

Comparison of Tensile Strength of Three Different Luting Cements in Implant-supported and Tooth supported Prosthesis: A Systematic Review

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Abstract-

Aim- This review aims to compare the tensile Bond Strength of three different luting cements namely, composite resin cement, Glass Ionomer Cement, and Zinc Phosphate cement.

Methods- In-vitro studies published between 1st January 2000 to 1st August 2021 were selected from PubMed, Cochrane Library, and Google Scholar after an extensive search, articles were reviewed independently by two reviewers.

Results- 3 studies met the eligibility criteria. The Tensile Bond Strength of Composite Resin cement was higher compared to glass ionomer and zinc phosphate cement in the tooth-supported and implant-supported prosthesis.

Conclusion- Composite resin cement has better tensile strength when compared to glass ionomer cement and zinc phosphate cement. Thus, it can be used in tooth-supported or dental implant prostheses. Glass Ionomer cement or Zinc Phosphate cement have similar tensile bond strength and can be used depending upon the clinician's preference.

Key words-Tensile Bond Strength, Glass Ionomer Cement, Composite Resin, Zinc Phosphate Cement, Fixed Prosthesis.

Introduction

The factors which determine the success of a crown on natural teeth is whether a single restoration or as a part of a fixed partial prosthesis, depends on various factors. These factors are the preparation of the tooth, the type of crown selected and the luting cement used.^[1] However, the prosthesis on a dental implant differs from that on a natural tooth. Dental implants have a separate component called the abutment on which the final prosthesis will be placed. The factors which may affect the retention of the fixed prosthesis in dental implants are the embellished tapered abutment, the surface area of the dental implant, the size of platform filling method of screw-retained crowns method, and the abutment finish which can be narrower than the natural tooth.^[2] Dental implant protheses can be restored by the screw-retained or cement-retained prosthesis.^[3] However, one of the common glitches in a screw-retained prosthesis is that of loosening of the screw.^[4] Cement retained prosthesis offers various advantages like the passive fit, not being technique sensitive, aesthetics, and superior occlusion.^[5]

One of the crucial factors that determine the success of a fixed prosthesis on a natural tooth or a dental implant depends on the luting cement and the technique of cementation.^[6] A dental luting cement acts as a barrier against microbial leakage, sealing the interface between the tooth/ implant abutment and fixed prosthesis and retaining them through mechanical, chemical attachment, or an amalgamation of both.^[7]

The de-cementation of a tooth-supported fixed prosthesis or implant-supported prosthesis is not uncommon. One of the factors responsible for de-cementation would be the retentive property of dental cements. The tensile bond strength that attribute strength coefficient which gives a total estimation of the bonding capacity of the luting agents. The tensile bond strength is preferred because of the effortlessness of obtaining the pure tensile strength of luting agents bonded to various materials.^[8]

Zinc Phosphate Cement ($ZnPO_4$) is the most widely used luting cement.^[9] Although it has a few disadvantages like low acidic pH, highly soluble in saliva, lack of chemical bonding yet it has the greatest biocompatibility to the pulp.^[6,7] Glass Ionomer Cements (GIC) adhere to the tooth surface due to the ionic bond.^[6] However, this cement is susceptible to saliva and water when it is exposed during the initial setting period.^[6]

Composite resin cements contain filled BIS-GMA resin and other methacrylates which polymerize by chemical initiated mechanism or through photo polymerization or combination of both^[6,10] These resin cements exhibit good compressive and tensile strength to tooth, metal, and ceramic restorations.^[11] This systematic review aims to compare the Tensile Bond Strength (TBS) of three different luting cements namely, Glass Ionomer Cement (GIC), Composite Resin Cement (CR), and Zinc Phosphate Cement ($ZnPO_4$).

Materials and Methods

Depending on the PICO criteria, a search strategy was formulated and executed using an electronic search. The PICO question framed was as follows: Among the three luting cements, which has the greatest tensile bond strength? The following databases: PubMed, Cochrane Library, and Google Scholar were searched for the relevant articles from 1st January 2000 to 1st August 2021. This search was facilitated using MeSH (Medline Subject Heading Terms) while searching in each database given in Table 1.

Since we had to study the tensile bonding strength of dental luting cements in-vitro studies were included. Studies comparing the tensile strength of GIC, CR, and $ZnPO_4$ were included. Also, only articles in English were selected. Case Reports, Case Series, Review articles were excluded. The search strategy was amassed using a combination of MeSH terms along with unspecific free-text words in simple or multiple conjunctions as presented in Table 1

Table 1: MESH Terms for Search Strategy

Keywords	MeSH Terms
Tensile Strength	Strength, Tensile, Strengths, Tensile, Tensile Strengths
Fixed Partial Dentures	Fixed Bridge, Bridge, Fixed, Bridges, Fixed, Fixed Bridges, Fixed Partial Denture, Denture, Fixed Partial, Dentures, Fixed Partial, Fixed Partial Dentures, Partial Denture, FixedPartial Dentures, FixedPontic, Pontics
Dental Implant Prostheses	Dental Prosthesis, Implant Supported, Implant-Supported Dental Prosthesis, Dental Prostheses, Implant-Supported, Implant Supported Dental Prosthesis, Implant-Supported Dental Prostheses, Prostheses, Implant-Supported Dental, Prosthesis, Implant-Supported DentalDenture, Implant-Supported, Denture, Implant Supported, Implant-Supported Denture, Dentures, Implant-Supported, Implant Supported Denture, Implant-Supported Dentures, Prosthesis Dental, Implant-Supported, Dental, Implant-Supported Prosthesis, Dentals, Implant-Supported Prosthesis, Implant-Supported Prosthesis Dental, Implant-Supported Prosthesis Dentals, Prosthesis Dental, Implant Supported, Prosthesis Dentals, Implant-Supported
Glass Ionomer Cement	Glass Ionomer Cement, Cement, Glass Ionomer, Cements, Glass Ionomer, Ionomer Cement, GlassPolyalkenoate Cement, Cement, Polyalkenoate, Cements, Polyalkenoate, Polyalkenoate Cements, Glass-Ionomer Cement, Cement, Glass-Ionomer, Cements, Glass-Ionomer, Glass-Ionomer Cements, Glass Polyalkenoate Cements, Glass Polyalkenoate Cement, Cement, Glass Polyalkenoate, Cements, Glass Polyalkenoate, Polyalkenoate Cement, Glass
Composite Resin	Composite Resin, Resin, Composite, Resins, Composite
Zinc Phosphate Cement	Cement, Zinc Phosphate

The PICO format was as follows: P-Dental Implant Prostheses/ Fixed Partial Dentures,I-Use of GIC, Composite Restoration or Zinc Phosphate cementO-The Tensile Strength of GIC.

Selection of studies

Two independent reviewers screened the titles and abstracts identified by the electronic searches in duplicate. Full reports were obtained for all titles that appeared to meet the inclusion criteria or where uncertainty was felt. Additional information from study authors was requested where necessary. Disagreements between reviewers were resolved by discussion, and one of two arbitrators adjudicated unresolved disagreements.

Data extraction and management

From the studies that met inclusion criteria, data was extracted pertaining to sample size, use of tooth or dental implants, type of dental luting agents used.

Results

The electronic databases like PubMed-Medline, Cochrane Library, and Google Scholar recognized 310, exclusive articles which were screened by titles and abstracts. After completion of full-text reading, 33articles were excluded according to the exclusion criteria. 3 articles that fulfilled the inclusion criteria were processed for data extraction. (Figure 1) An additional manual searching of the reference lists of the selected studies produced no supplementary articles. The selected studies and their characteristics are given in Table 2.^[5,6,12]

Table 2: Characteristics of Selected Studies

Author/ Publication Year	Country	Sample size and samples used	Luting Cements used			Tensile Bond Strength (TBS) (Mean± SD)		
			GIC	CR	ZnPO ₄	GIC	CR	ZnPO ₄
Parameswari B et al, 2014	India	n=40	Yes	Yes	Yes	1.677±0.26		
Kulkarni G et al, 2015	India	n=60 (teeth)	Yes	Yes	Yes	4.709 ± 0.1434	25.941 ± 0.7633	1.1068 ± 0.0931 (MPa)
Ganapathy D et al, 2015	India	n=40	Yes	Yes	Yes	93.1312 ± 3.2804	373.3964±6.6887	222.541 ± 6.4981
		(Dental Implants)				71(N)	72(N)	17 (N)

Glass Ionomer Cement: GIC, Composite Resin Cement: CR, Zinc Phosphate Cement: ZnPO₄

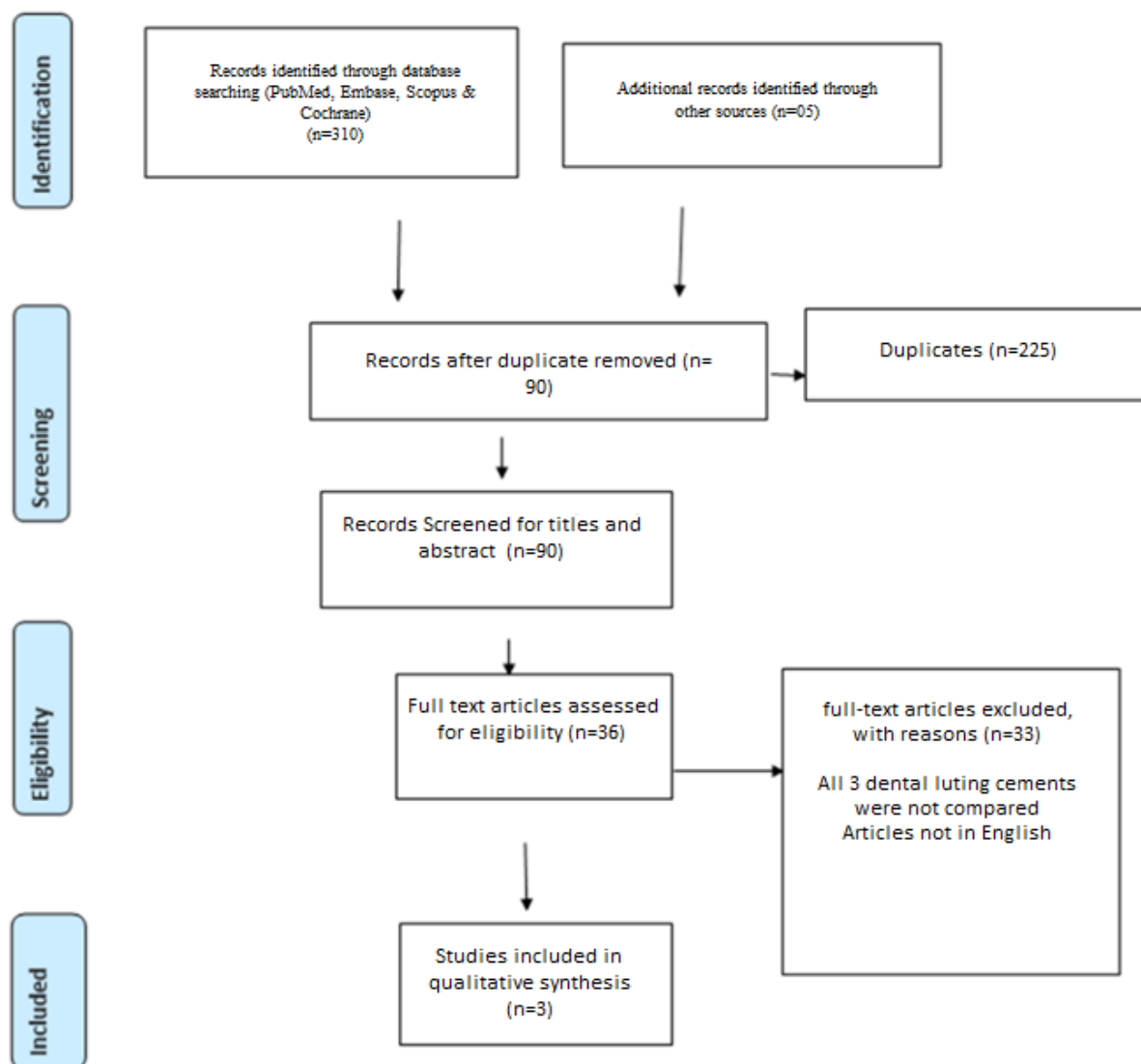


Figure 1: Selection of Studies (Proper image needed)

Characteristics of studies

All 3 studies were in-vitro studies. A total of 140 prostheses were included and these studies were conducted in a dental laboratory. One study had used dental implant-supported prostheses.^[5] Two studies had used teeth-supported prostheses.^[6,12] These included studies had used GIC, Composite Resin cement, and Zinc Phosphate Cement. The tensile Bond Strength (TBS) of dental luting cements was recorded in all three studies.

All three studies reported that composite resin cement had the highest tensile strength compared to the other cements.^[5,6,12] On comparing the tensile strengths between GIC and ZnPO₄, all three studies reported different results.^[5,6,7]

Discussion

Dental luting cement performs an important function of retaining the prosthesis to the natural tooth or dental implant. De-cementation of a crown can lead to loss of function, loss of aesthetics, and in some cases, can lead to swallowing of the prosthesis and asphyxiation.^[5] The retention of the fixed prosthesis can be evaluated by studying the Tensile Bond Strength (TBS).^[5]

Parameswari *et al*, Kulkarni G, and Ganpathy D in their respective studies reported that the Tensile Bonding Strength (TBS) of composite resin cement was highest compared to other cements used in the study.^[5,6,12] This can be attributed to the micromechanical bonding property of composite resin cement.^[13]

However, when GIC and ZnPO₄ were compared with each other, all three studies had different results.^[5,6,12] According to Ganpathy *et al*, the TBS of GIC was less compared to ZnPO₄, because the adhesion of GIC to implant abutment was purely mechanical rather than the ionic bond which it forms to the tooth.^[5] Kulkari G has reported that TBS of GIC is higher than ZnPO₄ because of the ionic forces between GIC and the enamel and dentin surfaces of the teeth whereas, for ZnPO₄ cement, the adhesion is micromechanical.^[12] On the contrary, Parameswari *et al* reported that TBS of GIC and ZnPO₄ is similar due to the tensiofrictional property of ZnPO₄ which helps in the retention of crowns and the ionic bonding of GIC.^[6]

Limitation

Though major databases were scanned for literature search, a few articles might be overlooked because they might be present in other sources. Also, only articles in the English Language were included due to which valuable information might have been left out. There is a shortage in dental literature regarding studies measuring TBS of different luting cements

Implications for research

The selected studies were performed in a dental laboratory. There is a need to simulate the oral environment in the dental laboratory to study these cements more closely. Also, there is a need to study the dental luting cements in implant abutments.

Conclusion

Dental luting cements play an important role in retaining the prosthesis on the tooth or dental implant. It can be concluded that composite resin cement has a higher tensile bond strength (TBS) when compared to GIC and ZnPO₄ and could be used for luting prosthesis on a tooth. GIC can be used for luting prosthesis on natural tooth whereas ZnPO₄ or composite resin can be used on dental implant abutment based on the clinician's preference.

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