International Journal of Research in Health and Allied Sciences

Journal home page: www.ijrhas.com

Official Publication of "Society for Scientific Research and Studies" [Regd.]

ISSN 2455-7803 Index Copernicus value 2016 = 68.10

Original Article

Comparative Assessment Of Tensile Bond Strength Of Two Commonly Used Dental Luting Agents: An Observational Study

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ABSTRACT

Aim: To compare tensile bond strength of Zinc Phosphate and Zinc Polycarboxylate luting cements. **Materials & methods:** A total of 40 freshly extracted maxillary permanent central incisors were included in the present study. Following extraction, each specimen underwent a thorough washing and drying process, after which they were preserved in containers filled with normal saline. Impressions of the specimens were obtained post-cavity preparation, leading to the creation of castings using dental stones. This casting procedure included the formation of wax patterns, followed by the processes of devesting, finishing, and polishing. For the purpose of analysis, the specimens were randomly divided into two groups: Group 1 was treated with zinc phosphate, while Group 2 was treated with zinc polycarboxylate. Subsequently, sectioning was performed, and the tensile strength of each specimen was assessed using a Universal Testing Machine. **Results:** Group A exhibited a mean tensile strength of 2.86 MPa with a standard deviation (SD) of 0.37, while Group B demonstrated a mean tensile strength of 2.01 MPa with an SD of 0.30. The p-value for the comparison between these groups is 0.0004, indicating a statistically significant difference in tensile strength between Group A and Group B. **Conclusion:** Zinc phosphate cement demonstrates a higher tensile bond strength in comparison to polycarboxylate cement, thereby underscoring its longstanding application and dependability in clinical environments. Although both types of cement possess distinct characteristics and possible uses, our research indicates a preference for zinc phosphate cement in situations that require improved mechanical retention.

Key words: Zinc phosphate, Cement, Zinc polycarboxylate

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This article may be cited as: Sidhu HK, Singh G, Kaur G. Comparative Assessment of Tensile Bond Strength of Two Commonly Used Dental Luting Agents: An Observational Study. Int J Res Health Allied Sci 2018;4(1):86-88.

Introduction

The primary objective of any clinician is to deliver a restoration that not only maintains the longevity and pulpal vitality of the natural abutments for fixed partial dentures but also restores lost functionality. The material utilized to bond indirect restorations to prepared teeth is referred to as a luting agent. The essential role of a luting agent is to occupy the space at the interface between the restoration and the tooth, thereby mechanically securing the restoration to prevent displacement during chewing. Depending on the anticipated duration of the restoration's effectiveness, a luting agent may be classified as either definitive (long-term) or provisional (short-term). In recent years, a variety of luting agents and dental cements have been developed, each claiming to offer superior clinical performance compared to existing materials, attributed to enhanced properties.[1- 3]

Zinc phosphate cement serves as the benchmark against which other luting cements are evaluated. Its setting mechanism is based on an acid-base reaction, and its physical characteristics can be influenced by factors such as the powder-to-liquid ratio, moisture

content, and mixing temperature. This cement exhibits high compressive strength but relatively low tensile strength, making it a cost-effective option. It is particularly suitable for luting long-span fixed partial dentures. However, it does not form a chemical bond with the tooth structure. Due to the low pH of the mixed cement, it is essential to preserve the smear layer to reduce the risk of penetration into the dentinal tubules.[4- 6]

Zinc polycarboxylate was introduced by DC Smith in 1968 as the first dental cement to achieve mechanical adhesion to tooth structure, earning widespread endorsement in the dental community. This material is also available in premeasured and encapsulated forms for convenience in mixing. Initially, the cement exhibits a very low pH upon contact with the tooth; however, its high molecular weight effectively inhibits acid penetration into the dentinal tubules, ensuring compatibility with pulp tissue. While its early compressive strength is lower than that of zinc phosphate, its tensile strength is comparatively higher. Due to its tendency to undergo significant plastic deformation when subjected to masticatory forces, the application of zinc polycarboxylate is generally restricted to short-span fixed partial dentures. Additionally, it demonstrates relatively low resistance to erosion in acidic environments.[7, 8] Hence; the present study was conducted for comparatively evaluating Tensile Bond Strength of two commonly used dental luting agents.

Materials and Methods

The present study was conducted for assessing tensile bond strength of Zinc phosphate cement and Zinc polycarboxylate cements. A total of 40 freshly extracted maxillary permanent central incisors were included in the present study. Only those subjects were included in which extraction of maxillary central incisor was indicated to due periodontal reasons. Patients exhibiting firm maxillary central incisors and those with severely decayed central incisors were excluded from this study. Following extraction, each specimen underwent a thorough washing and drying process, after which they were preserved in containers filled with normal saline. Impressions of the specimens were obtained post-cavity preparation, leading to the creation of castings using dental stones. This casting procedure included the formation of wax patterns, followed by the processes of devesting, finishing, and polishing. For the purpose of analysis, the specimens were randomly divided into two groups: Group 1 was treated with zinc phosphate, while Group 2 was treated with zinc polycarboxylate. Subsequently, sectioning was performed, and the tensile strength of each specimen was assessed using a Universal Testing Machine. The resulting data was recorded in an Excel spreadsheet and analysed statistically using SPSS software, with significance levels determined through Student's t-tests.

Results

40 freshly extracted maxillary permanent central incisors were included and were randomly divided into two groups: Group 1 was treated with zinc phosphate, while Group 2 was treated with zinc polycarboxylate.

Table 1: Mean tensile strength (MPa)

Groups	Mean tensile strength	SD	p- value
Group 1	3.021	0.31	0.0017*
Group 2	2.419	0.39	

*: Significant

Graph 1: Mean tensile strength (MPa)

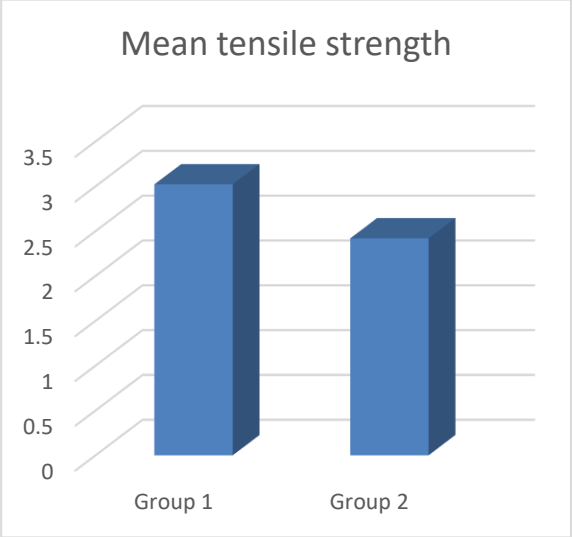

Table 1 presents the mean tensile strength values for two groups. Group 1 exhibited a mean tensile strength of 3.021 MPa with a standard deviation (SD) of 0.31, while Group 22 demonstrated a mean tensile strength of 2.419 MPa with an SD of 0.39. The p-value for the comparison between these groups is 0.0017, indicating a statistically significant difference in tensile strength between Group 1 and Group 2.

Discussion

Numerous factors influence the efficacy of fixed prosthodontic restorations, including preparation design, oral hygiene and microflora, mechanical forces, and the choice of restorative materials. Nevertheless, the selection of an appropriate luting agent and the execution of the cementation procedure are critical determinants of success. Research indicates that the loss of crown retention ranks as the second most common reason for the failure of crowns and fixed partial dentures, while uncemented restorations have been identified as the third most prevalent cause of prosthetic replacement, with failures occurring after an average service period of merely 5.8 years. The term 'luting' originates from the Latin word "Lutum," which translates to mud. Dental luting agents serve to establish a connection between the restoration and the prepared tooth, facilitating their bonding through various forms of surface attachment, which may

include mechanical, micro-mechanical, chemical, or a combination of these mechanisms. Depending on their physical characteristics and the anticipated longevity of the restoration, luting agents can be classified as either definitive or provisional.[8- 10] There exists a variety of cement types that can be utilized for this purpose. Zinc phosphate (ZOP) cement has been a staple in dentistry since the 1850s and is well-recognized among dental professionals. Traditionally, ZOP has served as a definitive cement for fixed crowns and partial dentures affixed to natural teeth. It was specifically formulated for tooth-supported fixed partial dentures and crowns. However, its characteristics may not be ideal for passive-fit metal-to-metal cementation required in implant prosthetics. Consequently, it may not be the most suitable option for the long-term retention of multiple implant-supported prostheses. A notable disadvantage of ZOP is its solubility, which is widely acknowledged as a harmful property.[11, 12]

In the present study, Group 1 exhibited a mean tensile strength of 3.021 MPa with a standard deviation (SD) of 0.31, while Group 22 demonstrated a mean tensile strength of 2.419 MPa with an SD of 0.39. The p-value for the comparison between these groups is 0.0017, indicating a statistically significant difference in tensile strength between Group 1 and Group 2. In a previous study conducted by Silvey RG et al, authors compared the efficacy of zinc phosphate, EBA-reinforced zinc oxide eugenol and polyacrylic acid cements as luting agents in fixed prostheses. A clinical trial for the final cementation of crowns and bridges with a reinforced zinc oxide and eugenol cement, a polyacrylic acid cement and a zinc phosphate cement was made over a 3-year period. The study involved 441 patients for whom 547 bridges and 162 single restorations were cemented. The patients were recalled at 6-month intervals for the duration of the study and the restorations were examined for looseness. Of the 547 bridges 520 remained firmly cemented to the abutment teeth. Of 1,082 bridge retainers, 1,049 remained in position; success and failure by types of retainers will be the subject of a subsequent paper. Of the 162 single restorations 159 remained in place.[11] In another study conducted by Raghunath Reddy MH et al, authors compared the retentive strengths of zinc phosphate, polycarboxylate and glass ionomer cements using Instron universal testing machine. Thirty preformed and pretrimmed stainless steel crowns were utilized for the cementation process on 30 extracted human primary molars, which were categorized into three groups, each containing 10 teeth. The specimens were subsequently stored in artificial saliva and incubated at a temperature of 37°C for a duration of 24 hours. A load was then applied to each crown, gradually increasing until dislodgement occurred, at which point measurements were recorded using an Instron recorder for statistical analysis. The surface area of each crown was determined through a graphical method. The retentive strengths of zinc phosphate and glass ionomer cements were found to exceed that of polycarboxylate cement. Furthermore, only a negligible difference in retentive strength was noted between zinc phosphate and glass ionomer cements. Given its advantages, glass ionomer cement is recommended for the cementation of stainless-steel crowns, as its retentive strength is nearly equivalent to that of zinc phosphate cement.[12]

Conclusion

Zinc phosphate cement demonstrates a higher tensile bond strength in comparison to polycarboxylate cement, thereby underscoring its longstanding application and dependability in clinical environments. Although both types of cement possess distinct characteristics and possible uses, our research indicates a preference for zinc phosphate cement in situations that require improved mechanical retention.

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