Evaluation Of Bond Strength Of Conventional Cast Metal And CAD/CAM Zirconia Posts With Different Luting Agents– An In Vitro Study.

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Abstract

Purpose: The purpose of the study was to evaluate and compare the bond strength of the Conventional Cast Metal and CAD/CAM Zirconia posts with different luting agents. **Materials and Method:** Post spaces were prepared in sixty extracted maxillary anterior teeth and divided into two main groups of 30 teeth each for cast metal (M group) and CAD/CAM zirconia posts (Z group).These groups were further divided into 6 subgroups of ten specimen each (n=10) according to the cement used for post cementation as follows: M1,M2 & M3 for Cast metal posts and Z1,Z2 & Z3 for CAD/CAM Zirconia posts luted with Resin modified GIC (GC Fuji Cem 2), 10 MDP based Self adhesive Self cure resin cement (Speed CEM Plus) and 10 MDP based Self adhesive Dual cure resin cement (Multilink N) with silane coupling agent respectively. The specimens were subjected to a pull out bond strength test in a Universal testing machine at a cross head speed of 0.5mm/min. Data was analyzed using analysis of variance (ANOVA) and Post Hoc Test (Bonferroni). **Results:** The mean pull out bond strength (MPa) of M1, M2 and M3 subgroups was 4.35 ,5.38 and 7.49 respectively. The mean pull out bond strength (MPa) of Z1, Z2 and Z3 subgroups was 8.27, 7.6 and 12.4. The difference in the mean bond strength between M1, M2 and M3 & Z1, Z2 and Z3 was statistically significant at $p < 0.0001$. **Conclusion:** The bond strength was significantly affected by the type of luting agent used to lute the post. Self adhesive, Dual cure 10 MDP based resin cement with silane coupling agent may be preferred in comparison to Self adhesive , Self cure ,10 MDP based resin cement and Resin modified GIC to achieve reliable and efficient bonding to both Conventional Cast Metal posts and CAD/CAM milled Zirconia posts.

Keywords: Resin cement, CAD/CAM, Zirconia posts, Pull out strength

INTRODUCTION:

Endodontically treated teeth are at higher risk of fracture as compared to vital teeth due to the removal of their structure during restorative procedures and root canal treatment[1] and the clinicians are presented with a multifaceted restorative challenge while treating such teeth. Post-core restoration is recommended for endodontically treated teeth when a restoration fulfilling the tooth's masticatory and esthetic functions is not possible using the remaining coronal tissue. Mangold and Kern stated that the loss of around more than 50% of the coronal structure requires the use of posts to retain the final restoration[2].

Endodontically treated teeth can be restored with conventional cast metal posts and cores[3], prefabricated posts[4], or the recent computer-aided design/computer-assissted manufacturing (CAD/CAM) fabricated posts[5,6,7]. Custom cast metal post-cores have long been used to successfully restore teeth[8]. As a cast post and core provides intimate adaptability in a canal wall and resists torsional force, it has been considered the gold standard, especially in the situation of an insufficient ferrule and irregularly shaped canal where prefabricated posts may not achieve adequate adaptation of the post to the canal, possibly compromising the retention of the post[9,10,11.12.13.14.15]. Another advantage to using custom cast post and cores is that it is cast as one unit with the same material, thereby providing the best possible junction between the post and the core.

With the development of CAD-CAM technology, a zirconia post and core has been used as an alternative to a cast post and core in the esthetic zone [16.17,18]. Zirconia posts were first introduced in 1993, given the high translucency and the ability to match tooth color, these posts were aesthetically superior and resulted in restoration resembling natural teeth.

CAD/CAM custom made post and cores, produced by a controlled milling process, show improved biomechanical behavior because of their excellent adaptation to the prepared root canal walls, promote an increased frictional resistance and a thin layer of cement, creating favourable conditions for retention of post. Furthermore, the use of CAD/CAM allows the fabrication of a post and core in a single piece, decreasing the number of interfaces between post and core, thereby reducing the chances of structural failure in the material through a more controlled milling process of homogenous material blocks [16,17,18,19,20].

The retention of a post is a major factor influencing the survival of the restoration. Most clinical failures involving endodontically treated teeth reconstructed with posts are due to cementation failure[9,21,22]. With the plethora of new luting agents flooding the markets, the practitioner must have sufficient knowledge to help choose the material for each clinical situation. Selecting the right cement for is a basic requirement for success of treatment not only with post and core systems but also with any restoration.

Adhesive cementation is an important factor which can improve the fracture resistance of teeth. Several studies have reported a significant increase in bond strength with resin cements compared to conventional cements[23,24,25]. The use of resin cements for post cementation makes roots less vulnerable to fracture under static loads, improves retention and tend to leak less than other cements.

Cementation of all-ceramic restorations by adhesive resin cements is highly recommended to compensate for marginal incongruities, to promote retention, and to strengthen the restoration[26]. The resin cements containing an adhesive functional monomer such as 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) or methacrylate phosphoric ester have been speculated to generate a durable chemical bond to zirconia-based ceramics[27].

Nevertheless, there is limited evidence on the bond strength of newer resin cements compared to the conventional cements and inconclusive and conflicting results have been reported relative to the retentive capability of cements with cast post and core. Hence the present study was conducted to compare the bond strength of the conventional cast metal and CAD/CAM zirconia posts with different luting agents.

MATERIALS AND METHOD

The methodology used in the study has been discussed under the following headings:

1. Sample collection and selection.2. Sample preparation a) Decoronation b) Working length determination c) Biomechanical preparation 3. Post space preparation 4. Fabrication of Resin pattern 5. Preparation of posts 6. Luting of Posts and sample grouping 7. Pull out bond strength test

1.Sample collection and selection:

Sixty intact crack and caries free, unrestored freshly extracted maxillary anterior teeth of comparable length with fully developed root apex and a single root canal extending from the pulp chamber to the apical foramen were collected. To standardize procedures and materials, buccolingual and mesiodistal dimension was measured with a digital caliper 16mm from the apex. The mean was calculated and specimens that showed 10% deviation from the mean were discarded. Teeth were examined radiographically for caries, canal ramifications and cracks were cleaned of calculus and all external debris with an ultrasonic scaler After scaling the teeth were stored in 0.9% normal saline solution and were transferred into 5.25% sodium hypochlorite solution 24 hours prior to preparation.

2. Sample preparation:

a) Decoronation:

The teeth were sectioned 1mm above the cemento-enamel junction (CEJ) perpendicular to the long axis of the root, with a slow speed diamond disc to obtain a mean root length of 16 mm and hence a working length of 15mm.

b) Working length determination:

After decoronation #10K file was introduced into the root canal to the working length of 15mm to check the patency of the canal. After preparation of glide path with # 15 K hand file, working length of 15mm was determined.

c) Biomechanical preparation:

Pulp chambers were accessed and root canals were instrumented with Neoendo rotary files using Endomotor at 350 rpm & 1.5 Ncm in sequential manner upto master apical file of #30/4% with recapitulation with K file, #10. Silicone stoppers were placed around the file shaft to control the working length of the files, and the accuracy of the internal canal dimensions were ensured. During instrumentation, 2.5% sodium hypochlorite and 17%EDTA solution were used to irrigate the canal and flush out debris during preparation.10 ml of distilled water was used as a final rinse to neutralize the residual effects of NaOCl. After the final irrigation, the canals were dried with absorbant paper points, #30/4%.ISO standardized gutta percha cone (#30/4%) was checked for tug back to the full working length. The roots were then obturated with lateral condensation of #30/4% gutta-percha and Adseal eugenol free sealer. The master gutta-percha point was coated with sealer and seated in the canal to the full working length. A finger spreader (Kerr; Romulus, Mich.) (size 20) was inserted into the canal to a level approximately 1 mm short of the working length. After that accessory cones (#15) were coated with AH Plus sealer and placed into the canal. Compaction and addition of accessory cones was continued till the spreader extended no further than 2-3 mm into the canal until the entire canal was obturated. The remaining gutta percha was seared off with hot plugger. Thereafter, tooth roots were inserted in acrylic resin blocks with plastic rings upto 2mm below the cemento enamel junction(CEJ) to simulate the alveolar bone levels, with their long axis parallel to the base. The apical end of each tooth was embedded in a block of polymethylmethacrylate **(Fig.No.1).**

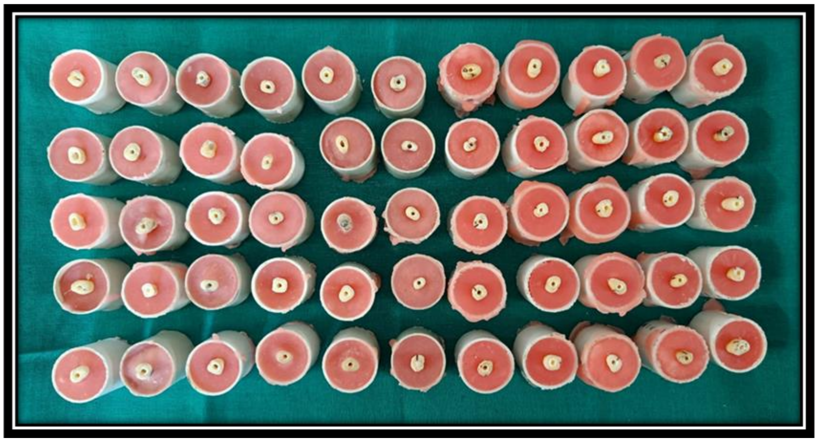


Fig.No.1: Sample roots fixed in acrylic resin blocks

3.Post space preparation:

The post space was then prepared by removing gutta percha from the root canals with Peeso reamer 1, 2, 3, and 4 used sequentially in a low speed contra angle hand piece at a 10mm depth leaving 4 mm of the root canal filling in the apical portion. During post space preparation 2 mL of NaOCl was used to irrigate root canals, which was later neutralized using 5 mL of distilled water. Teeth were then assessed radiographically to ensure efficient post space. The final enlargement of the post space was accomplished with the corresponding tapered drill supplied by the manufacturer to achieve a length of 10 mm for the standardization of all groups. The diameter of the post space preparations was standardized by the diameter of the drill used. Then, post spaces were irrigated with 2.5% NaOCl and 17% EDTA for 1 min and finally with distilled water.

4.Fabrication of resin pattern:

Resin pattern for canal was fabricated using cold cure acrylic resin. Acrylic pattern was trimmed so that it slides easily in and out of the canal. A notch was cut on the facial surface so that it can be easily oriented. The canal and the acrylic pattern was coated with petroleum jelly. The canal was filled with fluid resin and the pattern was inserted into the canal. After the acrylic becomes doughy, the pattern was moved in and out so that it does not lock into any undercut and once the resin polymerises it was removed from the canal and inspected for voids.

5.Preparation of posts:

After fabrication of acrylic posts for each teeth, the teeth were randomly divided into 2 groups of thirty each.30 acrylic posts were cast in nickel chromium base metal alloy (M Group) and 30 were milled from zirconia disc (Cercon® (Dentsply, Amherst, N.Y.), using Computed Aided Design and Computer Aided Miling (CAD/CAM) (Z Group) (Fig No.57) which has been elaborated as under:For casting, the pattern was invested using Phosphate bonded investment material and then cast in nickel chromium base metal alloy using an induction casting machine. Each casting was placed on its respective tooth to verify its fit and adjusted if needed using a no. ½ round carbide burr with a high speed handpiece. Finally cast posts were sanblasted with 50µm aluminium oxide particles. For fabrication of zirconia posts, the acrylic resin pattern for each specimen was scanned and milled according to the acquired data of a pattern using computed aided design and computer aided miling (CAD/CAM).The data was processed by the CAD software and a 3D digital model of the zirconia post was developed.

6. Luting of posts and sample grouping:

For cementation of posts, the canal surface preparation and mixing & handling of the cements was accurately followed according to the manufacturer's instructions. The luting agents used were:GC

Fuji Cem 2 (Resin modified GIC),Speed CEM Plus (10 MDP based Self cure Self adhesive resin cement) Multilink N (10 MDP based Dual cure Self adhesive resin cement)

Sample Grouping (Fig. No. 2):

Based on the luting agent used to lute the post, Conventional cast metal posts (M group) and CAD/CAM Zirconia posts(Z group) were randomly assigned to six equal subgroups of 10 each which were categorized as:

M1: Cast metal posts with Resin modified GIC (GC Fuji Cem 2).
M2: Cast metal posts with Self adhesive Self cure resin cement (Speed CEM Plus).
M3: Cast metal posts with Self adhesive Dual cure resin cement (Multilink N).
Z1: CAD/CAM milled zirconia post with Resin modified GIC (GC Fuji Cem 2).
Z2: CAD/CAM milled zirconia post with with Self adhesive Self cure resin cement (Speed CEM Plus).
Z3: CAD/CAM milled zirconia post with Self adhesive Dual cure resin cement (Multilink N).

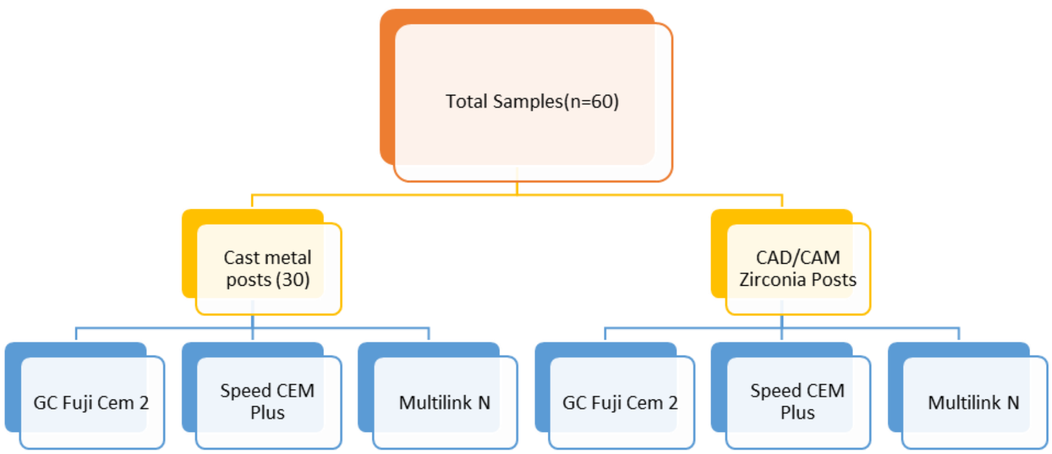


Fig No.2: Sample Grouping

The cement was placed in the canals using root canal tips and the posts were also coated with cements. Self adhesive resin cements were used in both dual cure and chemical cure mode. Light curing was carried out using a light cure unit for dual cure resin cement (Multilink N).Each post was inserted and held in position with finger pressure until the cement sets. After setting, excess cement was removed with an explorer. Complete seating of the post was confirmed by observing that the margins of tooth and post and core complex are flushed with no hindrance upon placing and removing within the prepared root canal and assessed radiographically. The specimens were stored in distilled water at 37ºC for 24 hours in an incubator before the test.

7. Pull out bond strength test:

Pull out bond strength was assessed using a universal testing machine with a cross head speed of 0.5mm/min (ISO TR 11405, 2003). Prior to tensile bond strength testing using the Universal Testing Machine, it was ensured that all posts were 3 mm exposed from the preparation to facilitate a grip on posts. A mounting jig was bolted to the universal testing machine. A clamp arising from the mounting jig secured the tooth against the force applied by the universal testing machine (**Fig No.3).**The universal testing machine was calibrated prior to data collection. Vertical force was applied at a crosshead speed of 0.5mm/min until the post-dentin seal was broken. The post/tooth junction was visually assessed until the cement seal was broken. Graphs of each sample confirmed coincidental cement bond failure with a certain peak. These tensile force readings were recorded, and the mean values and their standard deviations were calculated. Pull-out strength data was calculated in Newtons (N), which was converted to Mega Pascals (MPa) by dividing the load by the bonded surface area. The bonded area consisted of the lateral area of a truncated cone, and it was calculated using the formula: $A=\pi(R+r)\ \sqrt{((R)-r)}+h2$ where $\pi=3.14$, R=larger base radius, r= smaller base radius and h= Slant height.The maximum failure load was recorded and the mean pull out bond strength values and their standard deviations were calculated.

Fig No.3: Specimen secured to clamp

RESULTS:

Determination Of Sample Size:

Using GPOWER software (v 3.0.10; Franz Faul, Kiel University, Kiel, Germany), it was estimated that the least number of samples required in each group with 80% power, effect size of 0.50 and 5% significance level is 10. Since we have to compare six groups in our study, therefore a total of 60 samples were included in our study.

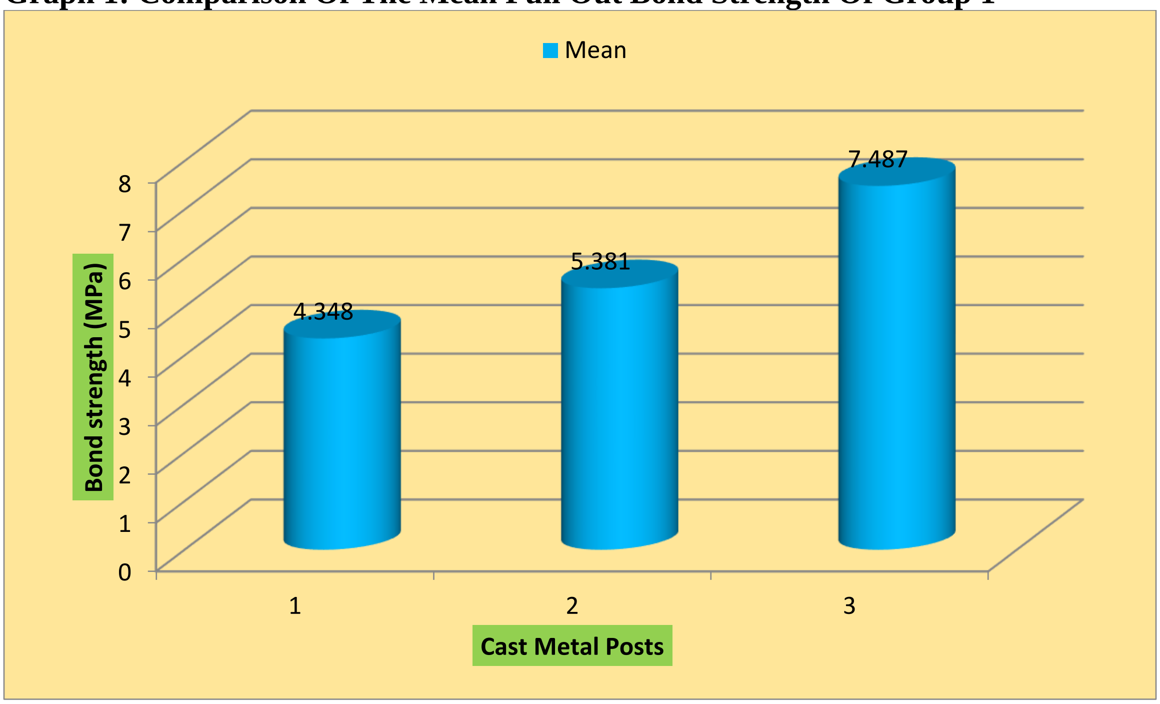
Statistical Analysis:

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Statistical software SPSS (version 20.0) and Microsoft Excel were used to carry out the statistical analysis of data. Continuous variables were expressed as Mean ± SD and categorical variables were summarized as frequencies and percentages. Analysis of variance (ANOVA) was employed for intra group analysis of data and for multiple comparisons, Post Hoc Test (Bonferroni) was applied. For intergroup analysis, Student's independent t-test was applied. Chi-square test or Fisher's exact test, was applied for comparing categorical variables. Graphically the data was presented by bar diagrams. A P-value of less than 0.05 was considered statistically significant.

Results:

The mean pull out bond strength of all the subgroups belonging to Group 1 & 2 was determined & compared with each other. The mean pull out bond strength (MPa) of M1, M2 and M3 subgroups was 4.35 ,5.38 and 7.49 respectively with highest mean bond strength seen in M3 followed by M2 and lowest mean bond strength in M1 subgroup. The mean pull out bond strength (MPa) of Z1, Z2 and Z3 subgroups was 8.27, 7.6 and 12.4 respectively with highest mean bond strength seen in Z3 followed by Z1 and lowest mean bond strength in Z2 subgroup. The difference in the mean bond strength between M1, M2 and M3 & Z1, Z2 and Z3 was statistically significant at $p < 0.0001$. The mean pull out bond strength of all the posts of Group 1 and Group 2 is listed in table and also represented graphically.

Graph 1: Comparison Of The Mean Pull Out Bond Strength Of Group 1



Graph 2: Comparison Of The Mean Pull Out Bond Strength Of Group 2

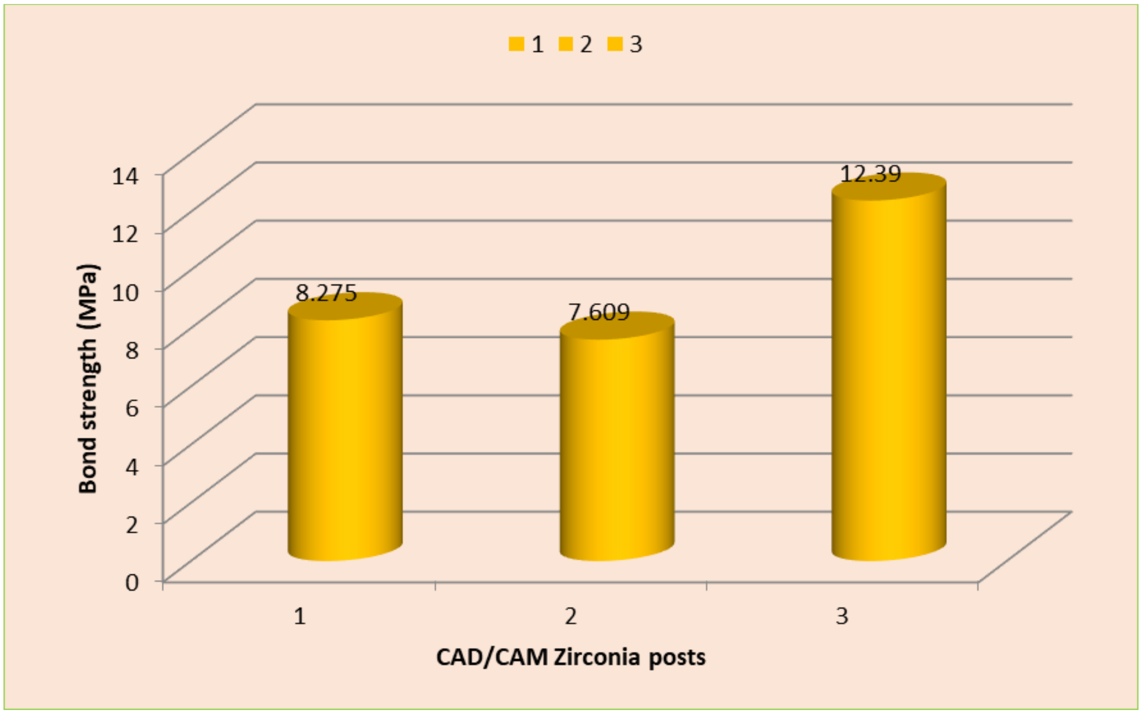


Table: 1 Post Hoc Tests (Bonferroni)

Dependent Variable	Group	Group	Mean Difference	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
M	M 1	M2	-1.03333	0.361	-2.6773	.6107
		M3	-3.13939*	<0.0001	-4.7834	-1.4954
	M2	M3	-2.10606*	0.009	-3.7501	-.4621

Table: 2 Post Hoc Tests(Bonferroni)

Dependent Variable	Group	Group	Mean Difference	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Z	Z1	Z2	0.66667	1.000	-1.2109	2.5442
		Z3	-4.11818*	<0.0001	-5.9957	-2.2406
	Z2	Z3	-4.78485*	<0.0001	-6.6624	-2.9073

DISCUSSION:

Extracted maxillary anterior teeth of comparable buccolingual and mesio distal dimension with almost intact crown, free of previous endodontic treatment, restorations, fractures, cracks, and significant erosion or enamel hypoplastic deficiencies were selected. The use of human teeth is a reliable methodology in testing, and it has also been validated by some authors[28,29,30,31].

According to the bond strength results, there was a significant difference between bond strength among groups ($p < 0.05$). The bond strength of the specimens in metal group (M) ranged from 4.35 MPa (for the group M1) to 7.487 MPa (for the group M3). Intra group analysis between various subgroups in metal group using subgroups using post hoc test (Bonferroni) showed that the difference in bond strength between cast metal posts luted with Resin modified GIC (GC Fuji Cem 2) and self adhesive self cure resin cement (Speed CEM Plus) was not statistically significant. However, there was statistically significant difference between cast metal posts luted with resin modified GIC (GC Fuji Cem 2) and self adhesive dual cure resin cement (Multilink N) in which universal primer with silane coupling agent was used. Also statistically significant difference in pull out bond strength in cast metal posts luted with self adhesive self cure resin (Speed Cem) and self adhesive dual cure resin cement (Multi link N) was found.
Similar results were seen in CAD/CAM zirconia posts although the mean bond strength in zirconia posts was found to be higher than cast metal posts. The mean bond strength of the specimens in zirconia group (Z) ranged from 7.6 MPa (for the group Z2) to 12.4 MPa (for the group Z3). The highest mean bond strength value was obtained with dual cure 10 MDP based self adhesive resin cement in which silane coupling agent was used (Multilink N). Intra group analysis between various subgroups using post hoc test (Bonferroni) showed that the difference in bond strength between M1&M2 and Z1&Z2 was not statistically significant. Although RMGIC does not contain any phosphate-ester monomer, such as 10-methacryloyloxydecyl-dihydrogen-phosphate (MDP), this does not prevent them from creating a good chemical and mechanical bonding to Cast metal and CAM/CAM zirconia posts which suggests that application of metal /zirconia primer is important to increase the bond strength with MDP containing self adhesive resin cements which is in agreement with study by Jin Soo et al [32] and Xin You et al[33].
Statistically significant difference in tensile bond strength was obtained between groups Z1 and Z3 with the bond strength in Z3 higher than Z1 and Z2. This is in agreement with previous studies, which have shown higher bond strengths for resin-based cements relative to resin modified GIC [34,35]. A recent study demonstrated similar findings, with RelyX Unicem showing higher bond strengths compared to FujiCEM 2 when bonded to base and noble metals, ceramic, and zirconia substrates. Another study by Zhang and Degrange showed higher bond strengths for Multilink Automix compared to other self-adhesive resin cements regardless of the restorative substrate[37]. The same study also found that the bond strengths for many of the tested cements were dependent on the nature of the restorative substrate. This is coincident with the results from our study which demonstrated that the interactions between cement and substrate, were also found to have a significant effect in the bond strength as bonding with CAD/CAM milled zirconia posts was found to be higher than cast metal posts. These differences in bond strengths between the investigated post types might be explained by different compositions and surface structures of zirconium-oxide and cast metal posts, which resulted in difference in the mean pull out bond strength.
Statistically significant difference in the mean pull out bond strength ($p<0.001$) was seen in group M3 and M1. This can be explained by the fact that self-adhesive resin cements provide chemical adhesion to the metal through the presence of hydrophilic functional monomers with phosphoric or carboxylic groups in their composition[38]. These monomers can promote bonding to metallic ions through an acid-base reaction. Also, the mechanical interlocking of resin cement in the post irregularities and its better bonding to root dentin may also explain the higher mean bond strength value (MPa)s with M3(7.487 ± 1.15) as compared to M1(4.35 ± 1.2).

Also the mean bond strength in group M3 (7.487 ± 1.15) was better than in the M2group (5.381±1.8).Although M2 and M3 both contained 10 MDP, an organic ester which can chemically bind to the oxide layer created on the metal surface through covalent bonds and also provide mechanical retention to the sandblasted surface, the bond strength in M3 was better which suggests the role of silane coupling agent as well dual cure polymerization method in achieving a stronger bond to cast metal post. Silanes act as coupling agents similar to metal primers, for bonding resin composites to metals[39].

Also some studies have revealed that the suppression, or decrease, of light intensity leads to lower conversion degrees of these cements, thereby indicating that chemical activation itself may not be sufficient to provide polymerization levels close or similar to those reached by photoactivation which are in accordance to our results obtained[40].

The use of cast post and core associated with dual cure 10 MDP based self-adhesive cement may offer a reliable rehabilitation choice, with user-friendly technique, low film thickness and adhesion to dentin walls and to the metal.

For CAD/CAM zirconia posts, polymeric dual cure cement displayed the highest tensile pull out bond strength (MPa) among all the luting agents (12.39 ± 2.2). The rationale for these findings is manifold, including the cementation technique, cement composition and interaction between dentin and luting cements.

Also the mean bond strength in Z3 group was better than Z1. The current results are in agreement with previous studies that showed higher bond strengths of resin-based self-adhesive cements compared to RMGIC when bonded to a variety of prosthetic substrates such as noble and non-noble alloys, zirconia and other types of glass-based ceramics [34,41]. Further studies [36,42,43] verified how resin-based materials containing MDP have the ability to create a strong bond strength to zirconia; such a high bond strength to zirconia may be attributed to a chemical reaction between MDP with zirconium oxide [44,45]. Some studies confirmed such a chemical interaction between MDP and zirconia[46] through contact-angle measurements, secondary ion mass spectrometry (TOF-SIMS)[47] and Fourier transform infrared spectroscopy[48,49]. In addition, adhesive bonding to root dentin with high affinity functional resin monomers in a thin layer of polymeric cement has shown improved bond longevity for the luting post.

Also the mean bond strength in Z3 was better than Z2. Interestingly, Speed CEM Plus contains MDP within its formulation but revealed inferior bonding ability when compared to Multilink N. These finding are in agreement with study by Jin Soo et al[32] in which MDP-containing primer application increased the bond strength between Y-TZP ceramics and MDP-containing self adhesive resin cements. This difference might be attributed to the different quality of MDP ,silane coupling agent used as well as a different concentration but also to a difference in their polymerisation initiation systems. Therefore, in conjunction with the MDP monomer, a possible improved polymerisation may have occurred in Multilink, which resulted in superior and improved bonding performance [50]. In addition, studies recommend dual cure polymeric resin cements as they allow for chemical chelation between functional acid methacrylate and calcium from dentinal tissues[51].

Thus it can be concluded that 10 MDP self adhesive dual cure resin cement along with silane coupling agent provides the highest bond strength with both Cast Metal and CAD/CAM Zirconia posts and may be preferred to achieve reliable and efficient bonding. Indeed, these outcomes are associated to the unique composition of such a modern self-adhesive cement and are in agreement with the recent study by Paula C [52] et al in which it was found that the surface treatment of implant abutments with 10-MDP containing universal dentin adhesive increased the shear bond strength of a self-adhesive resin cement. It is important to highlight that when using such permanent luting cements, in particular those reinforced with resin (e.g., resin-modified glass ionomer cements and resin-based cements), one can have numerous clinical advantages, in particular, a reduction of secondary caries due to low cement solubility, with consequent reduction of the risk for pulp harm. Moreover, it has been advocated that when cast post and- core build-ups are cemented using such materials, it is possible to attain an important drop of the risk for root fractures. It was also reported that the use of adhesive resin-based cements may increase the fracture resistance and extend the durability of aesthetic ceramic and composite indirect restorations.

With every study comes its limitations so has ours. Extracted teeth used for the study could present intrinsic defects and fracture lines not visible on the root exterior, and any hidden defects could affect the load to failure. These differences in tooth size and contour, however, could not be controlled, and this aspect of the study design is an inherent limitation. Pre-test failures can be considered a limitation of the testing protocol; and may have been caused by the weak adhesion and stresses during specimen preparation. In addition, in vitro studies do not exactly reproduce clinical conditions so long term in vivo studies should be conducted in future to corelate the findings clinically.

In the present study, a 24-hour immersion in a 37ºC water bath was used prior to bond strength testing since this represents the standard short-term storage protocol recommended by the International Organization for Standardization (ISO/TR 11405)[53]. Although the effects of thermal cycling and long term storage on the bond strength were not evaluated as a part of this investigation, they are important in the simulation of clinical conditions and should be investigated in future studies.

CONCLUSION:

The present in vitro study aimed to evaluate the Bond strength of the Conventional Cast Metal and CAD/CAM Zirconia Posts with Resin modified GIC (GC Fuji CEM 2), Self adhesive, Self cure ,10 MDP based resin cement (Speed CEM Plus) and Self adhesive, Dual cure, 10 MDP based resin cement (Multilink N) and within the limitations of this study, the following conclusions were drawn:

1. Dual cure 10 MDP based self adhesive resin (Multilink N) with silane coupling agent provided the highest bond strength to both the Conventional Cast Metal posts and CAD/CAM fabricated Zirconia posts followed by Speed CEM Plus & GC Fuji CEM 2 with Cast Metal Posts and GC Fuji CEM 2 & Speed CEM Plus in CAM/CAM milled Zirconia posts which showed comparable bond strength to each other.
2. However, there was no statistically significant difference in the mean bond strength after using Self adhesive Self cure 10 MDP based resin cement (Speed CEM Plus) and Resin modified GIC (GC Fuji CEM 2) with both the Conventional Cast Metal posts and CAD/CAM fabricated Zirconia posts.
3. Also, CAD/CAM milled Zirconia posts demonstrated higher bond strength values when compared to Conventional Cast Metal posts depending on the luting agent used.

Thus it can be concluded that the bond strength was significantly affected by the type of luting agent used to lute the post and Self adhesive Dual cure 10 MDP based resin cement along with silane coupling agent provided the highest bond strength amongst the various luting agents tested.

Hence to achieve reliable and efficient bonding to Conventional Cast Metal posts and CAD/CAM milled Zirconia posts, Self adhesive Dual cure 10 MDP based resin cement with silane coupling agent may be preferred in comparison to 10 MDP based self adhesive resin cement (Speed CEM Plus) and Resin modified GIC (GC Fuji CEM 2). Indeed, these outcomes are associated to the unique composition of such a modern self-adhesive cement which is worthy of long term clinical investigation.

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