrication of clear acrylic resin models: Polyvinyl siloxane material (speedexcoltonA, Switzerland) was used to make an impression for edentulous mandibular stone cast. The impression was poured in molten baseplate wax that was flasked after complete hardening. Three identical clear acrylic resin models were fabricated.

2-Simulation of oral mucosa layer: Residual alveolar ridges and retromolar pad area of acrylic resin models were caoted by 2mm thickness baseplate wax. A plaster index to the model was fabricated and extended to buccal and lingual areas. The wax was eliminated and the intaglio surface of the index was painted with separating medium and was filled with autopolymerized silicon material. The index was refitted on the model and fixed by rubber band untill complete polymerization of silicone soft liner. Excess material was removed with sharp scalpel.

3-insertion of implants in the resin models:

Aguide templatefor implant placement was fabricated from clear acrylic resin with two guide holes in canine region through the following steps:

- One of the clear acrylic resin models was duplicated in dental stone.
- Conventionalrecord block was constructed on the stone cast.
- Semi anatomical artificial teeth were arranged followed by waxing and flasking of the trial denture.
-Clear heat-cureacrylic resin dough was packed into the mold cavity.
- After the processing procedures, the guide template was finished and polished.
-Dental milling machine (milling unit BF2 ,Bredent ,GmbH &Co Senden, Germany)was used to drill two vertical holes through the guide template in canines region bilaterally.

Two dummy implants (DentiumSeoul ,South Korea) with 4.5mm diameter and 10mm length were inserted in the prepared sockets and abutments (Dentium ,Seoul,South Korea) of 4.5mm diameter and 1.5mm gingival height were screwed to the implants.**Fig 2.**

4-Study groups: according to the material of telescopic attachment fabrication, the models were categorized as follows: **(All Peek telescopic group (I) or pp):** The primary and secondary copings were made from PEEK. **(All Zirconia telescopic group (II) or zz):** The primary and secondary copings were made from ZrO_2. **(Zirconia Peek telescopic group (III) or zp):** The primary copingswere made from ZrO_2 and secondary oneswere made from PEEK. The models were scanned to design resilient telescopic attachment using CAD/CAM technology on 3D virtual model image.

The same parameters for designing primary copings were maintained for all groups concerning 5mm height (3mm gingival height was paralleled and the occlusal2mm was occlusaly tapered 4^{o}). The computer numeric control (CNC) data were transmitted to a milling machine and connected to the CAD system (Shera eco_scan3 Germany) to mill primary copings from semi-sintered zirconia (Zirconia Katan) for ZZ and ZP groups and PEEK blocks (Bredent Peek ,Germany)for PP group.

Scanning of primary copings was done for designing the secondary copings on their 3D image .Parameters used for designing secondary copings were parallel wall with minimal wall thickness of 0.5 mm and an occlusal space (0.3mm) was preserved between the primary and secondary copings.Projections were added to secondary copings design to enhancetheir mechanical retention to the overdenturefitting surfaceaccording to

Emera, 2016 (8)Fig 2. Data were finally transferred to the CAM program for milling of the secondary crowns from ZrO_2 for ZZ group and PEEK for ZP and PP groups.
Three identical mandibular complete overdentures were constructed. The secondary telescopic copings of each group were picked up within the intaglio surface of each denture. **Fig 3.**

5-Wear evaluation:

Surface topography changes of primary and secondary crowns were evaluated using scanning electron microscope(SEM). Analysis was performed to primary and secondary crowns at time of secondary copings pickup (T_0) and after simulation of 6 months of overdenture use (T_6) where repeated insertion and removal of the overdenture was done in axial direction up to the range of 540 cycles to represent six months of clinical function on the basis of three times daily removal and insertion of the overdenture per day.

The primary and secondary copings were prepared to be evaluated with scanning electron microscope (SEM) by coating with gold/palladium using Hummer VI deposition system for about 1.0-1.5 minutes of sputtering **Fig 4.** Samples were studied using electron microscope (JOEL-JSM-6510LV) at 14X, 150X magnification power. Evaluation of surface changes (wear) was done by using Computer Assisted digital image analysis (Digital morphometric study)**Fig 5,6,7**. The resultant images were analyzed on Intel® Core I3® based computer using Video Test Morphology® software (Russia) with a specific built-in routine for pixel statistics**.**

Statistical analysis:

Data were tabulated, coded then analyzed using the computer program SPSS (Statistical package for social science) version 23. Descriptive statistics were represented in the form of Mean ±Standard deviation (SD) .data was normally distributed as detected by Shapiro-wilk test.Student's t-test (paired) was used to compare means of the two different evaluation periods within each group. One way ANOVA (analysis of variance) was used to compare means of different groups followed by post-hoc tukey test.P- value<0.05 was considered as statistically significant.

III. Results:

Mean values ofSEM surface topography analysis at T_0 and T_6 of all groups primary copings (top and wall surfaces) and secondary coping

were presented in table (1), Comparison ofmean values between T_0& T_6 within each group showed a significant difference regarding all observed surfaces. Least mean values was observed in ZZ group followed by PP group, while ZP group showed the highest mean values especially for secondary copings.

Comparison ofsurface topography changes at T6 of primary copings (top and wall surfaces) and secondary copings revealed a significant difference between all groups as shown in table (2).While insignificant difference was found between PP, ZZ groups regarding secondary copings surface changes.

IV. Discussion:

Wear induced loss of retention represents a major clinical problem in attachment retained overdentures. Therefore, the selection of attachment type essentially depends on the material and design which will offers the best conditions for long functional life. [9,10] Unfortunately, the frictional wear during function represents a common problem of the double crown retention concept that often reduces the patient's satisfaction and resulting in a renewal of the prosthesis. [11,12]Decrease in retention force of telescopic attachmentis caused by tribological phenomena modifying the crowns surface structure. The amount and type of observed wear is based on the physical and mechanical properties of the materials in contact with one another. [13-16]However,preferablecombinations for certain materials in attachment systems remains inconclusive. [7]

Several materials and combinations of materials were used for telescopic crowns fabrication such as precious and non-precious metal alloys, zirconia and PEEK. Further long term studies were recommended to monitor the progonis of these materials and to innovate new materials and designs of telescopic attachments.[17]Consequently, the purpose of the current study was to evaluate and compare changes in surface topography of all PEEK, all zircon and zircon-PEEK telescopic attachments after simulating six months of overdenture use.

None of the problems associated with metal alloys was observed when the primary crowns wereconstructed of a tooth-colored material like zirconia that became possible by the improvements in the manufacturing techniques. [18] Its tooth color, high biocompatibility, and resistance to wear have encouraged its userecently. [19,20]Previous studies demonstrated zircon low abrasive and wear potential, even when placed in function against a like material just as hard with identical material properties.[21] In the study of Vafaee et al [22], the wear of ceramic and titanium attachments was clinically evaluated and the least wear was observed in ceramic attachments.This may explain the least wear of all zircon group in comparison to the wear observed in all PEEK and zircon- PEEK groupsin this study. Additionally, Turp et al [3] suggested that despite the lack of knowledge about the aging of zirconia in the oral environment without a veneer layer, zirconia primary crowns were advantageous regarding the low wear potential andpreservation of retention force.

It was concluded that PEEK may be a proper material for constructing primary crowns, regardless of the material and taper of secondary crown. [23]Telescopic attachment made of PEEK seems to show stable retention force. [24] However, limited data is available about wear behavior of CAD-CAM polymer materials especially PEEK. [25]

The results of this study revealed more wear in all PEEK telescopic attachment as compared to all zircon group. A potential explanation could be the low elastic modulus and ductility of PEEK. **Zsidai**and **Kátai** [26] reported thatphysical properties of materials (modulus of elasticity in particular) were said to modulate its wear behavior.

PEEK composites perform better than pure PEEK in tribological test. [27] Micro and nano-sized (SiO2) filler in PEEK provided less rate of wear and lower friction coefficients than the unfilled type. [28]Meanwhile, its polishing is difficult but necessary to obtain optimal smooth surface. [23] This finding may share in causing the significant wear of all PEEK telescopic attachment group despite using of ceramic filled PEEK (Bio Hpp) in this study.

Regarding retention load, PEEK can be considered as a suitable material for telescopic crown fabrication when used on zirconia crowns. [29] However, long term studies and more advancement of PEEK CAD-CAM processing are still requires as concluded by Merket al.[30]

It is clear that different CAD/CAM materials behave very differently when placed in function opposing one another .The use of hard and wear resistant material for primary crowns against a less hard material for secondary crowns may be advantageous. Minimum changes will occurin the primary crown, which is designed according to the treatment plan of the dentist, and the adaptation between both crowns will be achieved by the changes in the secondary crown. [14]

One of the prosthetic options in combining the use of PEEK restorations with zirconia is the load-cushioning capacity. [31] It was concluded that zircon-PEEK telescopic attachments transmitted the least stresses to the implants retaining mandibular complete overdentures in comparison to all PEEK, and all zircon ones. [32] PEEK has a low modulus of elasticity (4 GPa) compared to other conventional materials as titanium (110 GPa) or zirconia (210 GPa), thus PEEK restorations absorb occlusalloads and wear as natural teeth.These observationsare in consistence with the results of this study where the greatest wear was shown with zircon-PEEK group (mainly in secondary crowns). Fortunately, the exceptional advantage of double crowns digital construction is that in case of retention loss or damage of secondary crowns,reproduction ofany part of the system can be done, any number of times, based on the stored data.[30]

No standard protocol has been established for in-vitro evaluation of double crowns. Generally, each in-vitro wear test protocol poses a number of limitations. [33,34]So, the comparison of the present study results with that of other studies should be donewith caution as the test parameters are significantly different from one study to the other. [35,36]

Material loss in the clinical environment is in general lower than that in laboratory studies. In-vitro wear tests show little correlation to clinical situation but enables comparative evaluation of different materials under standardized conditions. [37]To investigate reliability of in-vitro wear results, clinical studies are needed and envisaged.[38]

Significant wear appeared in all groups after simulating six months of overdenture use may be a result of limitations of the present study where only the vertical forces exerted on the double crowns were evaluated, although lateral forces affecting the retainer are also present intraorally; Horizontal forces which are to be expected during the chewing process were not simulated. [39]As wear was only simulated in the axial direction; this can be a result of selective wear of certain attachment surfaces. [34] Additionally, no lubricating material was used in this study protocol. Although a large number of the sliding friction studieswere done in non-lubricatedenvironments; studies in lubricated environmentare necessary. A direct correlation was observed between the rate of wear and the presence of lubrication, wherein wear under hydrodynamic conditions was approximately 5 times lower than that without lubrication. [40]Clinically, presence of saliva betweenpatrixand matrix acts as a lubricant and protective layer that reduces wear.[41]

Moreover, the manufacturing technique and the precision of the milling process may affect the prognosis of the milled crowns. The milling path, depending on the milling strategy and work piece has to be considered as a limitation of the CAD-CAM constructed secondary crowns because of their effect on the quality of secondary crowns inner surface.[29]

V. Conclusion:

With respect to limitations of this study, it could be concluded that:
Combining PEEK and Zro_2 materials for telescopic attachment construction may be associated with more changes in surface topography in contrast to all PEEK or all zircon telescopic attachments.

Recommendations:

Further studies regarding thermo-mechanical loading andfatigue testing are recommended, clinical studies are also needed to support the use of PEEK for double crowns in long-term investigations.

References:

[1]. Estrada MM, Lopes BA.: Behavior of Implant-Bearing Overdenture materials With A Change In Number And Position Implants. J Dent Health oral DisordTher 2017; 8(1): 00269.

[2]. KarnikS :Burak Y : Edwin M.: Fabrication of amandibular implant-Supported overdenturewith anew attachment system :A review of current attachment systems .Int J Prosthodont . 2017: 30(3): 245-247.

[3]. Turp I, Bozdağ E, Sünbüloğlu E , Kahruman C .: Retention and surface changes of zirconia primary crowns with secondary crowns of different materials. Clin Oral Invest, 2014; 18(8):2023–2035.

[4]. Manicone P, Rossi Iommetti P, Raffaelli L.: An overview of zirconia ceramics: Basic properties and clinical applications. J Dent, 2007; 35(11): 819-826.

[5]. Liebermann A, Wimmer T, Schmidlin H, Loffler P, Roos M, Stawarczyk B: Physicomechanical characterization of polyetheretherketon and current esthetic dental CAD/CAM polymers after aging in different storage media. J Prosthet Dent, 2016;115(3):321-328.

[6]. Schwitalla A, Abou-Emara M, Spintig T, Lackmann J, Muller W.: Finite element analysis of the biomechanical effects of PEEK dental implants on the peri-implant bone. J Biomech, 2015; 48(1): 1-7.

[7]. Alsabeeha NH1, Payne AG, Swain MV.: Attachment systems for mandibular tow – implant overdentures :a review of in vitro investigation on retention and wear features. Int J Prosthodont. 2009; 22(5):429-440.

[8]. Emera, R. M.: All zirconia double crowns for retaining complete mandibular overdenture. Clinical and microbiological evaluation of natural abutments. Egyptial dental journal, 2016; 62:1959- 1972.

[9]. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses.Journal of Prosthetic Dentistry.2003; 90: 121-32.

[10]. Chaffee NR, Felton DA, Cooper LF, Palmqvist U, Smith R. Prosthetic complications in an implant-retained mandibular overdenture population: initial analysis of a prospective study. Journal of Prosthetic Dentistry.2002; 87: 40-4.

[11]. Bayer S, Kraus D, Keilig L, Gölz L, Stark H, Enkling N. Wear of double crown systems – electroplated vs. casted female part. J Appl Oral Sci. 2012;20(3):384-91

[12]. Majchera A., Leśniewska-Kochanekb A., MierzwińskaNastalskab E. A method and a device for the evaluation of the retention of telescopic dental crowns. J MechBehav Biomed Mater, 2017; 69:362–367.

[13]. Kochanek-Leśniewska A, Majcher A, Mierzwińska-Nastalska E. The Evaluation of Changes in Retention Force Values in Three-Element Telescopic Crown Systems using Simulated Load Cycles. Int J Dentistry Oral Sci. 2017;4(12):565-574.

[14]. Bayer S, Zuziak W, Kraus D, Keilig L, Stark H, Enkling. Conical crowns with electroplated gold copings: retention force changes caused by wear and combined off-axial load. Clin Oral Impl Res. 2011 Mar;22(3):323-329.

[15]. Bayer S, Stark H, Mues S, Keilig L, Schrader A, Enkling N. Retention force measurement of telescopic crowns. Clin. Oral Invest. 2010 Oct;14(5):607- 611. PubMed PMID: 19609574.

[16]. Mahross H, Baroudi K .Evaluation of Retention and Wear Behavior for Different Designs of Precision Attachments. OHDM 2015;14(4): 244-249.

[17]. HakkoumM ,WazirG. Telescopic Denture .The Open Dentistry Journal, 2018, 12, 246-254.

[18]. Uludağ B, Şahin V, Öztürk Ö (2008) Fabrication of zirconium primary copings to provide retention for a mandibular telescopic overdenture: a clinical report. Int J Prosthodont 21:509–510.

[19]. Beuer F, Edelhoff D, Gernet W, Naumann M (2010) Parameters affecting retentive force of electroformed double-crown systems. Clin Oral Investig 14:129 135.

[20]. Engels J, Schubert O, Guth JF, Hoffmann M, Jauernig C, Erdelt K, Stimmelmayr M, Beuer F (2013) Wear behavior of different double-crown systems. Clin Oral Investig 17(2):503–510.

[21]. ZUREK A. The wear characteristics and volume lLoss of different CAD/CAM Materials. MastersThesis . University of Illinois at Chicago, 2016

[22]. Vafaee F, Fotovat F, FiruzF,Soufiabadi S, RoshanaeiG,Amraei H, Khoshhal M. Hybrid Odontogenic Lesion: A Rare Entity. J Dent Mater Tech 2016; 5(4): 181-88

[23]. Stock V, Schmidlin P, Merk S, Christina Wagner C, Roos M, Eichberger M, Stawarczyk B . PEEK Primary Crowns with Cobalt-Chromium, Zirconia and Galvanic Secondary Crowns with Different Tapers—A Comparison of Retention Forces.Materials 2016, 9, 187.

[24]. Wagner C, Stock V, Merk S, Schmidlin PR, Roos M, Eichberger M, Stawarczyk B.Retention lLoad of telescopic crowns with different taper angles between Cobalt-Chromium and Polyetheretherketonemade with three different manufacturing processes examined by pull-off Test. J Prosthodont. 2018;27(2):162-168.

[25]. WimmerT,Huffmann A,EichbergerM, Schmidlin P,Stawarczyk B. Two-body wear rate of PEEK, CAD/CAM resin composite and PMMA: Effect of specimen geometries, antagonist materials and test set-up configuration. Dental Materials 2016; 32(6):e127-e136.

[26]. LászlóZsidai, LászlóKátai .Abrasive Wear and Abrasion Testing of PA 6 and PEEK Composites in Small-Scale Model System. ActaPolytechnicaHungarica 2016; 13(6): 197-214.

[27]. Lind J, Lindholm P , Qin J , KassmanRudolphi A. Friction and wear studies of some PEEK materials. Finnish Journal of Tribology 2015 ; 33(2): 20-28.

[28]. Shao X, Xue Q: Effect of Nanometer and Micrometer SiO(2) Particles on the Tribology Properties of Poly (phthalazine ether sulfone ketone) Composites, Materials and Mechanical Engineering. 2004; 28 (6): 39-42.

[29]. Merk S, Wange C, Stock V , Echberger M, Schmildin P, Roos M, Stawarczyk B. Suitability of secondary PEEK telescopic crown on zirconia primary crown: The Influence of fabrication method and taper. J materials 2016; 9: 908-917.

[30]. Schubert O, Reitmaier J, Schweiger J, Erdelt K, Güth JF.Retentive force of PEEK secondary crowns on zirconia primary crowns over time.Clin Oral Investig. 2018;6:1–8

[31]. Parmigiani-Izquierdo J M , Cabaña-Muñoz M E , Merino J J, Sánchez-Pérez .Zirconia implants and peek restorations for the replacement of upper molars. Intl J Impl Dent. 2017; 3:1-5

[32]. Elbashir S, Emera R, AltonbaryG: Comparison between all Zirconia, all PEEK and Zirconia-Peek telescopic attachments for two implants retained mandibular complete overdentures. In-vitro stress analysis study. MastersThesis.Faculty of Dentistry, Mansoura University, 2018.

[33]. Heintze SD, Forjanic M. Surface roughness of different dental materials before and after simulated toothbrushing in vitro. Oper Dent. 2005;30:617-26.

[34]. Rutkunas V, Mizutani H, Takahashi H. Influence of attachment wear on retention of mandibular overdenture. J Oral Rehabil. 2007;34:41-51.

[35]. Heintze SD. How to qualify and validate wear simulation devices and methods.Dent Mater 2006;22:712-34

[36]. Lambrechts P, Debels E, Van Landuyt K, Peumans M, Van Meerbeek B. How to simulate wear? Overview of existing methods. Dent Mater 2006;22:693-701.

[37]. Rosentritt M, Siavikis G, Behr M, Kolbeck C, Handel G. Approach for evaluating the significance of laboratory simulation. J Dent 2008;36:1048-53.

[38]. Park J, Ahn J, Cha H, and Lee J. :Wearresistance of 3D printing resin material opposing Zirconia and metal antagonists.Materials 2018, 11, 1043-1053.

[39]. Lughi V, SergoV :Low temperature degradation — aging – of zirconia: a critical review of the relevant aspects in dentistry. Dent Mater. 2010; 26:807–820.

[40]. Andrade T, Wiebeck H, Sinatora A. Effect of surface fnishing on friction and wear of Poly-Ether-Ether-Ketone (PEEK) under oil lubrication Polímeros. 2016; 26(4), 336-342.

[41]. Holst S, Blatz MB, Eitner S, Wichmann M. In vitro wear of different material combinations of intracoronal precisionattachments.Int J Prosthodont. 2006; 19: 330-32.

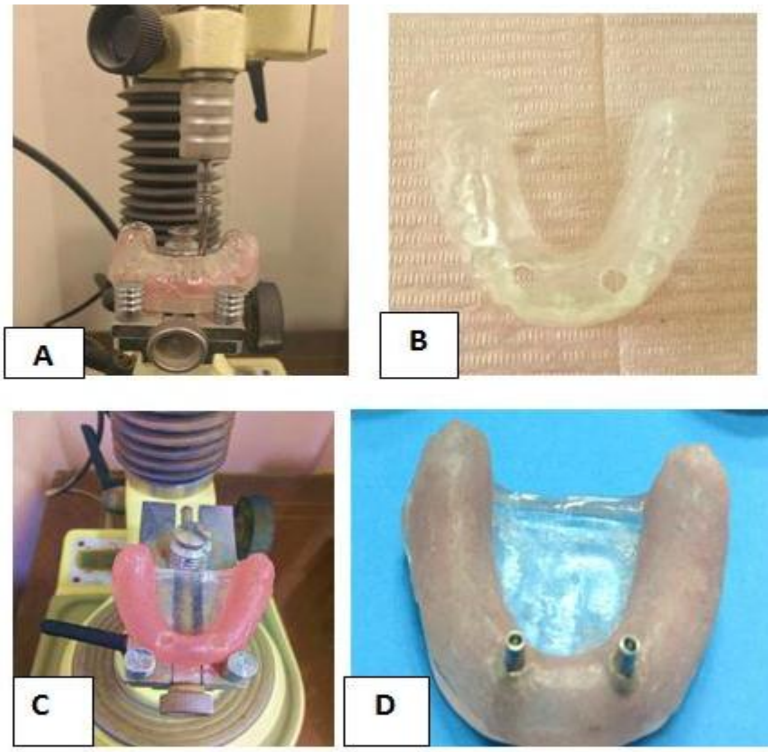

Fig 1: A-Two holes were drilled in the guide template using the milling machine.
B- Finished implant placement guide template.
C-Two holes were drilled in canine region of the model.
D:Two implants were inserted bilaterally in canine regions of the model.

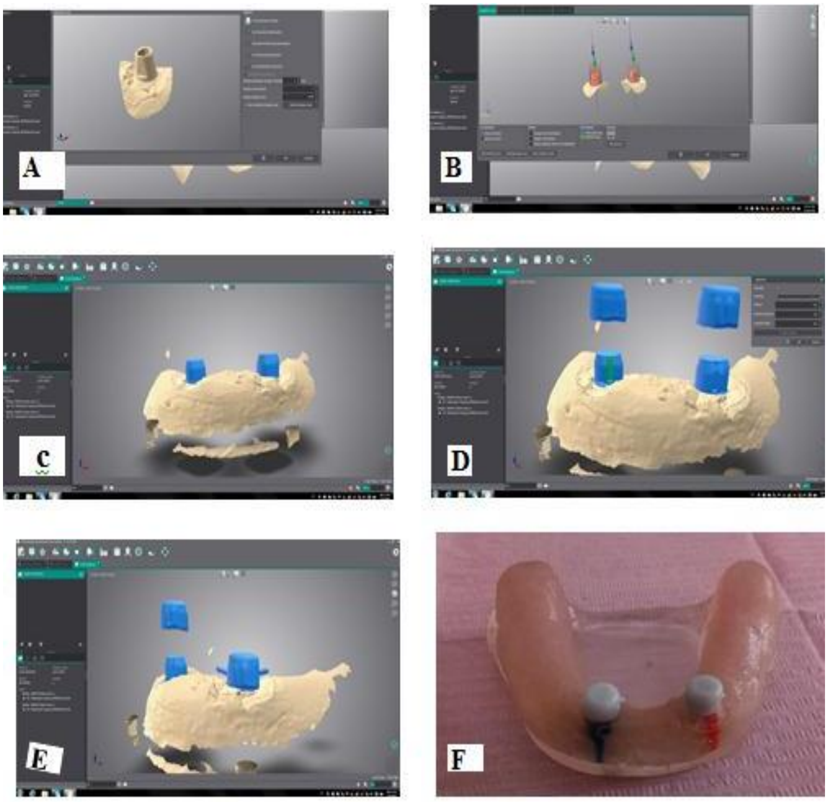

Fig 2: CAD CAM design sequence for telescopic attachment where:

A- 3D virtual imageof scanned implant abutments.
B-Green and blue arrowsrepresents path of insertion of primary and secondary coping respectively.
(C&D) –3D image of virtually designed primary and secondary copings.
E- Mesial and distal projections were added to the design of each secondary coping for mechanical interlocking.
F- primary copingsof telescopic attachment on the model.

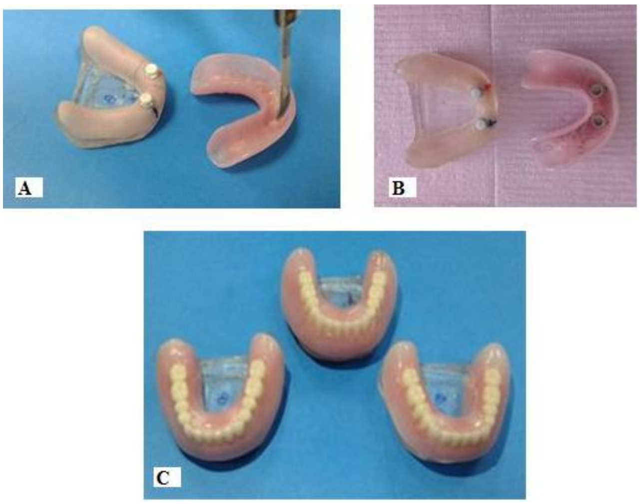

Figure 3:A- adding of self-cure acrylic resin in the overdenture fitting surface.
B- picked up secondary coping to the overdenturefitting surface.
finished mandibular overdentures for all groups on their models.

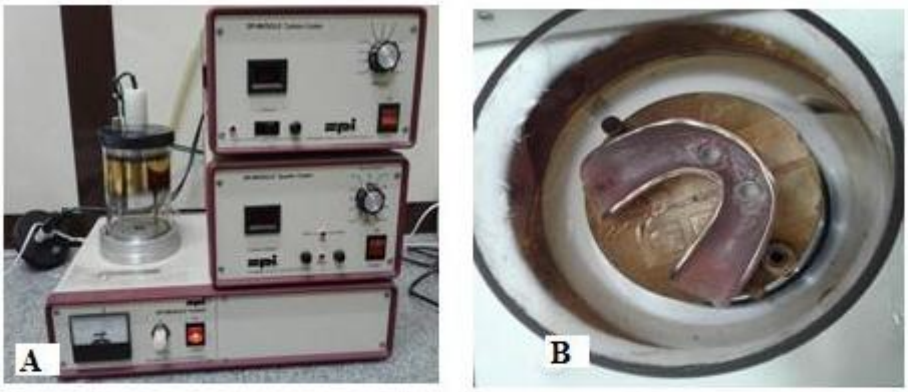

Fig 4 a-Hummer VI sputter deposition system for coating samples with gold.
b- secondary copings coated with gold while fitted to overdenture.

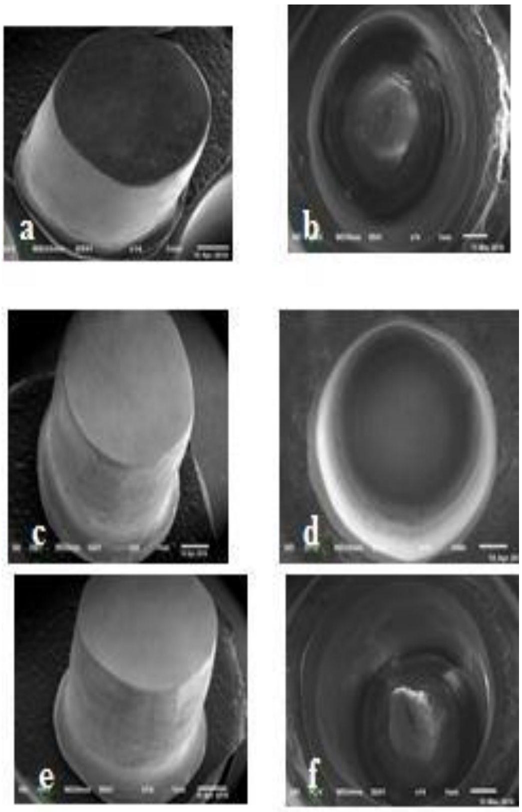

Fig 5. : Primary and secondary copings of different telescopic attachments under SEM at (14 X)at (T_0) showed a smooth, finely grained surface where a-b : primary and secondary coping for group I (PP telescopic attachment), c-d: for group II (ZZ telescopic attachment), e-f: for group III (ZP telescopic attachment)

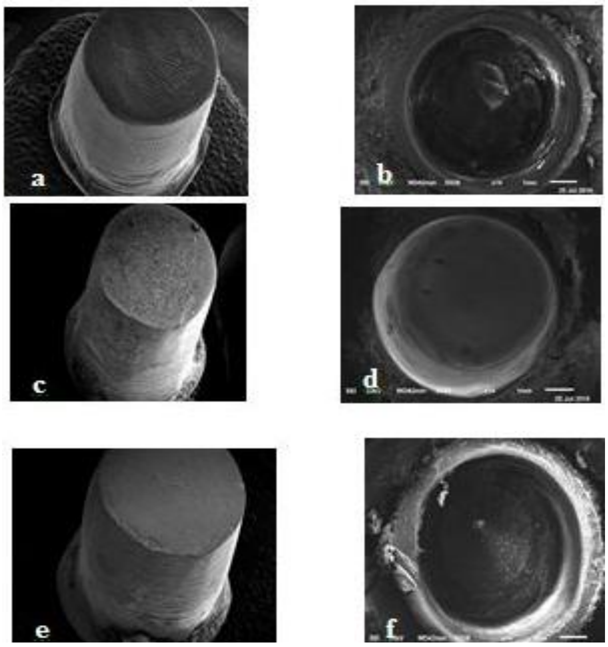

Fig 6-: Primary andsecondary copings of different of telescopic attachment under SEM at(14 X) at (T_6) showed minor surface irregularities, scratch lines along the path of insertion/removal, and localized deformation where a-b : primary and secondary coping for group I (PP telescopic attachment), c-d: for group II (ZZ telescopic attachment), e-f: for group III (ZP telescopic attachment)

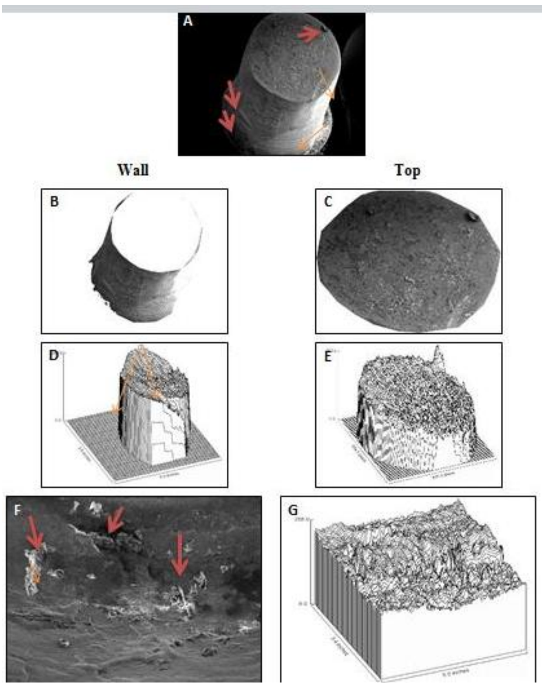

Fig. 7: A, B,C- SEM images of wall and top surfaces of primary coping.
D,E-   histogramimage at (14x).
F, G- histogram image at (150x) of zirconia primary coping at T_6 showedlocalized deformation and minor surface irregularities, scratch lines along the path of insertion/removal.

Table(1):Comparison of surface topography between T_0& T_6 of primary coping (top and wall surfaces) and secondary coping within each group:

		Group I(PP)		P value	Group II(ZZ)		P value	Group III (ZP)		P value
		T0	T6		T0	T6		T0	T6	
Primary (Top surface)	Mean	0.007	7.727	0.001*	0.009	2.842	0.001*	0.008	2.89	0.001*
	±SD	0.001	1.288		0.002	0.4740		0.0013	3.482	
Primary (wall surface)	Mean	0.3550	1.920	0.001*	0.1420	0.392	0.001*	0.2750	2.895	0.001*
	±SD	0.0590	0.3200		0.0240	0.0200		0.0460	0.4830	
Secondary	Mean	0.0220	2.935	0.001*	0.2380	2.914	0.001*	0.0160	22.89	0.001*
	±SD	0.0040	0.4890		0.0400	0.5290		0.0030	3.816	

M: Mean SD: standard deviation P:Probability *:significance <0.05Test used: Student's t-test

Table (2):Comparison ofsurface topography changes at T6 ofprimary copings (top and wall surfaces) and secondary copings between all groups:

	GroupI (PP)		GroupII (ZZ)		GroupIII (ZP)		P1	P2	P3
	Mean	±SD	Mean	±SD	Mean	±SD			
Primary(Top surface)	7.727	1.288	2.842	0.4737	2.89	3.482	0.001*	0.001*	0.001*
Primary(wall surface)	1.565	0.2608	0.25	0.0417	2.62	0.4367	0.001*	0.001*	0.001*
Secondary	2.914	0.4856	2.676	0.4896	22.88	3.813	0.96	0.001*	0.001*

M: mean SD: standard deviation P:Probability*:significance <0.05
Test used: One way ANOVA followed by Post-hoctukey test.
P1: significance between Group I & Group II
P2: significance between Group I & Group III
P3: significance between Group II & Group III

Radwa Mohsen kamalEmera" Surface wear of All Zicronia, All PEEK and Zirconia-Peek Telescopic Attachments for Two Implants Retained Mandibular Complete Overdentures . in-Vitro study using scanning electron microscope." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 2, 2019, pp 56-65.