

Effect of Various Esthetic Clasp Materials on the Retentive Capacity of Circumferential Clasp Assembly - An

Invitro Study

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Abstract

Introduction: Retention achieved in removable partial dentures through Cobalt Chromium clasp assemblies has shown to be clinically successful. However, due to poor aesthetics, attention has been drawn towards developing materials that could yield sufficient retentive forces with better aesthetic outcome. The role of resins as a replacement for metal components of clasp assemblies has been under study.

Objective: To evaluate and to compare the retention of circumferential clasps made of different materials. (i.e Cobalt-Chromium, Flexible resin, Polyoxymethelene and Semi-flexible resin.).

Methodology: A mandibular partially edentulous acrylic model of Kennedy's class 1 situation was prepared using cold cure resin. The model incorporated natural teeth as abutments. Standardized clasp assemblies were fabricated with Cobalt-Chromium, Flexible resin, Acetal resin and Semi-flexible resin on this model. The clasps assemblies were attached to the universal testing machine and their

dislodging forces were recorded. The data was statistically analyzed.

Results: Cobalt Chromium clasp assemblies showed higher retentive capacity [12.40 N] than clasps fabricated with flexible resins [3.83 N-5.29 N]

Conclusion: The study led to the conclusion that the retentive capacity of all the clasp materials tested in the study was sufficient for prostheses to withstand the dislodging forces.

Clinical Significance: All the clasp materials tested in the study can be successfully incorporated into partial dentures with the additional advantages of favorable aesthetics.

Keywords: Direct retainers, Cobalt-Chromium, Semi-flexible resin, Flexible resin, Polyoxymethylene.

Introduction

Removable partial dentures are one of the most feasible treatment options for replacement of partially edentulous conditions. This is especially true for patients in the lower

socio-economic status, for whom fixed prosthesis may be out of reach due to financial constraints. [1, 2]

Retention is the ability of prosthesis to resist dislodging forces during function. Clasps are of great importance in achieving retention. They provide retention by engaging the tooth below the height of contour. [3, 4]

A major problem with removable partial dentures is the display of the clasp assemblies. Many methods have been used to overcome the esthetic problem such as camouflaging of clasps [5], rotational path prosthesis [6, 7, 8], lingual retention design [6, 9, 10] and tooth-colored clasps. [6, 11, 12]

Direct retainers fabricated in a tooth-colored material and made from thermoplastic resin have been used to improve the appearance of metal clasp assemblies and are promoted for superior esthetics. [6]

The purpose of this invitro study is to evaluate the retentive capacity of circumferential clasps made with different flexible materials and to compare them with conventional Cobalt-Chromium clasps.

The null hypothesis tested in this study was that the type of material does not affect the retention of the clasp of the removable partial denture.

Clinical Significance

The observations derived from this study enable clinicians to understand the properties of these flexible materials better, so that the clinicians can include this information while planning the restoration of partially edentulous arches with removable partial dentures.

Methodology

Preparation of Model

A mandibular partially edentulous acrylic model of Kennedy's class 1 situation with bilaterally missing second premolar, first molar and second molar was prepared using cold cure resin (DPI, The Bombay Burmah Trading Corporation Ltd., India).

Placement of teeth

Placement sites were marked, in positions of the second premolar and second molar on the acrylic mandibular model. Extracted natural teeth (second premolar and second molar) were placed in a cavity created in the marked locations. They were secured in place with self-cure acrylic resin. A surveyor was used to maintain parallelism. [Fig-1]

Preparation of the teeth

Occlusal rests and guide planes (to facilitate easy insertion and removal of clasps assembly) were prepared on the natural teeth.

Preparation of the clasp assembly

The circumferential clasp assembly for the prepared second premolar was made approaching from the distal aspect of the second premolar and the mesial aspect of the prepared second molar with the following materials i.e.; Cobalt Chromium, which acts as control for the study, polyoxymethylene [Acetal resin], semi flexible resin [Dentcare flex] and flexible resin [Valplast]. They were grouped from one to four respectively [Table I]. All clasps were standardized in shape (half-round), length, thickness and engaged to the tooth to the same extent. The two clasp assemblies were connected to each other by a bar attached to the base of the approach arm. The under surface of the bar was parallel to the ridge on the model. [Fig-2]

Testing for retention

The mid-point of the bar was marked and attached to the jig of the universal testing machine to test the forces required to dislodge the prosthesis. The most flexible resin clasp material was tested first so that the insertion and removal of the clasp would not hamper the tooth surface. The different forces to dislodge this assembly were noted and compared. [Fig-3]

Statistical analysis

The results obtained were tabulated [Table II]. Mean retention values of the clasps (N) in different groups were compared and subjected to one way ANOVA to detect statistically significant differences. [Table III]

Results

The highest mean retention value was found in Cobalt-Chromium Group followed by polyoxymethylene[Acetal resin] Group, semi flexible resin [Dentcare flex] Group and flexible resin [Valplast] Group. The difference in mean flexural strength among them was found to be statistically significant ($P < 0.05$).

Discussion

Removable partial dentures are one of the most common types of prostheses used in rehabilitating edentulous areas of elderly persons; Restoration of partially edentulous arches with removable partial dentures is related to socio-economic status, demographics, education attainment levels and income. Patients with lower educational and socio-economic levels, or those living in rural areas, are more likely to choose removable partial dentures over fixed partial dentures.^{1,2}

Various metallic materials have been used to fabricate the clasps and the physical properties of these materials have been examined. The most common alloys used for clasps are cobalt-chromium (CoCr) alloys^{12,13}.

Polyoxymethylene has been used in dentistry all over the world as a substitute for acrylic resins and metals in many prosthetic applications. The most widely used appliances were the esthetic clasps of partial removable dental prostheses, cast posts and cores and brackets^{7,15,16,17}

In the present study, the Cobalt Chromium clasps showed significantly higher retentive force as compared to thermoplastic resin clasps. Therefore, the null hypothesis that there would be no difference in the retentive force between resin clasps and cast Cobalt Chromium alloy

clasps was rejected. Turner et al. suggested that a suitable polyoxymethylene [acetal resin] clasp must be approximately 5 mm shorter than Cobalt Chromium clasps with a larger cross-sectional diameter (approximately 1.4 mm) in order to have the retentive capacity similar to a cast Cobalt Chromium clasp 15 mm long and 1 mm in diameter.^[18] Also, Fitton et al. stated that the polyoxymethylene [acetal resin] clasps must have greater cross-section area than metal clasps to provide adequate retention.^[19] It could be claimed that the two bulkier designs which used to make the thermoplastic clasps could prevent the self-cleaning functions and cause more plaque accumulation.^[20,21]

The results of the present study showed that resin clasps had significantly lower retentive force than Cobalt Chromium clasps (< 0.05). According to Sato et al. a retentive force of 5N is sufficient for adequate function of the prosthesis.^[22] Frank et al. showed that 3 to 7.5 N represents an acceptable amount of retention for a bilateral distal-extension denture.^[23] The present study shows that the retentive force ranges from 11.3 N to 13.4 N for Cobalt Chromium, 4.8 N to 5.6 N for polyoxymethylene[Acetal resin], 4.3 N to 5.2 N for semi flexible resin [Dentcare flex], 3.3 N to 4.2 N for flexible resin [Valplast]. Thus it can be suggested that these materials can be used for the fabrication of clasps.

The retention properties of CoCr alloys have been studied by Bridgeman et al.²⁴ and Kim et al.²⁵ using repeated insertion/removal tests. Retentive clasp arms must be flexible and should retain the prosthesis satisfactorily. Clasps should not unduly stress abutment teeth or be permanently distorted during service. Clasps made of more elastic materials like titanium demonstrated a higher resistance to retention loss.^{26,27,28}

Arda and Arian did a study to compare the retentive force and deformation of acetal resin and cobalt-

chromium clasps. They found that the mean dislodgement force for acetal resin clasps was significantly lower than that for Cobalt Chromium clasps, but, flexibility of acetal resin clasps would allow for the retentive clasp arms to be placed in deeper undercuts on abutments.^[16]

Hence from the present study, it may be noted that flexible resin clasps can replace metal clasps as they have the sufficient retentive capacity, exhibit no significant loss of retentive capacity over a period of time and there is a great amount of patient satisfaction with regard to esthetics.

Conclusion

The following conclusions were drawn from the present study:

1. All the different materials used in the study have an effect on the retention of the circumferential clasps.
2. The mean peak load of dislodgement using Cobalt-chromium, polyoxymethylene[Acetal resin], semi flexible resin [Dentcare flex] and flexible resin [Valplast] materials as clasps was 12.40 N, 5.29 N, 4.86 N and 3.83 N respectively.
3. The clasp assembly made with Cobalt-Chromium demonstrated the higher retentive value when compared to other materials i.e. 12.40 N.
4. The clasp assembly made with the fully flexible material (Valplast) had the least retentive value when compared to other materials i.e. 3.83 N.

We can derive that flexible resin clasp assemblies have significantly lower mean peak load of dislodgement when compared to that of Cobalt Chromium Clasp assemblies. However, mean peak load of dislodgement of all the flexible resin materials are within the acceptable range of retentive force^[22, 23], which enables them to be successfully incorporated into partial dentures along with favorable aesthetics.

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Legends Figures and Tables

Figures



Fig-1 Model with abutment teeth

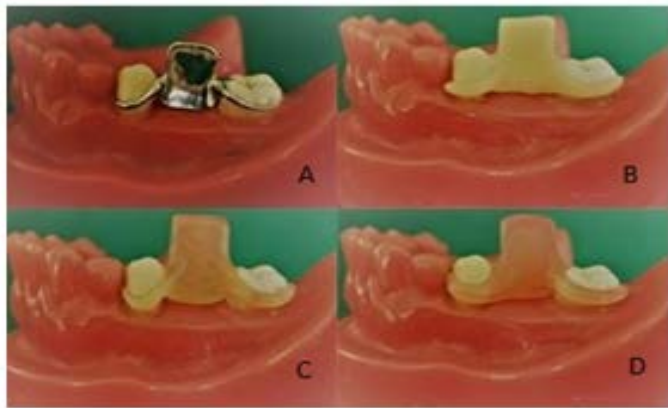


Fig-2 Model with A. Co-Cr Clasp B. Acetal Resin Clasp C. Dentcare Flex Clasp D. Valplast Resin.

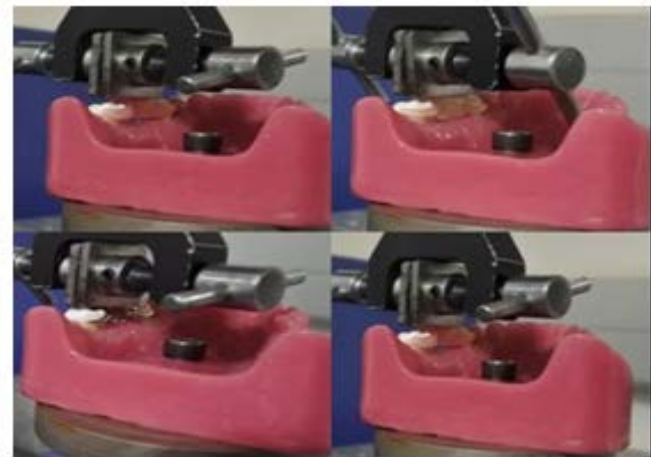


Fig- 3 Testing of Retention

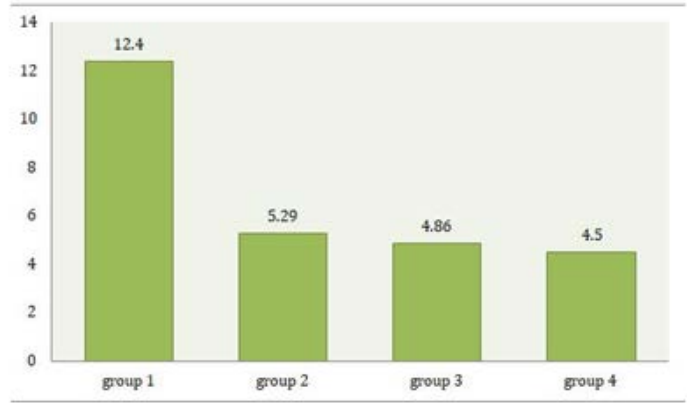


Fig-4 Mean retention values of the clasps (N)

Tables:

Group	Type Of Material Used	
I	Cobalt-Chromium	Co-Cr
II	<u>Polyoxymethylene</u>	Acetal resin
III	Semi flexible resin	<u>Dentcare flex</u>
IV	Flexible resin	<u>Valplast</u>

Table- 1 Grouping of samples

Sl.No	Group 1	Group 2	Group 3	Group 4
	Cobalt-Chromium (N)	Acetal resin (N)	<u>Dentcare flex(N)</u>	<u>Valplast (N)</u>
1	13.4	5.6	5.2	4.2
2	12.7	5.3	4.9	3.5
3	13.3	5.5	5.1	4.0
4	12.9	5.2	4.8	3.9
5	12.4	5.2	4.8	3.9
6	11.8	4.8	4.4	3.2
7	13.2	5.4	5.0	4.1
8	11.6	5.4	5.0	4.1
9	11.4	5.6	5.1	4.1
10	11.3	4.9	4.3	3.3
Mean	12.400	5.290	4.860	3.830
SD	.8165	.2726	.2989	.3622

Table-2 Retention Values

Clasp material	Group	Number of samples	Retentive value Mean	Std. Deviation
Cobalt-Chromium	Group 1	10	12.400	.8165
Acetal resin	Group 2	10	5.290	.2726
Dentcare flex	Group 3	10	4.860	.2989
Valplast	Group 4	10	3.830	.3622

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	460.565	3	153.522	638.639	.000*
Within Groups	8.654	36	.240		
Total	469.219	39			

Table-3 Statistical Analysis