



Retention Performance of Polyamide Clasps Against Zirconia and Porcelain Fused to Metal Restoration

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سلوك احتفاظ مشابك البولي أميد في ترميمات تيجان الزركونيا والخزف المدمج بالمعدن

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Abstract:

This study compared the retention of polyamide clasps engaging porcelain-fused-to-metal and zirconia retainers with identical 0.50 mm undercuts in posterior free-end saddle maxillary removable partial dentures. Four standardized acrylic resin models simulating maxillary bilateral posterior edentulous with first premolar abutments were prepared to receive either porcelain-fused-to-metal or zirconia crowns incorporating mesial occlusal rest seats. Polyamide RPA clasps were fabricated using an injection molding technique and tested for retention using a universal testing machine at a crosshead speed of 5 mm/min. The mean retention force of polyamide clasps was 6.68 ± 2.59 N for zirconia crowns and 5.47 ± 2.27 N for porcelain-fused-to-metal crowns. The results demonstrated minimal loss of retention for polyamide clasps against both ceramic materials, with no significant difference in retention related to the type of ceramic retainer.

Keywords: Polyamide clasps, Zirconia abutments, Retention.

المخلص:

قارنت هذه الدراسة قوة تثبيت مشابك البولي أميد مع مغلفات تيجان من البورسلين المدمج بالمعدن ومغلفات تيجان من الزركونيا ذات تجاويف سفلية متطابقة بعمق 0.50 مم في أطعم الأسنان الجزئية المتحركة العلوية الخلفية ذات النهاية الحرة. تم تحضير أربعة نماذج قياسية من راتنج الأكريليك تحاكي حالة فقدان الأسنان الخلفية من الجهتين مع بقاء الضواحك الأولى للجهتين، وذلك لاستقبال تيجان من البورسلين المدمج بالمعدن أو تيجان من الزركونيا تتضمن مقاعد إطباق أمامية. صنعت مشابك البولي أميد RPA باستخدام تقنية قولبة الحقن، واختُبرت قوة تثبيتها باستخدام جهاز اختبار عالمي بسرعة رأس متحرك تبلغ 5 مم/دقيقة. بلغ متوسط قوة تثبيت مشابك البولي أميد 6.68 ± 2.59 نيوتن لتيجان الزركونيا و 5.47 ± 2.27 نيوتن لتيجان البورسلين المدمج بالمعدن. أظهرت النتائج الحد الأدنى من فقدان الاحتفاظ للمشابك المصنوعة من البولي أميد مقابل كلا المادتين الخزفيتين، مع عدم وجود فرق كبير في الاحتفاظ بتعلق بنوع المثبت الخزفي.

الكلمات المفتاحية: مشابك البولي أميد، دعامة الزركونيا، القدرة على الاحتفاظ.

Introduction:

Nylon is a generic name used for certain types of thermoplastic polymers belonging to the class known as polyamides. However due to certain drawbacks of the early forms of nylon polyamides such as color deterioration and staining, high water sorption, difficult to process effectively, its use was restricted to limited conditions such as proven allergy to traditional acrylic, repeated denture fractures, and construction of orthodontic appliances. ⁽¹⁾

In order to overcome these shortcomings, Nylon with relatively low water sorption levels and melting points, were developed. ⁽²⁾ It was further modified by reinforcement with metal wires or plates, fibers, and modification of chemical structure. More recent grades of nylon with low water absorption have proved to be more flexible. ⁽³⁾

Flexible partial dentures are indeed more aesthetic and comfortable because they use gum-colored thermoplastic materials for clasps making it almost impossible to detect in the mouth, eliminating bulky metal, fitting snugly without irritation. ^{(4) (5)}

Porcelain-Fused-to-Metal or (PFM) crowns were the dental standard due to their strong metal core providing durability and a porcelain layer offering natural looks, achieving high success rates and satisfying both function and aesthetics, but newer all-ceramic options like zirconia are now challenging them for better aesthetics and biocompatibility.

So, this research aimed to compare between retention of Nylon clasps with porcelain-fused-to-metal and zirconia retainers in different undercuts for posterior free end saddle removable partial denture.

Materials and Methods:

This laboratory study was done on a four standard artificial dental arches acrylic resin models which missing posterior teeth on both sides with remaining teeth extending from right to left first premolars teeth.

We were dividing the four models into two groups with two models in each group. The abutment premolars in the first group were reduced to fit porcelain fused to metal crowns with mesial occlusal rest seats and mesiobuccal undercuts of 0.50 mm in a model.

While the abutment premolars in the second group were reduced to fit zirconia crowns with either mesial occlusal rest seats and mesiobuccally undercuts of 0.50 mm in a model. To protect the acrylic master models from damage during the demanding fabrication process, all dental models were copied to create new, heat-resistant models (refractory casts).

Wax patterns for the metal framework are built on the refractory casts, with anteroposterior palatal strap major connectors and mesial occlusal rests, then the wax pattern was metal casted. Multipress machine was adjusted to the preset program for the deflexed RPA polyamide material clasps on metal frameworks in all models.

The universal testing machine (UTM) applied gradually increasing tensile forces at crosshead speed of 5 mm/min until automatically stopped.

Simulated Cycling:

The specimens, immersed in artificial saliva, were cycled by a test apparatus, specially configured for clasps insertion and removal intervals corresponding to 2 s. providing a mean number of insertions and removals losses of retention force was measured as the clasps underwent 60 months of simulated clinical use (7200 cycles) of a RPD.

Statistical analysis:

One way ANOVA followed by Tukey's post-hoc tests were performed to detect significance between groups within each undercut.

Results:

Table 1: It was found that for Polyamide clasps against Zirconia crowns *with 0.50 mm undercut*, retention force means values \pm SD was (6.68 \pm 2.59 N) with minimum value (2.95N) and maximum value (9.90N). And Polyamide clasps against *porcelain fused to metal crowns with 0.50 mm undercut*, retention force mean values \pm SD was (5.47 \pm 2.27 N) with minimum value (3.09N) and maximum value (8.60N) figure 1.

Table 1: Comparison between retention of polyamide clasps against zirconia and porcelain fused to metal crowns with 0.50 undercuts.

0.50 mm undercuts.								
Type of crowns	Zirconia crowns				Porcelain fused to metal crowns			
	Mean	\pm SD	Min	Max	Mean	SD	Min	Max
Polyamide clasps	6.68	\pm 2.59	2.95	9.90	5.47	\pm 2.27	3.09	8.60

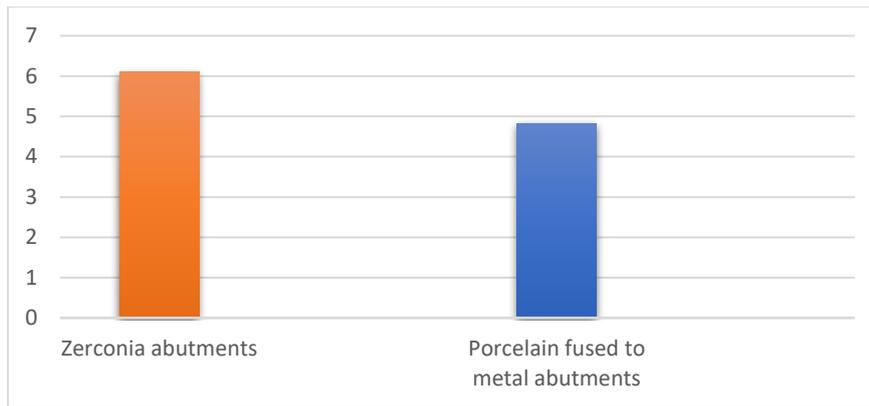


Figure (1): A column chart comparing retention of polyamide clasps against zirconia and porcelain fused to metal crowns with 0.50 undercuts.

Discussion:

Lack of posterior abutment in distal extension RPDs affects retention of the denture due to absence of a posterior direct retainer. Also, the inability to use a rigid direct retainer on the anterior abutment complicates the problem ⁽⁶⁾; therefore, the use of aesthetic flexible clasp material like poly amide polymers will resolve more of these problems.

Porcelain-fused-to-metal (PFM) crowns were widely used with a metal core for strength and porcelain for a natural look, but risk chipping and can show a dark gum line due to the metal, leading many to prefer all-ceramic options for better aesthetics, in this study we fabricated two types to compare between them and to produce pre-determined retentive under cuts. ⁽⁷⁾

In order to enhance the rigidity of maxillary major connector, uniting the anterior and posterior bars to form circle was done. This union provides the major connector rigidity as twice as if each bar is used separately. ⁽⁸⁾

A mesial placed occlusal rest on a distal extension partial denture offers key biomechanical advantages: it creates a more favorable fulcrum, promotes anterior tipping that utilizes adjacent teeth for support, reduces lever arm length, and results in less stress on the abutment teeth and less impingement on distal soft tissues, making it superior to distal rest. ⁽⁹⁾

Retentive clasp arms must be capable of flexing and returning to their original form and should retain a RPD satisfactorily. The tooth should not be unduly stressed or permanently distorted during service and should provide esthetic results. ⁽¹⁰⁾ In this study poly amide clasps which were fabricated on metal framework will provide that.

The insertion and removal of denture involves repeated expansion and return of the elastic deformation region on the clasp arm, but clasp retentive force on abutment tooth is influenced by the expansion of the clasp arm during repeated insertion and removal. ⁽¹¹⁾

In this study there was different in retention loss of poly amide clasps against both ceramic types between the initial tests and after cycling, which was against porcelain fused to metal at (3.09N) in minimum value and (8.60N) in maximum value, while against zirconia abutments at (2.90N) in minimum and (9.90N) in maximum. These results weren't accordance with the research of Juan Cruz MUTTO et al. ⁽¹²⁾

A previous study, a properly made, glazed porcelain surface effectively resists the wear and tear from removable partial denture (RPD) clasps, preventing damage to the clasp arms and tooth. In this study poly amid clasps showed little advance against zirconia crowns compared with porcelain fused to metal crowns but without statistical significance. These results are in agreement with those of Tietge et al. ⁽¹³⁾ and Marso et al. ⁽¹⁴⁾

Conclusion:

Within the limitations of this study, it was concluded that;

1. Polyamide clasps showed retention against zirconia abutments and porcelain fused to metal crowns.
2. Polyamide clasps had little loss of retention after the cycles against both ceramic types.
3. The amount of retention was indifferent by either form of ceramics.

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