Original Research

Comparative Evaluation of Tensile Bond Strength: Zinc Phosphate vs. Zinc Polycarboxylate Luting Cements in Dentistry

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ABSTRACT

Background: Testing the Tensile Bond Strength of Dental Luting Cements: Zinc Phosphate vs. Zinc Polycarboxylate.
Materials & methods: In this study, fifty 2nd premolars extracted from freshly excised maxillaries were collected and prepared for testing. After washing and drying, each specimen was stored in normal saline for future use. Impressions were taken of all specimens following cavity preparation, and castings were poured using type IV dental stones. The casting process involved creating wax patterns, followed by devesting, finishing, and polishing the castings. Subsequently, the specimens were randomly assigned to one of two groups: Group A, treated with zinc phosphate, and Group B, treated with zinc polycarboxylate. The average tensile strength of each group was then measured using a Universal Testing Machine.
Results: The average tensile strength of Group A specimens was measured at 2.34 MPa, whereas Group B specimens averaged 1.86 MPa. Upon comparing the average tensile strength of samples from Groups A and B, statistically significant differences were observed.
Conclusion: The study revealed a statistically significant difference in the mean tensile strength between the Zinc phosphate and Zinc polycarboxylate groups, with the Zinc phosphate group exhibiting a significantly greater mean tensile strength.
Key words: Zinc phosphate, Tensile strength, Cement

INTRODUCTION

The restoration of primary and permanent teeth with advanced carious lesions has been a constant and The restoration of primary and permanent teeth with advanced cariouslesions has been a constant and The restoration of primary and permanent teeth with advanced carious lesions has been a constant and The restoration of primary and permanent teeth with advanced carious lesions has been a constant and The restoration of primary and permanent teeth with advanced carious lesions has been a constant and difficult problem for the dentist, to prevent premature loss of primary teeth and to maintain normal occlusion. Studies have shown that amalgam, a commonly used restorative material, had to be replaced with stainless steel crowns in 70% of multi-surface amalgam restorations. Stainless steel crowns have proved to be efficacious and are relatively easy to use, they have become an important factor in the restoration of hypoplastic, endodontically treated teeth, malformed teeth and fracture teeth to perform their normal function.[1,2] Hence; the present study conducted for comparing the comparing the tensile bond strength of two different luting cements (Zinc phosphate and Zinc polycarboxylate) used in dentistry.

MATERIALS AND METHODS

In this study, fifty 2nd premolars extracted from freshly excised maxillaries were collected and prepared for testing. Following extraction, each specimen underwent a thorough washing and drying process before being stored in containers filled with normal saline for preservation. Impressions of the specimens were taken post-cavity preparation, and subsequently, castings were made using type IV dental stones. The casting procedure involved the initial creation of wax patterns, followed by the devesting, finishing, and polishing stages.To conduct our analysis, the specimens were randomly divided into three groups: Group A received zinc phosphate, while Group B received zinc polycarboxylate. The

tensile strength of each specimen was then measured using a Universal Testing Machine. The resulting data was recorded in an Excel spreadsheet and subjected to statistical analysis using SPSS software. Significance levels were determined through Student t-tests.

RESULTS

The average tensile strength of Group A specimens was 2.34 MPa, while Group B specimens averaged 1.86 MPa. When comparing the average tensile strength of samples from groups A and B, statistically significant differences were found.

Table 1: Mean tensile strength (MPa)

Groups	Mean tensile strength	SD	p- value
Group A	2.34	0.42	0.0002*
Group B	1.86	0.36	

*: Significant

DISCUSSION

Zinc phosphate cement has a long history in dentistry, dating back over a century. It finds wide application in clinical settings, such as cementing crowns, bridges, and onlays[3,4]. This cement belongs to the acid–base group, with its acidic component primarily comprising phosphoric acid solution (47–66%), often containing aluminium and zinc[5]. Aluminium and zinc play pivotal roles in regulating the reaction rate, crucially by forming appropriate phosphate amounts in solution, which elevates the pH and reduces reactivity. Fully reacted cements retain water in a chemical combination without phase separation during setting. The chemical and mechanical properties of the fully reacted cement hinge on the initial phosphoric acid concentration, necessitating stringent control over the liquid component's water content to prevent atmospheric gain or loss[6,7]. The current study aimed to compare the tensile bond strength of two luting cements commonly used in dentistry: zinc phosphate and zinc polycarboxylate. Results showed that the average tensile strength of Group A specimens (using zinc phosphate) was 2.34 MPa, whereas Group B specimens (using zinc polycarboxylate) averaged 1.86 MPa. Statistically significant differences were observed when comparing the average tensile strength of the two groups.Contrary to findings by David R. Myers[8] and Garcia Godoy[9], who reported no significant difference in retention ability between zinc phosphate and polycarboxylate cements, this study found that zinc phosphate cement exhibited superior retentive strength compared to polycarboxylate cement, with statistical significance ($P < 0.05$). This disparity could stem from the fact that zinc phosphate cement relies on mechanical interlocking for retention and close physical adaptation for sealing restorative margins, lacking chemical bonding to tooth or metal surfaces.Parameswari BD et al, in another previous study explored similar findings. The study was divided into four groups with 10 samples for each of the luting cement taken up for testing TBS and four groups with 5 samples for each luting agent chosen for assessing marginal fit. The results were tabulated and statistically analyzed.In their in vitro study, the TBS of luting cements, and marginal fit in relation to luting cements were tested by using appropriate testing devices. The TBS of cement is measured using universal testing machine, and the results are tabulated. The marginal gap that exists between the margin of the cast metal crown, and the finish line is measured using travelling microscope before and after cementation. The difference between these two values gives the discrepancy that is due to the film thickness of cement used for luting the restoration. The TBS value of zinc phosphate cement and glass ionomer cement were found to be almost same. The chemical adhesiveness of the glass ionomer with calcium ions of enamel and dentin may be the attributed reason (ionic bonding).[11]Tomar SS et al compared various surface treatments of the intaglio surface of crowns in combination with various luting agents for maximal retention. Totally, 150 dies of a standard complete crown preparation were fabricated. Wax pattern with a loop on the occlusal surface was prepared on each die using standard procedures, and then crowns were cast with nickel-chromium alloy. These crowns were randomly divided into five groups as per the surface of the intaglio surface of the metal copings. The crowns in each group were again subdivided randomly into three groups as per the luting agents used resin-modified glass ionomer cement, glass ionomer cement, and zinc phosphate cement. Retention was measured (MPa) by separating the metal crowns from the metallic die under tension on a Universal testing machine. The data were recorded and statistically analyzed using one-way analysis of variance followed by Tukey's test. The retention differed both with surface treatment and type of luting agents. Untreated group showed the least bond strengths < sandblasting with 50 µm alumina < sandblasting with 50 µm alumina with ultrasonic cleaning < sandblasting with 110 µm alumina < sandblasting with 110 µm alumina along with ultrasonic cleaning. For luting agents, glass ionomer cement showed least bond strength because there was no chemical bonding present between metal crown and metallic die, followed by zinc phosphate cement and maximum bond strength were found for resin-modified glass ionomer cement.Among all types of surface treatments used in this study, maximum bond strength was yielded by sandblasting with 110 µm alumina + ultrasonic cleaning and the best luting agent was resin-modified glass ionomer cement.[12]

CONCLUSION

The study revealed a statistically significant difference in the mean tensile strength between the Zinc phosphate and Zinc polycarboxylate groups, with the Zinc phosphate group exhibiting a significantly greater mean tensile strength.

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