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RETENTION AND DEFORMITY OF DIFFERENT RPD CLASP MATERIALS (AN IN-VITRO EXPERIMENTAL STUDY)

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ABSTRACT

An in-vitro experimental study was conducted to compare retention and deformity of three different RPD clasp materials (poly ether ether ketone, nickle titanium alloy, and acetal materials) with conventional cobalt chromium alloy; material and methods; A total of (56) RPD's Aker clasps were divided into four equal main groups (n=14) according to type of clasp materials; poly ether ether ketone (PEEK), nickle titanium (Ni/Ti), acetal, and cobalt chromium (Co/Cr) materials. All clasp samples in each group were used for retention test and deformity test.

Results: One way ANOVA test and Pairwise comparison between each 2 groups using Post Hoc Test were used for retention and deformity tests at base line and after 730 , 1460 ,2190 and 2920 cycles revealed that metallic (Co/Cr) clasps ofer greater retentive forces followed by(Ni/Ti) than non metallic (PEEK) then acetal resin clasps with differences considered as Statistically significant as $p \leq 0.05$ at all testing loading cycles. also (Co/Cr) clasps offer greater deformity value followed by(Ni/Ti) than non metallic (PEEK) and acetal resin clasps with differences considered as Statistically significant as $p \leq 0.05$ nearly at all testing loading cycles except at 2920 cycles where non-metallic (PEEK) followed by acetal resin clasps offer greater deformity than metallic(Co/Cr) clasps then(Ni/Ti) with differences considered as Statistically significant as $p \leq 0.05$.

Conclusion within limitations of this study it is better to use PEEK clasps for esthetic reasons; and (Co/Cr) clasps for retention reasons.

KEYWORDS : removable partial denture, PEEK, acetal, cobalt chromium,nickle titanium, retention, deformity.

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INTRODUCTION

Partial dentures with extra coronal direct retainers "clasp-retained RPD" in comparison to precision attachment RPD is used about 100 times more. **[1]** Newer dental technologies, allow the fabrication of RPD with satisfactory mechanical, esthetical, functional, and biological outcomes with no or minimal periodontal tissue problems**.** **[2,3]** In free end saddle RPDs clasps are the basic mean of retention and it must be designed in a manner to provide maximal retention without harmful tipping or rotational forces on the abutment teeth**.** **[3, 4]**

Clasp assembly should meet six basic requirements in order to perform its function safely: retention, stability, support, reciprocation, encirclement, and passivity. [1, 5] Infra-bulge clasps are more aesthetically acceptable than supra-bulge clasps because they can be hidden in the distobuccal undercut of the tooth. [6]

Clasp type, position, retentive arm length and cross section, material, tooth position, and pull out location are all factors that can influence clasp retention. Retention force should be kept as low as possible in order to withstand reasonable dislodging forces while causing no harm to the teeth or surrounding periodontium. [3]

Base metal alloys were the most commonly used dental metal alloys; they are less expensive than gold alloys, have better mechanical properties, are lighter in weight, and have greater stiffness. Cobalt-chromium, nickel-chromium, and nickel-titanium alloy systems are the most commonly used base metal alloys in dentistry. [7]

Poly (etheretherketone) (PEEK) material has been used in construction of removable partial denture framework instead of base metal alloys. PEEK presents many advantages in comparison with other RPD materials, such as, high biocompatibility with no evidence of allergic reactions, absence of metallic display, chemical stability in oral cavity, good mechanical properties, and high temperature resistance. **[8-10]**

Acetal resin (a resin based on semi-crystalline polyoxymethylene) is a thermoplastic resin material that is unbreakable and monomer-free. It has many desirable properties, including proper flexibility, high elastic memory, high tensile strength, and high abrasion resistance, no need for periodic adjusting to maintain optimal contact with the tooth surface, and sufficient elasticity to allow the clasp to enter deeper undercuts on canine and premolar teeth. Furthermore, acetal resins have good fracture strength, wear resistance, and tooth-colored aesthetic properties. [11, 12]

Titanium alloys have a remarkable use in dental prosthesis due to their significant shape memory and magnificent elastic properties, in addition to many desirable properties of pure titanium such as light weight, better fit accuracy, and excellent biocompatibility. Nickel titanium (Ni/Ti alloy) is a titanium alloy with the unique property of rebounding from elastic deformation and remaining constant until proportional limit. [13]

Null hypothesis of this study was that there will be no differences inretention and deformity values of of PEEK,acetal and nickel titanium when compared with conventional cobalt chromium as RPDs clasp material.

This invitro study aimed to compare retention and deformity of poly ether ether ketone (PEEK), acetal material and nickel titanium (Ni/Ti) alloy with conventional cobalt chromium (Co/Cr) alloy as RPDs clasp material..

Aim of the study

This in-vitro experimental study aimed to compare retention and deformity of poly ether ether ketone (PEEK), nickle titanium (Ni/Ti) alloy, and acetal material with conventional cobalt chromium (Co/Cr) alloy as RPDs clasp material.

MATERIAL AND METHODS

Study design

Controlled experimental invitro study

Sample size and Grouping

Following Kim D et al [14] and Kola M et al, [15] a total number of (56) RPD's Aker clasps were used in this study. Clasp samples were divided into four equal main groups (n=14) according to type of clasp material; poly ether ether ketone (PEEK), nickle titanium (Ni/Ti) alloy, acetal, and cobalt chromium (Co/Cr) alloy. All clasp samples in each group were used for retention and deformity tests.

Study models preparation

Patient with missed mandibular 1st, 2nd premolars and 1st molar was selected from the outpatient clinic of the removable prosthodontic department, faculty of dental medicine, Al-Azhar University, Cairo boys; mandibular 2nd molar was used as abutment for Aker clasp.

Ethical approval was taken from ethical committee, Faculty of Dental Medicine, Alazhar University Cairo Boys with ethical code 902/2935

A models were fabricated from improved dental stone (Phosphate-bonded casting investment material GC Fujirock EP; GC Corp) casted in silicone impression with stock tray.

Preparation of modified full metal crown

A total of (56) full metal (Ni/Cr) crowns were made in the following manner: the mandibular second molar was prepared to receive a surveyed full metal crown. The model with the prepared molar was duplicated using silicone impression material; the crown was waxed up and then the model was transferred to the surveyor, who created a 0.75mm retentive undercut area on the distobuccal surface of the waxed crown with a wax carver and the surveyor's undercut gauge. To standardise the path of insertion, a triangular rest seat with a depth of 2mm and mesial and lingual guide planes were prepared with a surveyor blade.

The waxed full crown was invested in casting rings using phosphate-bonded investment material,the mold was casted using Ni/Cr alloy in an induction cast apparatus (Neutrodyn EasyTi; F.lli Manfredi S.p.A., Torino, Italy), under vacuum and argon-inert atmosphere, with the molten alloy injected into the mold by centrifugation according to the manufacturer's specifications.

After casting, Ni/Cr modified complete crown was removed from the investment, finished, and polished with blasting machine using aluminum oxide with a grain size of 50 μm at an air pressure of 0.4 MPa for 30 seconds and finally cemented on the selected tooth with zinc phosphate cement.

Casts preparation to receive aker clasps

Each cast with the cemented crown was surveyed to determine the vertical path of insertion for aker clasp, Ledges were carved in the block-out material to standardize the position of clasp arms and tripod marks were added to index casts for future repositioning. Impressions of casts with cemented full metal crowns were made, poured with a phosphate-bonded casting investment material; and individual refractory die was poured for each clasp. [14]

Wax circumferential clasps for Co/Cr **(n=14)** and acetal **(n=14)** with mesial occlusal rest, minor connector, retentive arm of 1.4 mm, reciprocal arm and small residual ridge base were fabricated using preformed semicircular clasp patterns (Protek wax pattern, Molar clasp wfl mk; Bredent, Senden, Germany) .

A round plastic sprue (Kunststoff-Guskanal-stifte; Degussa) was connected to the residual ridge base parallel to the path of insertion using a surveyor (This sprue was later used to maintain clasp test specimens in the universal testing machine.

Fabrication of CAD/CAM milledPEEK and Ni/Ti clasps:

Before testing of Co/Cr Aker clasp, a digital impression with digital camera (medit i700) was made recording the clasp assembly with special attention to captur the attached plastic sprue. Also, an accurate digital impression of the model was made.

A three-dimensional image was produced and was read by computer-aided design (CAD) software. The CAD software (3Shape Dental System, version 2.9.9.3) was then used to design the Aker clasp and generate a standard triangulation language (STL file) then transferred to a computer aided machine (CAM) (Redon milling machine) to mild Aker clasp from Ni/Ti alloy and PEEK blocks. [16]

Fabrication of acetal Aker clasp: (n=14):

Fabrication of acetal clasps were carried-out by injection process; wax circumferential clasps (n=14) were placed inside the un-set stone while the wax sprue extended to the main flask hole. The Acetal resin granules were placed inside aluminum cartridge and lubricated by cartridge lubricating material;The flask was placed over the flask heating disc of the furnace in the manner that permitted the flask's hole facing the cartridge injection hole through which the acetal resin was injected. The control panel of the thermopress (Thermopress 400, Bredent, Senden, Germany) was set so that the pre-injection temperature was reached 220 ^{0}C within 15 minutes. The injection with heating process was performed at a temperature of 220 ^{0}C for 1 minute, and the pressure inside the furnace was 7.5 bar.

After the injection process had finished the furnace was opened, the flask was removed, left to cool at room temperature and Acetal resin Aker clasp were removed from the flask, finished, and polished.

Fabrication of (Co/Cr) Aker clasps (n=14):

An assembly (die and pattern) were invested in casting ring with the same investment material used to make the dies, clasp patterns were casted using Co/Cr alloy following the manufacturer's specifications as same as casting Ni/Cr crowns; polishing procedure was limited only to remove any nodules and burs.

Retention test

Instron universal testing machine (Instron® 3345, Instron (4) Co. Ltd, Norwood, MA) was used for measurement of the retention test; the clasp specimens with correspond models were attached to the Instron universal testing machine.

To perform the retention test, an insertion/ removal test set up was used where the retention forces were considered as the maximum load that required removing the clasp at 0, 730, 1460, 2190, and 2920 representing the simulated insertion and removal of the framework over 2 years. Estimating 4 complete cycles per day; the test conditions were maintained at room temperature (25 ± 2°C) and wet condition.

The occlusal rest of the Aker clasp was fully seated in its rest seat. The vertical sprue was attached to the movable compartment of the universal testing machine.

A total of 2920 cycles of placement and removal of the clasps were repeatedly performed out according to the direction determined by the primary surveying procedures of the abutment crown.

The force in Newton (N) required to remove clasps was measured using a universal testing machine with a crosshead speed of 5 mm/min with load cell of 5 KN. The test was performed with 40 cycles/ minute.

Data obtained during removal and insertion cycling of clasps intervals were recorded by the computer software and tabulated for statistical analysis

Measuring the deformity of the clasps

For studying deformity the distance between 2 reference points on the tips of the retentive and reciprocal arms of each clasp was measured before and after each removal cycles using a digital micrometer (Digimatic Micrometer Mitotoyd, Japan) with a resolution 0.001mm. Data obtained were recorded and tabulated for statistical analysis.

RESULTS

Results of retention

Statistical analysis of retention test results for PEEK, Acetal, Ni/Ti, and Co/Cr clasps as determined by One way ANOVA test and Pairwise comparison between each 2 groups using Post Hoc Test (LSD) are summarized in **Table (1)** and graphically drawn in (**Figure 1).**

Table (1), showing the mean values and standard deviation (**±SD)** of different retention values in newton (N) for PEEK, Acetal, Ni/Ti, and Co/Cr clasps over the different cycles.

The statistical analysis of retention of the tested groups at base-line revealed that; the difference between the tested groups was non-statistically significant as indicated by One way ANOVA test where P=(0.062) ; Statistically significant at $p \leq 0.05$). Where; the heighst (mean ± SD) values of retention was recorded for Co/Cr group (4.08 ± 0.41N) followed by Ni/Ti group (3.9 ± 0.15 N), then Acetal group (3.83 ± 0.34N) while the lowest (mean ± SD) values of retention was recorded for PEEK group (2.68 ± 2.4N) clasps respectively.

TABLE (1) Retention values of different clasp materials over different cycles.

Time	(Ni/Ti) (Mean± SD) (n=10)	PEEK (Mean± SD) (n=10)	Acetal (Mean± SD) (n=10)	(Co/Cr) (Mean± SD) (n=10)	F	p
Base- line	3.9 ± 0.15	2.68 ± 2.4	3.83 ± 0.34	4.08 ± 0.41	2.676	0.062
After 730 cycle	3.58 ± 0.19	2.35^{a} ± 0.1	1.89^{ab} ± 0.25	3.76^{abc} ± 0.11	27.887^{*}	$<0.001^{*}$
After 1460 cycle	2.36±0.15	1.24^{a}±0.6	0.85^{ab} ±0.5	2.84^{abc}±0.24	50.413^{*}	$<0.001^{*}$
After 2190 cycle	1.86±0.27	0.85^{a}±0.1	0.47^{a} ±0.8	1.94^{bc}± 0.38	24.797^{*}	$<0.001^{*}$
After 2920 cycle	0.54±0.23	0.53±0.2	0.29±0.3	1.18^{abc} ±0.64	9.814^{*}	$<0.001^{*}$

F: F for One way ANOVA test, Pairwise comparison between each 2 groups was done using Post Hoc Test (LSD).
p: p value for comparing between the different studied groups a: Statistically significant with Ni/Ti
*b: Statistically significant with PEEK c: Statistically significant with Acetal *: Statistically significant at p ≤ 0.05*

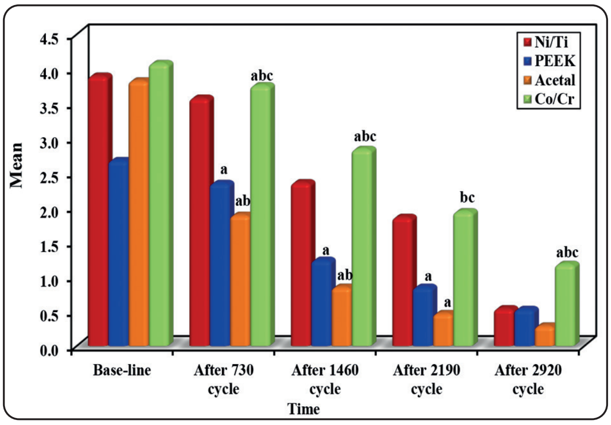

Fig. (1): Comparison of deformation for PEEK, Acetal, Ni/Ti, and Co/Cr clasps over the different cycles.

The statistical analysis of retention values after 730 cycle for PEEK group was statistically significant with Ni/Ti. Also for Acetal group, it was statistically significant with Ni/Ti and with PEEK. Again, Co/Cr group was statistically significant with Ni/Ti , PEEK and Acetal group as P <0.001. Where; the heighst (mean ± SD) values of retention was recorded for Co/Cr group (3.76± 0.11N) followed by Ni/Ti group (3.58 ± 0.19N), then PEEK group (2.35± 0.1 N) while the lowest (mean ± SD) values of retention was recorded for Acetal group (1.89 ± 0.25N) clasps respectively.

On the other haand, the statistical analysis of retention after 1460 cycle for PEEK group was statistically significant with Ni/Ti. Also for Acetal group was statistically significant with Ni/Ti and with PEEK, while for Co/Cr group, it was statistically significant with Ni/Ti, PEEK, and Acetal group as P <0.001.Where; the heighst (mean ± SD) values of retention was recorded for Co/Cr group (2.84 ±0.24N) followed by Ni/Ti group (2.36±0.15 N), then PEEK group (1.24±0.6N) while the lowest (mean ± SD) values of retention was recorded for Acetal group (0.85 ±0.5N) clasps respectively.

The statistical analysis of retention values after (2190) cycle for PEEK group was statistically significant with Ni/Ti. Also for Acetal group, it was statistically significant with Ni/Ti. Again Co/Cr group was statistically significant with PEEK and Acetal group as P <0.001.

The heighst (mean ± SD) values of retention was recorded for Co/Cr group (1.94± 0.38N) followed by Ni/Ti group (1.86±0.27 N), then PEEK group (0.85±0.1 N) while the lowest (mean ± SD) values of retention was recorded for Acetal group (0.47±0.8N) clasps respectively.

Finally, the statistical analysis of retention after (2920) cycle for Co/Cr group was statistically significant with Ni/Ti ,PEEK and Acetal group as P <0.001. Where; the heighst (mean ± SD) values of retention was recorded for Co/Cr group(1.18 ±0.64N) followed by Ni/Ti group (0.54±0.23N), then PEEK group (0.53±0.2N) while the lowest (mean ± SD) values of retention was recorded for Acetal group (0.29±0.3N) clasps respectively.

Results of deformation:

Statistical analysis of deformity test results for PEEK, Acetal, Ni/Ti, and Co/Cr clasps as determined by One way ANOVA test and Pairwise comparison between each 2 groups using Post Hoc Test (LSD) are summarized in Table (2) and graphically drawn in (Figure.2).

Table (2), showing the mean values and standard deviation (±SD) of different deformation values measured in milimeter per millimeter mm/mm for PEEK, Acetal, Ni/Ti, and Co/Cr clasps over different cycles.

The statistical analysis of deformity values of different tested groups at base-line reveal that, PEEK group was statistically significant with Ni/Ti one. Acetal group was statistically significant with Ni/Ti and PEEK groups. While, Co/Cr group was statistically significant with PEEK and Acetal group as P <0.001 (Statistically significant at p ≤ 0.05). The heighst values of deformity at base-line was recorded for Co/Cr group (4.02±0.23 mm/mm), followed by Ni/Ti group (3.86±0.24mm/mm), then Acetal group (1.17 ± 0.23mm/mm), while the lowest values of deformity was recorded for PEEK group (0.45± 0.12mm/mm) clasps respectively.

TABLE (2): Deformation values of different clasp materials over different cycles.

Time	(Ni/Ti) (Mean± SD)	PEEK (Mean± SD)	Acetal (Mean± SD)	(Co/Cr) (Mean± SD)	F	p
Base-line	3.86±0.24	0.45^{a}± 0.12	1.17^{ab} ± 0.23	4.02^{bc}0.23±	755.073*	<0.001*
After 730 cycle	3.48±0.19	0.19^{a}± 0.18	1.2^{ab} ± 0.69	3.64^{bc}0.11±	209.115*	<0.001*
After 1460 cycle	1.54±0.32	0.80^{a} ± 0.4	0.95^{a} ± 0.55	1.92^{abc} ±0.23	17.578*	<0.001*
After 2190 cycle	1.24±0.16	0.26^{a}± 0.1	0.86^{ab} ±0.129	1.70^{abc} ±0.27	118.682*	<0.001*
After 2920 cycle	0.36±0.20	1.15^{a}± 0.5	0.77^{ab}± 0.25	0.62^{b} ± 0.37	8.906*	<0.001*

F: F for One way ANOVA test, Pairwise comparison between each 2 groups was done using Post Hoc Test (LSD)

p: p value for comparing between the different studied groups ***a: Statistically significant with Ni/Ti***

b: Statistically significant with PEEK ***c: Statistically significant with Acetal*** ****: Statistically significant at p ≤ 0.05***

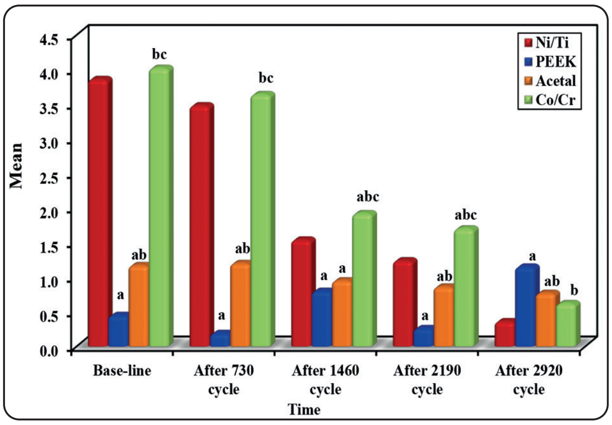

Fig. (2) Comparison of deformation for PEEK, Acetal, Ni/Ti, and Co/Cr clasps over the different cycles.

The statistical analysis of deformity values after 730 cycle for PEEK group was statistically significant with Ni/Ti. For Acetal group was statistically significant with Ni/Ti and with PEEK. While, Co/Cr group was statistically significant with PEEK and Acetal group. The heighst values of deformity was recorded for Co/Cr group (3.64±0.11mm/mm) followed by Ni/Ti group (3.48±0.19mm/mm), then PEEK group (0.19± 0.18mm/mm). The lowest values of deformity was recorded for Acetal group (1.2± 0.69mm/mm) clasps respectively.

The statistical analysis of deformity after 1460 cycle for PEEK group was statistically significant with Ni/Ti. Also foe Acetal group was statistically significant with Ni/Ti and with PEEK. While Co/Cr group was statistically significant with PEEK and Acetal group. The heighst values of deformity was recorded for Co/Cr group(1.92 ±0.23mm/mm) followed by Ni/Ti group (1.54±0.32mm/mm), then Acetal group (0.95 ± 0.55mm/mm). The lowest values of deformity was recorded for PEEK group (0.80 ± 0.4mm/mm) clasps respectively.

The statistical analysis of deformity after 2190 cycle for PEEK group was statistically significant with Ni/Ti. Also for Acetal group was statistically significant with Ni/Ti. While Co/Cr group was statistically significant with Ni/Ti, PEEK, and Acetal group. The heighst values of deformity was recorded for Co/Cr group (1.70±0.27mm/mm) followed by Ni/Ti group (1.24±0.16mm/mm), then Acetal group (0.86 ±0.129mm/mm). The lowest values of deformity was recorded for PEEK group (0.26± 0.1mm/mm) clasps respectively.

The statistical analysis of deformity after 2920 cycle for PEEK group was statistically significant with Ni/Ti. Also for Acetal group was statistically significant with Ni/Ti and PEEK group. Co/Cr group was statistically significant with PEEK group. The heighst values of deformity was recorded for PEEK group (1.15± 0.5mm/mm) followed by Acetal group (0.77± 0.25mm/mm) then Co/Cr group (0.62 ± 0.37mm/mm). While the lowest values of deformity was recorded for Ni/Ti group (0.36±0.20mm/mm) clasps respectively.

DISCUSSION

To replace missing natural teeth, all removable partial dentures use standard denture teeth. However, there are significant differences in the materials used to support such teeth and to keep the RPD in the mouth. Although many materials (polymeric and metallic) are available for denture construction, none of these materials meet all of the ideal requirements for denture components. [13]

Conventional RPD clasps are made of metal alloys such as Co-Cr and Ni-Ti alloys, but most denture wearers today strongly oppose metal display when the clasp is in the aesthetic zone. Furthermore, some patients experience metallic allergic reactions, which can exacerbate the condition. [8, 9]

The demand for RPDs that reveal little or no metallic retentive elements or supporting structures has increased as the demand for aesthetics dentistry has increased. Acetal resin was improved to meet the patient's aesthetic needs. Polyetheretherketone (PEEK) is also being researched for use in RPD frameworks. It has excellent chemical and mechanical properties, as well as perfect aesthetic characteristics. [9,17,18]

This an in-vitro experimental study was conducted to compare retention and deformity of poly ether ether ketone (PEEK), nickle titanium (Ni/Ti) alloy, and acetal material with conventional cobalt chromium (Co/Cr) alloy as RPDs clasp material.

According to Kim D et al, [14] to standardize this study, metallic crowns on lower second molar were used to evaluate retentive force of the clasps; Preformed semicircular clasp patterns were used to facilitate standardization of clasp (thickness, width, and shape) which can affect clasp flexibility, to minimize human errors, and to eliminate the effect of manual variations.

In this study the created undercuts were (0.75 mm or 0.03 inch), as this condition of undercuts simulate the clinical cases in which clasps should be placed more gingivally, where the undercut tends to be deeper, in order to achieve more esthetic results;[14,19] According to **Bridgeman J,** this value of undercut (0.75 mm) is considered to be deep and so, it is blamed to increase the amount of permanent deformation in the studied groups[20]. while Tannous F et al. recommended the use of 0,5mm undercuts where retention force values of PEEK clasps considered sufficient for clinical use.[21].

There is a great tendency to incorporate (CAD/CAM) computer-aided design/computer-aided manufacturing into designing and fabrication of dental prostheses. This technique is more effective in production of such appliances, because it saves time, materials, and effort, and includes the possibility of mass production.[10] .

The milled technology was used in this study instead of the traditional casting technology to avoid casting defects and porosities that could cause clasp degradation, loss of retention, and subsequent failure. [14] This method agrees with Muhsin SA, Wood DJ, Johnson A, et al., who demonstrated that milled PEEK clasps demonstrated higher retentive force than thermo-pressed ones in terms of fabrication method of PEEK frameworks. After 3 years of fatigue simulation, both milled and thermo-pressed PEEK clasps demonstrated higher retaining forces at deeper undercuts with a thicker clasp design than Co-Cr clasps.[22] .

Because the clasp's main function is to retain RPDs by engaging abutment undercuts, the retentive clasp arm should deflect elastically, that is, it must be capable of flexing and returning to its original form during RPD insertion and removal.[23] As a result, the retention and amount of deformation of four different clasp materials were chosen to be tested in this study. The retention force was calculated as the maximum load required to remove the clasp at 0, 730, 1460, 2190, and 2920 cycles; these test specifications were chosen to correspond with 6, 12, 18, and 24 months of simulated clinical use of an RPD; this is consistent with Tannous F et al.[19]

In this study, Ni/Ti clasps have lower retentive forces when compared to the Co/Cr clasps, and this could be attributed to the greater flexibility and lower modulus of elasticity of Ni/Ti alloy.[23]

The retention values of PEEK clasps are lower than Co-Cr ones before and after cyclic loading and this is in agreement with Tribst JPMet al who found in two in vitro studies that PEEK clasps exhibited lower retentive force than Co-Cr alloy clasps;[24] also significant differences were found in deformation of PEEK and metal clasps after fatigue testing in contrast to Peng TY et al who found nosignificant differences were found in deformation of PEEK and metal clasps after fatigue testing.[25]

On the other side, Tribst et al. claimed that PEEK should not be used for clasp fabrication because stress values during removal of clasps with higher undercuts are higher than the material strength.[26]

The retention values of acetal clasps are lower than those of Co-Cr clasps before and after cyclic loading, which is consistent with Young et al and LSato Y et al [27, 28] because lower retentive forces of acetal clasps are associated with higher flexibility of this resin in comparison to Co-Cr alloy.

According to Turner J et al, [18], to achieve stiffness comparable to that of a cast Co-Cr clasp, acetal clasps must increase in cross-sectional area while decreasing in length, as both factors contribute to increased material rigidity; according to Fitton P et al[8], acetal resin clasps must have greater cross-sectional area than metallic clasps to provide adequate retention.

Increased deformatity by raising the number of cyclic loading can explain the gradual loss of retention of the clasps regardless the type of the material. [1] In the present study, increasing in the amount of deformation of all tested clasp materials over the study periods could be related to the prolonged cold working effect during cycling loading which is commonly associated with decreasing of flexibility and increasing in elastic recovery. [1, 14]

In this study, the amount of deformation of metallic clasps after cyclic loading (either Ni/Ti clasps or Co/Cr ones) was higher than non-metallic clasps in nearly almost groups (except after 2920 cycles).This is in agreement with Young L and Saplata R, as they found that metals and metal alloys undergo more permanent deformation and fatigue when exposed to repeated stress as the condition during continuous insertion and removal of the clasp of RPDs. [29]

CONCLUSION

Within the limitations of this in vitro study the followings can be concluded cobalt chromium clasps have the higher retentive forces when compared to nickel titanium,PEEK and acetal partial denture clasps; in addition cobalt chromium clasps have the heigher deformity when compared to to nickel titanium,PEEK and acetal clasps.Although Co/Cr showed higher retention values after cycling load, all materials exhibited sufficient retention to recommend usage under clinical conditions. It is recommended to use PEEK clasps for esthetic reasons and conventional Co/Cr clasps for retention reasons

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