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EVALUATE RETENTIVE PROPERTY OF CONVENTIONAL DENTAL LUTING CEMENTS AND RESINOUS SELF ADHESIVE IN CROWN PROSTHESIS – AN IN VITRO COMPARATIVE STUDY

Prosthodontics

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ABSTRACT

Dental cements used to attach indirect restorations over prepared teeth is called a luting agents. In recent years, so many advanced luting agents have been introduced with the claim of clinically better performance than existing luting agents due to its improved characteristics. The retention of crown prosthesis on an abutment is vital to successful prosthetic service. This study evaluate and compare retentive strength of cast copings using Glass Ionomer Cement, Zinc Phosphate Cement and Self-adhesive resin cement. The results were obtained from digital tensile testing machine. The study shows crowns cemented with Panavia SA luting cement on the metallic cast coping presented higher tensile strength followed by Glass ionomer cement and zinc phosphate cement.

KEYWORDS

Glass ionomer cement, Zinc phosphate cement, Panavia SA resin cement, Tensile strength, Crown prosthesis, Retention, Tensile testing machine

INTRODUCTION:

The most important goal of any clinician is providing the patient with a restoration which preserves the longevity and pulpal vitality of natural abutments of fixed partial dentures and regaining the lost function.[1] Dental cements used to attach indirect restorations over prepared teeth is called a luting agents.[2] Depending on the expected longevity of the restoration, a luting agent may be considered to be definitive or provisional.[3] In recent years, so many advanced luting agents have been introduced with the claim of clinically better performance than existing luting agents due to its improved characteristics.

The retention of crown prosthesis on an abutment is vital to successful prosthetic service. In general retention is a function not only of the mechanical properties of luting agents but also of topography of the preparation and restoration.

The two primary adhesive mechanisms of dental cements are mechanical interlocking and physicochemical bonding.[4] Zinc phosphate cement is a luting agent that adheres by mechanical interlocking to irregularities in the tooth and casting.[5] Glass ionomer cements attain their adhesion primarily through physicochemical bonding.[6] It has been claimed that self-adhesive resin cement adheres chemically and mechanically to tooth structures.[7]

OBJECTIVE:

To compare retentive strength of crown using Glass Ionomer Cement, Zinc Phosphate Cement and Self-adhesive resin Cement.

MATERIALS:

1. Saline solution (Abaris Healthcare Pvt. Ltd., India)
2. Self-cure resin (DPI RR cold cure acrylic repair material, India)
3. Lubricant (Isolit DeguDent, Dentsply, India)
4. Die spacer (Color spacer, Han Dae Chemical Co. Ltd., South Korea)
5. Blue inlay Wax (Kronewachs blau, BEGO, Canada)
6. Surface reducing agent (Aurofilm, BEGO, Germany)
7. Phosphate bonded investment powder (Bellasun, India) and liquid (BegoSol, Canada) material
8. Cellulose ring liner (Whipmix, USA)
9. Nickel-chromium alloys (Dentsply, USA)
10. Silica (Global mineral works, India)
11. Glass Ionomer Cement (GC, Gold Label, GC india)
12. Zinc Phosphate Cement (PREVEST DenPro, USA)
13. Self adhesive resin cement (Panavia SA Luting Multi, Kuraray, Germany)

METHODOLOGY:

Thirty freshly extracted non-carious human mandibular first molars, which were advisable for extraction, selected for the study. The teeth were cleaned by tap water immediately after extraction and were stored in normal saline solution throughout the course of the study. The root of each tooth were embedded into a cylindrical shape block (6.5cm x 2.5cm) of self-cure resin which fits in digital tensile testing machine's tool.

TOOTH PREPARATION

Teeth were placed in a cylindrical shape block of self-cure resin and reduced and finished with a diamond bur under water spray using airotor handpiece. A chamfer width of 0.5 mm was prepared circumferentially to outline a gingival finish line.

Fig.-1

For standardization the preparation was fixed by adjusting the height of the surveying arm and hand piece. (Fig.1) The occlusal surface was flattened perpendicular to the long axis of the tooth. (Fig.2)

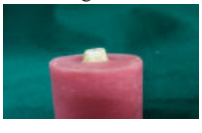


Fig.-2

WAX PATTERN FABRICATION

On the prepared tooth a lubricant was applied with help of brush to prevent the sticking of wax on preparation.

Die spacer applied over prepared samples.

Blue inlay wax was used to prepare pattern on prepared tooth with help of digital wax carving touch pencil.

The 'U' shape loop (Fig.3) was used to facilitate the removal of crown for testing with digital tensile testing machine.

Fig.-3

INVESTING PROCEDURE

Surfactant was painted on to the wax pattern and air-dried using gentle stream of compressed air to facilitate wetting.

Cellulose ring liner was adapted inside the casting ring which was then placed over the crucible former.

The Gate's Sprue design of 2.5mm wax was used as sprue former, phosphate bonded investment powder and liquid material was used in vaccum mixing machine for investing procedure as per manufacturer's instructions.

CASTING PROCEDURE

The castings were made in Ni-Cr alloys in the induction casting machine in routine manner.

Fig.-4

SAND BLASTING AND SURFACE FINISHING

After cooling the cast samples were removed from the ring and sand blasted with 50-100 micron particle size silica used at 50 lbs. pressure to remove adherent investment. (Fig.5)

Fig.-5

SURFACE TREATMENT OF THE CROWN

All the samples were cleaned in distilled water and air dried and stored in clean bottles to avoid contamination.

The samples were divided into three groups for cementation of the crown in order to compare retentive properties of resinous adhesive and other luting agents.

Group A – In this group the cementation was done with Glass ionomer cement (Fig.6)

Fig.-6

Group B - In this group the cementation was done with Zinc phosphate cement (Fig.7)

Fig.-7

Group C – In this group the cementation was done with self-adhesive resinous cement (Fig.8)

Fig.-8

CEMENTATION OF THE CROWN

After drying of cast crown, different luting cements were mixed according to the manufactures direction.

All of cemented copings were kept for 10 minutes for final setting of cement under 3 kg weight and stored at room temperature in closed plastic container before testing for retention.

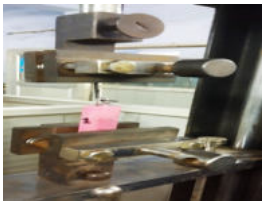


Fig.-9

The retention test was performed in digital tensile testing machine (Fig.9) by using a cross head speed of 1.00 mm per minute till the crown got separated from the tooth. The values obtained were tabulated and subjected for statistically analysis.

RESULTS:

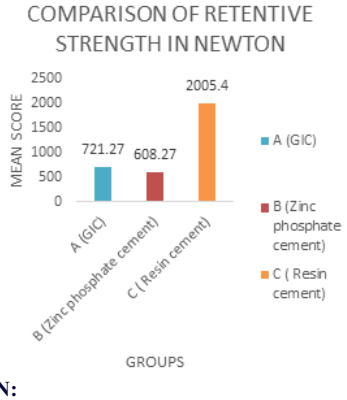
Table - 1 Mean Score Of Retentive Strength Of Crown Using Glass Ionomer Cement, Zinc Phosphate And Self Adhesive Resin Cement

Groups	Retentive strength (Newton) Mean ± SD	p-value
A	721.27 ± 37.34	**<0.001***
B	608.27 ± 26.40	
C	2005.40 ± 27.66	
Total	**1118.31± 641.06**	

Test applied: One-Way ANOVA

*p-value ≤ 0.05 statistically significant

GRAPH - 1



DISCUSSION:

The modern concept in dentistry aims at preserving the natural teeth, and maintaining the normal anatomy, physiology and function of the masticatory system. Thus cast crowns and fixed partial denture restoration play an important role in maintaining the form and function of masticatory system. Failure of cementation is the main reason for failure in clinical scenario.

There is a wide choice of many luting agents available today. However, none of the presently available luting agent is ideal for all clinical situations. Hence, the choice of luting agent is mandated to a large degree by the functional and biological demand of the specific situation.8 The first mandibular molars were chosen for study as these teeth are subjected to maximum masticatory load and are also most commonly found to be in use of a fixed prosthesis. In this study an off-axis tensile force was applied to the crowns because it was suggested

that this force is applied to crowns in-vivo, along with many other forces. The retentive strength of each cement was tested as a function of the tensile separation force in order to separate the cemented crown from the abutment using the Digital Tensile Testing Machine has been used. The data collected was systematically tabulated and was subjected to statistical analysis.

Li ZC and White SN9 stated that luting cements differed considerably with respect to mechanical properties. A high compressive strength is necessary to tolerate masticatory forces and also most of the luting agents are extremely brittle and prone to tensile failure; stronger cements provide more equitable stress distribution, less probability of tensile or compressive failure, and greater probability of clinical success.[10]

Zinc phosphate cement principally depend only on mechanical interlocking for retention. Glass ionomer cement bonded chemically to tooth structure in addition to mechanical bonding.[11,12] In this way retention capacity of Glass ionomer cements are significantly greater than Zinc Phosphate cements. The mean retentive strength of Glass ionomer cement was found to differ greatly than that of Resin cement. Possible explanation for this significant disparity could be that the glass ionomer contained polyacrylic acid which makes bonds only with calcium present in enamel and dentin but it does not form any bond with metal restoration. This adhesive bond failure attributed to this less retentive property of this cement. However, Glass ionomer showed more mean retentive value than the Zinc Phosphate in our study.

The present study compared the retentive property of Glass ionomer cement, Zinc phosphate cement and resinous self-adhesive cement. Resinous adhesive cement provided greatest retention followed by glass ionomer and Zinc phosphate cement. Zinc phosphate cement provided the least retention. Factor influencing the retention of full cast crown may be attributed to the choice of the cementing medium used, provided other factors like configuration of the preparation are kept standardized. An ideal luting agent should provide an efficient bond between teeth and prosthesis, increasing the resistance to fracture and reinforcing the remaining tooth structure.[13] Glass Ionomer and Zinc Phosphate luting material, also called " Conventional cements ", are well suited for use when the tooth preparation is adequate to guarantee a resistance form to limit the paths of displacement of the cast restoration.[14] however, in situations with short abutment height, or to avoid too invasive preparation, adhesive resin-based luting materials are indicated because of their better bond to the tooth structure.[15,16,17] These good mechanical properties, coupled with adhesive capabilities, make the use of resin luting agents an excellent choice for difficult retention situations. Resin luting agents are manufactured specially for the cementation of crowns.[18] Considering the functional and biological demand, the prosthodontist can select the luting agent of choice for a specific clinical situation.

SUMMARY AND CONCLUSION:

This study was conducted in the Department of Prosthodontics, Crown & Bridge and Implantology, Jaipur Dental College, Maharaj Vinayak Global University, Jaipur. The present in vitro study was conducted to evaluate and compare the tensile strength of different types of luting cements. As mentioned in the study, the retention of crown prosthesis on an abutment is vital to successful prosthetic service. In general retention is a function not only of the mechanical properties of luting agents but also of topography of the preparation and restoration. This study was conducted by selecting most commonly used conventional luting cements - Glass ionomer cement and Zinc phosphate cement and recent self-adhesive resin Panavia SA luting cement. 10 specimens for each luting cement were fabricated and tested for tensile strength with digital tensile testing machine. The data were obtained and sent to biostatistician for the result and comparison.

Within the limitations of this study, it may be concluded that crowns cemented with Panavia SA luting cement on the metallic cast coping presented higher tensile strength. Although there is no established value of load that can be considered ideal for clinical success, Panavia SA luting cement showed the best retention value to metal cast crown, which could prove to important when additional crown retention is used for tooth rehabilitation. In addition, the zinc phosphate cement showed the lowest tensile strength followed by glass ionomer cement among the cements studied.

CONFLICT OF INTEREST:

No conflict of interest.

FINANCIAL DISCLOSURE:

Nil

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