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Comparative evaluation of tensile bond strength of two different luting cements (Zinc phosphate and Zinc polycarboxylate) used in dentistry

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Abstract
Background: This study was conducted for comparative evaluation of tensile bond strength of two different luting cements (Zinc phosphate and Zinc polycarboxylate) used in dentistry.
Materials & methods: In the present study, one hundred freshly extracted maxillary first premolars were employed. The samples were meticulously cleaned and preserved in sterile saline for future use. Upon completion of the cavity preparation, castings made of type IV dental stones were placed into each specimen. Wax patterns were utilized for the casting process. Subsequently, the castings underwent polishing, devesting, and finalization. The specimens were categorized into two research groups as follows: Group A consisted of teeth treated with zinc phosphate, while Group B comprised of teeth treated with zinc polycarboxylate. The mean tensile strength was determined using a universal testing apparatus. All results were analyzed using SPSS software and subsequently compiled into a Microsoft Excel spreadsheet. A student t test was conducted to assess the level of significance.
Results: In group A, there were 50 teeth treated with zinc phosphate and in Group B, there were 50 teeth treated with zinc polycarboxylate cement. The samples from Group A and Group B exhibited mean tensile strengths of 4.52 MPa and 3.56 MPa, respectively. Notable results emerged from the statistical analysis comparing the mean tensile strengths of groups A and B.
Conclusion: It has been determined that the average tensile strength of Zinc phosphate cement significantly exceeds that of Zinc polycarboxylate cement.
Key words: Dental cement, Tensile strength

INTRODUCTION

A dental cement utilized for securing indirect restorations to prepared teeth is referred to as a luting agent.[1,2] Luting agents can be classified as either definitive or provisional, based on their physical characteristics and the anticipated duration of the restoration. A luting agent must maintain the position of an indirect restoration for an indefinite duration and effectively fill the gap at the interface between the tooth and the restoration.

Nearly all cements are produced through the interaction of a powder that can release cations into an acidic solution (acting as a base) and a liquid (an acid) that can liberate cement-forming cations, along with acid anions that create stable complexes with these cations to form a salt. Consequently, the set cement is a salt hydrogel matrix that encases unreacted powder.[3]

Set cements do not experience phase separation throughout the setting process; rather, water exists within a specific chemical mixture. The concentration of phosphoric acid in the initial solution is vital for the

chemical and mechanical characteristics of the fully reacted cement, making it essential that the liquid component is not allowed to gain or lose water to the surrounding environment.[4,5]
Consequently, this research was conducted to compare the tensile bond strength of two different luting cements, namely Zinc phosphate and Zinc polycarboxylate, used in dental applications.

MATERIALS AND METHODS

In the present study, one hundred freshly extracted maxillary first premolars were employed. The samples were meticulously cleaned and preserved in sterile saline for future use. Upon completion of the cavity preparation, castings made of type IV dental stones were placed into each specimen. Wax patterns were utilized for the casting process. Subsequently, the castings underwent polishing, devesting, and finalization. The specimens were categorized into two research groups as follows: Group A consisted of zinc phosphate, while Group B comprised zinc polycarboxylate. The mean tensile strength was determined using a universal testing apparatus. All results were analyzed using SPSS software and subsequently compiled into a Microsoft Excel spreadsheet. A student t test was conducted to assess the level of significance.

Results

Table 1: Group-wise distribution of specimens based on the type of cement used.

Groups	Number of specimens	Percentage
Group A (Zinc Phosphate)	50	50
Group B (Zinc Polycarboxylate)	50	50
Total	100	100

In group A, there were 50 teeth treated with zinc phosphate and in Group B, there were 50 teeth treated with zinc polycarboxylate cement.

Table 1: Mean tensile strength (MPa)

Groups	Mean tensile strength	p- value
Group A (Zinc phosphate)	4.52	0.0000*
Group B (Zinc polycarboxylate)	3.56	

*: Significant

The samples from Group A and Group B exhibited mean tensile strengths of 4.52 MPa and 3.56 MPa, respectively. Notable results emerged from the statistical analysis comparing the mean tensile strengths of groups A and B.

DISCUSSION

Dental luting cements can be classified according to their application and chemical composition. Regardless of the material selected, it is essential that they demonstrate suitable consistency and film thickness for effective cementation. Dental cement may be formulated from resin, water, or oil.[6] Currently, a variety of long-term and temporary cements are available in the market, differing in their chemical composition, properties, and medical applications. Generally, temporary cements can be classified as either oil-based or oil-free.[7]

Historically, eugenol was a common component in most formulations; however, in contemporary practices, it is predominantly excluded. In contrast to water and polymer-based cements, these alternatives exhibit greater film thickness but inferior physical properties. Before the application of final cements, it is essential that the tooth is entirely devoid of any residual provisional cements. Given that oil can disrupt the curing process of long-term cementation, thereby diminish the bond strength and promote the use of ethanol-free cement, efforts are being made to reduce its presence.[8,9]

Consequently, this research was conducted to compare the tensile bond strength of two different luting cements, namely Zinc phosphate and Zinc polycarboxylate, used in dental applications.

In this study, in group A, there were 50 teeth treated with zinc phosphate and in Group B, there were 50 teeth treated with zinc polycarboxylate cement. The samples from Group A and Group B exhibited mean tensile strengths of 4.52 MPa and 3.56 MPa, respectively. Notable results emerged from the statistical analysis comparing the mean tensile strengths of groups A and B.

David R. Myers[10] and Garcia Godoy[11] indicated that there was no notable difference in the retention capabilities of zinc phosphate and polycarboxylate cements. However, in this investigation, zinc phosphate cement demonstrated superior retentive strength compared to polycarboxylate cement, a finding that was statistically significant ($P< 0.05$). This discrepancy may be attributed to the fact that zinc phosphate cement relies on mechanical interlocking for its retention and achieves close physical adaptation for sealing restorative margins, although it does not establish any chemical bonding with tooth or metal surfaces.

Reddy S et al.[12] conducted a study that compared the tensile bond strength of two distinct luting cements, namely Zinc phosphate and Zinc polycarboxylate, utilized in the field of dentistry. The study included 40 freshly extracted maxillary first premolars. Following a thorough cleaning process, all specimens were preserved in normal saline until they were needed for further experimentation. Once the cavity preparation was completed, impressions of all specimens were taken, and casts were poured using type IV dental stones. Subsequently, wax patterns were created, and casting was performed. The castings were then devested, finished, and polished. All specimens were categorized into three study groups as follows: Group A, which consisted of the Zinc phosphate group, and Group B, which comprised the Zinc polycarboxylate group. A Universal Testing Machine was employed to assess the mean tensile strength. The mean tensile strength for specimens in Group A and Group B was determined to be 1.88 MPa and 1.51 MPa, respectively. Statistical analysis revealed significant results when comparing the mean tensile strength between Group A and Group B. It was found that the mean tensile strength of Zinc phosphate cement is significantly greater than that of the Zinc polycarboxylate group.

Parameswari BD et al.[13] conducted a comparison of the tensile bond strength and marginal fit of complete veneer cast metal crowns utilizing various luting agents. The investigation was organized into four groups, each comprising 10 samples for the testing of tensile bond strength (TBS) and four groups with 5 samples for each selected luting agent to evaluate marginal fit. The findings were systematically tabulated and subjected to statistical analysis. The TBS of the luting cements, along with the marginal fit concerning these cements, were assessed using suitable testing apparatus. The TBS of the cement was determined using a universal testing machine, and the results were recorded in tabular form. The marginal gap between the margin of the cast metal crown and the finish line was measured with a traveling microscope both prior to and following cementation. The variation between these two measurements indicates the discrepancy attributed to the film thickness of the cement employed for luting the restoration. The TBS values for zinc phosphate cement and glass ionomer cement were observed to be nearly identical.

CONCLUSION

It had been concluded that the mean tensile strength of Zinc phosphate cement is much higher as compared to Zinc polycarboxylate cement.

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