

A Comparison of Pushout Bond Strength of Fibre Post Luted With Four Different Resin Cements – An In Vitro Study

Abstract:

Aim: To compare the push out bond strength of a fibre post in single rooted tooth at coronal and middle third using four different resin based luting cements.

Materials & Methods: In this in-vitro study 80 mandibular premolars were decoronated 2mm above the CEJ, and roots were treated endodontically. The samples were then sectioned using safe-sided diamond disc in coronal and middle regions of root (1mm thickness). On the basis of two regions (coronal and middle), samples were divided in two subgroups. Fibre-reinforced composite posts were cemented with four resin cement systems: (a) RMGIC, (b) Paracore, (c) SoloCem, and (d) Maxcem Elite. The push-out test was performed with a universal testing machine at a crosshead speed of 1 mm/min, and bond strength values were evaluated. The data was statistically analyzed using ANOVA one way test for comparing mean resistance values and post hoc test for multiple comparisons using SPSS 23.0.

Results: Multiple comparisons revealed that difference between all 4 groups is significant with P value <0.05 suggesting that Paracore dual cured resin based luting cement has highest bond strength at coronal as well as at middle region of post cemented root sections as compared to other three dual cured resin based luting cements RMGIC, SoloCem and Maxcem Elite.

Conclusion: Fibre post luted with dual-polymerized glass-reinforced composite resin cement- Paracore has highest bond strength in coronal as well as in middle sections as compared to other 3 cements (RMGIC, SoloCem, Maxcem Elite). RMGIC & Maxcem Elite resin cements shows approximately equal values, which can be considered to have similar bond strength in middle as well as in coronal sections.

Clinical Significance: Push out bond strength test by application of single compressive load it simulates the dynamics of delivery and distribution of force in clinical situation. Significance of this result, when applied to clinical situations, lies in the fact that selection of luting cement affects the adhesion of post within the canal.

Key-words: Fibre post, Pushout bond strength, Resin cement, Retentive failure

Introduction:

The modern developments in prosthodontic and surgical treatment techniques for replacement of missing teeth favours implant placements which is proven to be less complicated than the one practiced in past, however the most accepted treatment is the one which favours natural dentition unless it affects the prognosis.

Here is a twofold reason for the statement. Firstly, natural dentition allows micromovement by periodontal ligament unlike implants. Secondly, in aesthetic zone like maxillary anteriors, implant faces several soft tissue related anatomic challenges.[1]

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Endodontic treatment and prosthetic rehabilitation of tooth is the most viable therapeutic choice to preserve natural dentition, a further deterioration of tooth may often lead to its loss and replacement by newer implants or fixed/removable partial dentures. Furthermore, the restoration of endodontically treated teeth can be a challenge because, in general, the teeth that undergo this treatment lose a large amount of coronal structure which create difficulties for the aesthetic outcome of subsequent prosthetic restorations.[2]

In such cases, an interdisciplinary approach is necessary to evaluate, diagnose & restore aesthetic problems using a combination of endodontic and prosthetic treatment.

The primitive restorative technique included cast metal post and core because of its toughness and ability to restore the actual shape of the canal. However, this same rigidity leads to concentration of undesirable stress at the apical region of tooth leading to unfavourable root fractures. To overcome this drawback, fibre posts come in role due to its modulus of elasticity which is close to dentin leading to even distribution of forces. Since, everything comes with its cons and pros as do fibre posts, its failure has been associated with its failure to adhere at cement dentin junction. Also, unlike metallic posts they tend to cause repairable fractures.[3]

The bond strength of fibre post to root canal dentin obtained from recent resin based luting system is limited and often accounts for debonding at both surfaces, either between cement and dentine or between cement and post. Therefore, it is important to measure regional bond strengths of fibre post-bonded teeth to determine the most favorable bonding technique for fibre post cementation.[2] Clinical success of fibre post may often rely on its resistance to displacement after adhesion.

This study compares the push out bond strength of a fibre post in single rooted tooth at coronal and middle third using four different resin based luting cements. This can be calculated by applying a tensile load positioned vertically to the long axis of the root till the fibre post is displaced to simulate the dynamics of delivery and distribution of force in clinical situation.[4,5]

Thus, the aim of the study is to compare the push out bond strength of a fibre post in single rooted tooth at coronal and middle third using four different resin based luting cements.

Materials & Methodology :

This in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics, after attaining ethical approval from Mahatma Gandhi Dental College and Hospital, Jaipur, Rajasthan, India .

80 freshly extracted single rooted teeth (premolars) extracted due to orthodontic treatment with a single canal were collected and all the samples were sectioned using safe-sided diamond disc (*API, Stuttgart, Germany*) in coronal and middle regions of root (1mm thickness) to standardize the root length of 14 mm and were mounted on acrylic block.

All samples were endodontically treated till No. 50K, 2% Taper (*Dentsply Maillefer, Ballaigues, Switzerland*) using step back technique till working length. Irrigation was performed using a 5.25% solution of NaOCl (*RFCL Limited, Faridabad, Haryana, India*), 17% of EDTA (*Glyde, Dentsply Maillefer Ballaigues, Switzerland*) followed by saline (*Clarix Lifescience Ltd.*). Obturation with gutta percha cones (*Dentsply Maillefer, Ballaigues, Switzerland*) was done using cold lateral compaction and resin based sealer (*AH Plus Sealer, Dentsply Maillefer, Ballaigues, Switzerland*). For post space preparation, excess gutta percha was removed with a peeso reamer size 1, 2, 3 and 4 (*MANI Inc., Utsunomiya, Tochigi, Japan*) leaving a minimum of 5 mm apical seal creating a standard post space of 9mm from CEJ. A final flushing of the canal space was accomplished using sterile water and the canals were dried with paper points. The prepared roots were randomly divided into four treatment groups according to the different resin cements being used. After post cementation using the respective luting procedures, the coronal part of the exposed dentin was completely covered with composite.

Based on different resin cements, the samples were divided into 4 groups A, B, C, & D as follows-

- **GROUP A**
Group A (n=20) - Fibre post luted with Resin modified Glass Ionomer Cement (*Kerr*) in isolated condition.
- **GROUP B:**
Group B (n=20) - Fibre post luted with Paracore Resin Cement (*Coltene Whaledent Private Limited*) in isolated condition.
- **GROUP C:**
Group C (n=20) - Fibre post luted with SoloCem Resin Cement (*Coltene Whaledent Private Limited*) in isolated condition.

- **GROUP D:**
The Group D (n=20) - Fibre post luted with Maxcem Elite Resin Cement (*Kerr*) in isolated condition.

All the samples of Group A, B, C & D were sectioned into two slices and further divided into 2 subgroups.

Subgrouping:

Bonded specimens were sectioned horizontally with a slow speed diamond disc to produce two 1mm thick post sections to yield 40 slices for each group.

- The first slice represented the coronal region (Subgroup I, n=20) the next slice was of middle third region (Subgroup II, n=20).
- Each section was then placed in universal testing machine to check the push out bond strength.

Push out bond strength evaluation:

- An Instron Universal Testing Machine was used to apply a constant load at a crosshead speed of 1 mm per min until debonding occurred. The acrylic block holding the tooth was positioned in the universal testing machine. Load necessary to fracture the sample was recorded in Newtons.

Statistical Analysis:

- The data was statistically analyzed using ANOVA one way test for comparing mean resistance values and post hoc test for multiple comparisons using SPSS 23.0.

Results

Mean values of Subgroup I (Coronal region) were 1394.25; 2671.75; 2473.65; 1450.55 for RMGIC (Group A), Paracore (Group B), SoloCem (Group C), Maxcem Elite (Group D) respectively. (Table 1)

Inter-subgroup comparison of Coronal section (Subgroup I) showed that Paracore (Group B) has highest mean push out bond strength as compared to RMGIC (Group A), SoloCem (Group C) and Maxcem Elite (Group D)(Graph 1 & Table 2)

Mean values of Subgroup II (Middle regions) were 1217.50; 2079.40; 1989.10; 1125.70 for RMGIC (Group A), Paracore (Group B), SoloCem (Group C), Maxcem Elite (Group D) respectively. (Table 3)

Inter-subgroups comparison of Middle sections (Subgroup II), showed that Paracore (Group B) has highest mean push out bond strength as compared to RMGIC (Group A), SoloCem (Group C) and Maxcem Elite (Group D) and (Graph 2 & Table 4)

Multiple comparison with in Subgroup I and Subgroup II revealed that difference between all 4 groups is significant with P value <0.05 suggested that Paracore dual cured resin based luting cement has highest bond strength at coronal as well as at middle region of post root sections as compared to other three dual cured resin based luting cements RMGIC, SoloCem and Maxcem Elite.

Discussion :

The clinical success and longevity of fibre post depends on the resistance to displacement. Major advantages of fibre posts are their modulus of elasticity, which is similar to dentine (15-20 GPa) high fatigue, tensile strength and can be cemented with an adhesive luting material avoiding development of friction between posts and root canal walls so that force applied would be distributed evenly along length of post.[6]

In the present in-vitro study push out bond strength test was used to measure the resistance to displacement of cement luted post which calculated the stress required to debond the fibre post from post space. The push out test method simulates the dynamics of delivery and distribution of force in clinical situation because luted post usually gets debonded from post space by a single compressive load.[7]

In the current in vitro study, the investigation regarding the bond strength of glass fibre post to dentin of root canal wall using 4 different resin-based luting cements, push-out test was used to present a shear stress at cement dentin interface as well as between cement and post interface, which are comparable to each other for stresses under clinical conditions. In this study, no premature failure of bond of samples to be tested was observed in any of the tested group samples prepared with resin based luting cements.

The bond strength shows variations with the type of resin based luting cement used and the regions of post space within the root canal. Related to the difference between bond strength at different regions, result shows statistically significant difference.

In the present study, with respect to coronal segment (Subgroup I) mean push out bond strength was highest for Paracore followed by SoloCem and Maxcem Elite and lowest was seen in RMGIC with statistically significant difference of $p < 0.001$ (Table-1)

This result is in accordance with the in-vitro study conducted by Khalil Aleisa et al,[8] where a similar result was obtained i.e. bond strength of Paracore found to be highest comparing

to other resin cement (Variolink II, RelyX Unicem). The reason for highest bond strength is, its dual-polymerizing nature with glass-reinforced composite resin cement also the film thickness of 25 µm or less, meeting the relevant ISO standard.

This result is also in accordance with an in-vitro study conducted by [Chen Q.\[9\]](#) which evaluated the push-out bond strengths of prefabricated glass-fibre posts, with polydopamine functionalized to root dentin using two different resin cements (Paracore and RelyX Unicem) in different root regions (cervical, middle, and apical). The bond strength of Paracore to fibre posts was not significantly different from that of RelyX Unicem, and considering its convenient application, Paracore can be recommended.

In the present study with respect to middle section (Subgroup II) in all four groups (Group A,B,C&D) the mean push out bond strength was highest for Paracore followed by SoloCem, Maxcem Elite and RMGIC with statistically significant value of $p < 0.001$ (Table-3)

This result was observed in accordance to the in-vitro study done by [Twisha Garasia et al\[10\]](#) evaluated bond strength of a fibre-reinforced composite post system luted with two different self-adhesive resin cements (Panavia F And Variolink II) and achieved similar results of high mean bond strength at coronal sections followed by middle and apical sections.

Also, the inter-subgroup comparison of all Groups (A,B,C,D) in coronal section (Subgroup I) show statistical significant difference with $p < 0.001$ With the exception of Maxcem Elite (Group D) and RMGIC (Group A) having $p > 0.05$ indicating similar push out bond strength to the subjected load under UTM at coronal section with no significant difference (Graph-1 & Table-2)

This result is in accordance with the study done by [Gerson Bonfante et al¹¹](#) compared resin modified glass ionomer cement (RMGI RelyX luting and RMGI Fuji Plus) and resin cements (RelyX ARC and Resin cement Enforce, showed no significant intra-group difference in RMGIC.

Also, an in-vitro study by [Si-Eun Lee\[12\]](#) who compared Shear-Bond Strength of RMGIC and Six dental self-adhesive resin cements (G-CEM LinkAce, Maxcem Elite, Clearfil SA Luting, PermaCem 2.0, RelyX U200, SmartCem 2) and concluded that all of self-adhesive resin cement except Maxcem Elite demonstrated higher bond strength than that of RMGIC regardless of thermocycling.

On inter-subgroup comparison of all groups in Middle section (Subgroup II), comparing Paracore (Group B) with RMGIC (Group A) & Maxcem Elite (Group D) gives statistically highly significant value with $p < 0.001$. This could be explained by having lower film thickness of Paracore i.e 15µm, allow improved luting around post and on dentinal wall and hence, better penetration and bond strength. However, when compared with SoloCem (Group C) there was no significant difference between the resin based composite cement (Paracore- Group B) and resin based cement (SoloCem- Group C) with $p > 0.05$ considered to be have equal bond strength approximately. (Graph-2 & Table 4)

This result is in accordance with the study done by [Suat Özcan et al¹³](#) who compared the push out bond strength of two resin based adhesive cement (RelyX Unicem and Panavia F 2.0) and found no significant difference amongst both.

Also, these results corresponded with study done by [Si-Eun Lee\[12\]](#) who compared 6 resin based cements with resin modified glass ionomer cement and confirmed the greater bond strength of Resin cement than that of RMGIC when fractured resistance measured under UTM.

Based on the present and the above mentioned studies, for rehabilitation of grossly damaged teeth demands the judicious selection of restorative material that provide optimum bond strength and improves the longevity of treatment.

The disadvantage of post and cores is the poor retention of posts. The cement, post material, surface structure, post length and amount of remaining tooth structure, all affect retention of the post. In-vitro studies regarding effect of cement on retention of post has been investigated extensively. Studies have shown that use of resin cement significantly increases retention and fracture resistance of tooth by providing adhesive bonding.[14]

Use of self-adhesive resin cement in present study eliminated the use of curing light for polymerization in the present study. Literature reviews of various studies reported the transmission of curing light reduces on moving apically leading to incomplete curing of cement.[15]

The present study had few limitations:

It is difficult to extrapolate the results directly into clinical practice as the oral conditions cannot be replicated perfectly.

Conclusion:

Within the parameters and limitations of the present in vitro study the following conclusions can be drawn. Setting mechanism of luting cement affects its adhesion. The resin based cement with self adhesive mechanism provide intimate adhesion to dentinal wall and required higher force to debond post from canal. Paracore has lowest film thickness and highest bond strength, desirable to intimately lute canal wall and to resist debonding forces respectively. RMGIC & Maxcem Elite resin cements shows approximately equal values, which can be considered to have a similar bond strength in middle as well as in coronal sections. However, further in-vitro studies and long-term clinical trials are required to confirm and correlate the present findings.

TABLES & GRAPHS

	Group	N	Mean	SD	Median	P value
RMGIC	A	20	1394.25	116.283	1367.5	0.001 (S)
Paracore	B	20	2671.75	145.911	2656	
SoloCem	C	20	2473.65	140.036	2520.5	
Maxcem	D	20	1450.55	141.196	1460.5	

Table-1 Mean values of Subgroup I (Coronal region)

P<0.05= Significant

P<0.01= Very Significant

P<0.000=Highly Significant

		Mean differences	P value
RMGIC (Group A)	Paracore	-1277.500*	.000
	SoloCem	-1079.400*	.000
	Maxcem	-56.300	1.000
Paracore (Group B)	RMGIC	1277.500*	.000
	SoloCem	198.100*	.000
	Maxcem	1221.200*	.000
SoloCem (Group C)	RMGIC	1079.400*	.000
	Paracore	-198.100*	.000
	Maxcem	1023.100*	.000
Maxcem (Group D)	RMGIC	56.300	1.000
	Paracore	-1221.200*	.000
	SoloCem	-1023.100*	.000

Table 2: Inter-subgroup comparison of Mean Push Out Bond Strength of Coronal section (Subgroup I)

P<0.05= Significant

P<0.01= Very Significant

P<0.000=Highly Significant

	Mean	SD	Minimum	Maximum	Median	P value
RMGIC	1217.50	106.060	1020	1480	1200	0.001 (S)
Paracore	2079.40	164.108	1734	2365	2056.5	
SoloCem	1989.10	184.688	1635	2336	2005	
Maxcem	1125.70	110.019	1013	1396	1068.5	

Table 3- Mean values of Middle section (Subgroup II)

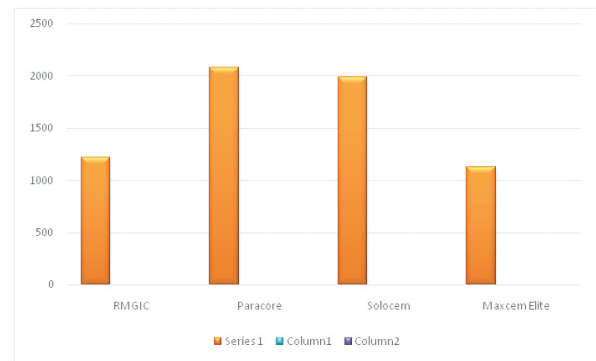
P<0.05= Significant

P<0.01= Very Significant

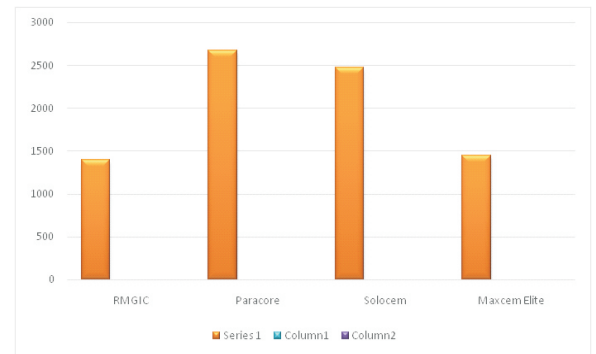
P<0.000=Highly Significant

		Mean differences	P value
RMGIC	Paracore	-861.900*	.000
	SoloCem	-771.600*	.000
	Maxcem	91.800	.295
Paracore	RMGIC	861.900*	.000
	SoloCem	90.300	.318
	Maxcem	953.700*	.000
SoloCem	RMGIC	771.600*	.000
	Paracore	-90.300	.318
	Maxcem	863.400*	.000
Maxcem	RMGIC	-91.800	.295
	Paracore	-953.700*	.000
	SoloCem	-863.400*	.000

Table 3-Inter-subgroup comparison of Mean push out bond strength of Middle section (Subgroup II)



Graph 1- Inter-subgroup comparison of Mean Push Out Bond Strength of Coronal section (Subgroup I)



Graph 2- Inter-subgroup comparison of Mean push out bond strength of Middle section (Subgroup II)

References:

1. Pereira J.R., Pamato S., Santini M.F., Porto V.C., Ricci W.A., S6 M.V.R. Push-out bond strength of fibreglass posts cemented with adhesive and self-adhesive resin cements according to the root canal surface. Saudi. Dent. J. 2021;33:22–26.
2. Belli, S., Eraslan, O., Eskitascioglu, G. Direct Restoration of Endodontically Treated Teeth: A Brief Summary of Materials and Techniques. Curr Oral Health Rep.2015;182–189.

3. Mannocci, F., Cowie, J. Restoration of endodontically treated teeth. *Br Dent J*.2014;341–346.
4. Dem K, Wu Y, Kaminga AC, Dai Z, Cao X, Zhu B. The push out bond strength of polydimethylsiloxane endodontic sealers to dentin. *BMC oral health*. 2019 Dec;19(1):1-6.
5. Bouillaguet S, Troesch S, Wataha JC, Krejci I, Meyer JM, Pashley DH. Microtensile bond strength between adhesive cements and root canal dentin. *Dental materials*. 2003 May 1;19(3):199-205.
6. Soejima H, Takemoto S, Hattori M, Yoshinari M, Kawada E, Oda Y. Effect of adhesive system on retention in posts comprising fibre post and core resin. *Dental materials journal*. 2013 Jul 30;32(4):659-66.
7. Aleisa K, Al-Dwairi ZN, Alsubait SA, Morgano SM. Pull-out retentive strength of fibre posts cemented at different times in canals obturated with a eugenol-based sealer. *The Journal of prosthetic dentistry*. 2016 Jul 1;116(1):85-90.
8. Toman M, Toksavul S, Sarıkanat M, Firidinoğlu K, Akın A. The evaluation of displacement resistance of glass FRC posts to root dentine using a thin slice push-out test. *International endodontic journal*. 2009 Sep;42(9):802-10.
9. Chen Q, Cai Q, Li Y, Wei XY, Huang Z, Wang XZ. Effect on push-out bond strength of glass-fibre posts functionalized with polydopamine using different adhesives. *J Adhes Dent*. 2014 Apr 1;16(2):177-84.
10. Garasia T.,Bagda K.,Vadher R.,Patel N.,Sha V. An In Vitro Comparative Study To Evaluate Pull-Out Bond Strength Of A Fibre-Reinforced Composite Post System Luted With Two Different Self-Adhesive Resin Cements. *IOSR-JDMS*. Aug 2015;14(8):42-48.
11. Bonfante G, Kaizer OB, Pegoraro LF, Valle AL. Tensile bond strength of glass fibre posts luted with different cements. *Brazilian oral research*. 2007;21:159-64.
12. Lee SE, Bae JH, Choi JW, Jeon YC, Jeong CM, Yoon MJ, Huh JB. Comparative shear-bond strength of six dental self-adhesive resin cements to zirconia. *Materials*. 2015 Jun 5;8(6):3306-15.
13. Özcan S, Aktuna S, Nayir Y, Yaman D, Bala O. Push-out bond strength of fibre posts luted using different adhesive resin cements. *J Restor Dent*. 2013;1:75.
14. Vallejo-Labrada M, Ojeda-Garces JC. Microbiological Study of Cast Posts before Cementation. *International Journal of Dentistry*. 2017 Feb 20;2017.
15. Goracci C, Ferrari M. Current perspectives on post systems: A Literature Review. *Australian Dental Journal*. 2011 Jun;56:77-83.