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ORIGINAL RESEARCH

Bond Strength of Overdenture Locator Posts Cemented with Seven Luting Agents

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ABSTRACT

Statement of the problem: Post retention is crucial factor in restoration survival. Posts are commonly failed due to loss of retention. It is unknown which luting agents would provide the maximum bond strength for Locator overdenture posts.

Aim: The aim of this study was to evaluate the bond retentive strengths of Locator overdenture posts cemented with 7 luting agents.

Materials and methods: One hundred and five single rooted human teeth were decoronated and randomly assigned to 7 groups (n = 15). Post spaces were prepared with Locator post drills to the depth of 6 mm. The Locator posts were cemented with Variolink II, RelyX ARC, Multilink N, RelyX Unicem, ParaCore, or MultiCore Flow resin luting agents. Zinc phosphate cement was served as control group. Specimens were stored in water at 37°C for 24 hours. Each specimen was loaded in tension in an Instron universal testing machine. The maximum force required to dislodge each Locator post was recorded. Means and standard deviations were calculated and data were statistically analyzed with one-way analysis of variance (ANOVA).

Results: The highest mean bond strength value for Locator posts was recorded for MultiCore® Flow group (mean = 550.1 N), while the lowest mean value was for RelyX Unicem™ resin cement group (mean = 216.8 N). A statistically significant difference in mean locator overdenture post bond strength was observed between the 7 cement types ($p < 0.0001$). ParaCore™ and MultiCore® Flow groups had significantly higher bond strength than all other groups, but they were not differed from each other.

Conclusion: Bond strength of Locator overdenture posts were influenced by the type of luting agents. MultiCore Flow and ParaCore resin cements offered the greatest retention.

Clinical significance: The type of luting agents had a significant effect on the retention of Locator posts. The use of Core build-up resin cements as luting agent with Locator post demonstrated the greatest retention.

Keywords: Laboratory research, Locator overdenture posts, Bond strength, Luting agents.

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INTRODUCTION

Complete dentures wearers are sometimes dissatisfied with their prostheses for reasons of limited retention and stability. Clinicians have found that retaining teeth to support overdenture prosthesis can help in solving these problems by increasing the retention and stability of the denture.[1] The Locator root attachment is a type of overdenture attachment.[1] It is designed for use with overdentures retained by endodontically treated roots of the mandibular or maxillary arches.[1] It allows the patient to easily seat their overdenture prosthesis without the need for accurate alignment of the attachment components.[1]

The types of luting agents may affect the retention of overdenture post attachment.[2] Luting agents can help in enhancement of post retention, distributing the stresses and sealing the gaps between the post and the tooth.[3,4] Zinc phosphate cement is the most commonly used luting agent for metallic endodontic posts with adequate mechanical retention. [4] It remains the comparison standard for the other luting agents.[2,5] The high solubility and lack of adhesion to the tooth structure are the main disadvantages.[4] Resin cements are indicated for situations when increased post retention is required. However, these cements are highly technique-sensitive, are affected by moisture and require extended chair time.[6]

Elsayed et al[2] evaluated the retention of overdenture posts cemented with self-adhesive resin cements. They found that Breeze™ self-adhesive resin cement resulted in the highest retention force.[2] Duncan and Pameijer[7] examined the retention of titanium posts cemented with six luting agents (Two resin-ionomer hybrid, two resin cements with their corresponding dentin bonding agents, glass ionomer cement, and zinc phosphate cement). Their results showed

that the Advance™ hybrid resin-ionomer cement with Prime and Bond™ systems was found to be statistically more retentive than all other groups tested. Balbosh et al[8] compared the retention of titanium posts using four luting agents. They concluded that the resin cements provided the highest retention.

Despite the large number of studies on the retention of posts there is limited data on the retentive strength of Locator overdenture posts. Therefore, the aim of this study was to evaluate the bond retentive strength of the Locator overdenture attachment posts cemented with seven different luting agents. The null hypothesis was that there would be no differences in tensile bond strength of Locator overdenture post cemented with different luting agents.

MATERIALS AND METHODS

Tooth Preparation

One hundred and five single rooted intact human mandibular premolar teeth were selected. All teeth were sectioned horizontally 2 mm coronal to the midfacial cementoenamel junction using straight fissure carbide bur (Komet, Gebr. Brasseler GmbH & Co. Kg, Lemgo, Germany) in a high-speed handpiece under copious water cooling leaving a flat coronal surface.

The root canals were left unobturated. The preparation for Locator overdenture post spaces was performed with Peeso reamers (Pulpdent Corporation, Watertown, MA, USA) sequentially from no. 1 through 5 to a depth of 6 mm. Locator pilot drills and countersink diamond burs (Zest Anchors, Escondido, CA, USA) were then used in a slow speed handpiece under copious water cooling. The resultant post space was then 6mm in depth. Water irrigation was used during instrumentation to clean debris from the canal. Throughout all post space preparations, teeth were soaked in water to maintain moistness. The prepared canals were then rinsed with an air-water spray and dried with air and paper points. All Locator attachment posts (Zest Anchors, Escondido, CA, USA) were passively fit when completely seated in their respective canals.

Specimens Preparation

All root surfaces were roughened with inverted cone carbide bur (Komet, Gebr. Brasseler GmbH & Co Kg) in a high-speed handpiece under copious water cooling to help in the retention of the roots in the acrylic block. In addition, a hole coronal to the root apex was made using a small round carbide bur (Komet, Gebr. Brasseler GmbH) in a high-speed handpiece. A 0.5 mm in diameter of an orthodontic wire (Remanium spring hard wire, Dentaurum Inc, Ispringen, Germany) was inserted in the hole and twisted to a length of 10 mm. Specimens were then mounted in a short length of polyvinyl chloride pipe with autopolymerizing resin (Ortho Resin, Dentsply DeTrey, Konstanz, Germany) using a dental surveyor (JM Ney Co, Bloomfield, CT, USA).

Locator Post Cementation

Before luting, the root canals were cleaned with a 5.25% solution of sodium hypochlorite. Rinsed immediately with water and dried with suction and paper points. The specimens were assigned to 7 test groups (n = 15) according to the cement type used, as follows:

Group I: Locator overdenture posts were luted with Variolink II (Ivoclar Vivadent, Schaan, Liechtenstein) dual-polymerized luting composite system. Acid etch was applied to the tooth (phosphoric acid gel 37%, Ivoclar Vivadent) for 15 seconds. The canal was rinsed immediately with water and dried with paper points. Two coats of adhesive (Excite DSC, Ivoclar Vivadent) were applied to the canal using microbrush for 15 seconds and then dried with air and paper points. The cement mixed in a 1:1 ratio on a mixing pad for 10 seconds. The cement was applied to the bonding surface of the canal using a lentulo spiral and thin layer of mixed cement on the Locator post as well. Excess cement was cleaned and post was held in situ and a light activation of the resin cement was performed using a halogen light-polymerizing unit (Astralis 10; Ivoclar Vivadent) at 750 mW/cm^2 for 40 seconds; placed at 3 mm of the canal orifice.

Group II: Locator posts luted with RelyX ARC (3M ESPE, St Paul, MN, USA), dual-polymerized resin cement. Acid etching of the root canal walls was performed with 37% phosphoric acid (Scotchbond, 3M ESPE) for 15 seconds, followed by thorough rinsing using water and drying with paper points. Two coats of adhesive (Adper™ Single Bond Adhesive, 3M ESPE) were applied into the root canal with an ultra-thin applicator (Microbrush X, Microbrush International, Grafton, WI, USA) and air dried for 5 seconds. The cement was applied to the bonding surface of the canal using a lentulo spiral and thin layer of mixed cement on Locator post. Excess cement was cleaned and post was held and then light polymerized same as group I.

Group III: Locator posts luted with Multilink N (Ivoclar Vivadent) self-polymerized resin cement. The cement was prepared following the manufacturer's instructions. A mixed of Multilink N primer A/B (Ivoclar Vivadent) was applied to the root canal with an ultra-thin applicator (Microbrush X, Microbrush International) for 15 seconds. Paper points were used to remove excess of primer. The resin cement was applied into the root canals by means of Root Canal Tips (Ivoclar Vivadent) provided by the manufacturer. The posts were also coated with the cement and inserted to the

prepared canals with finger pressure, and excess cement was removed flush with the top of the tooth. The light activation was performed same as group I.

Group IV: Locators luted with RelyX Unicem (3M RelyX, 3M, St Paul, MN, USA) self-polymerized, self-adhesive resin cement. The cement was used according to the manufacturer's instructions. The cement capsule was activated for 2 seconds and mixed automatically in a high-speed amalgamator (Ultramet 2, SDI Limited, Bayswater, Victoria, Australia) for 10 seconds. Afterward, the resin cement was applied into the root canals by means of Elongation Tip (3M ESPE). The posts were also coated with the cement and inserted to the prepared canals with finger pressure, and excess cement was removed flush with the top of the tooth. The light activation was performed same as group I.

Group V: Locators luted with ParaPost® ParaCore™ cement (ParaPost, Coltene Whaledent, Altstätten, Switzerland) dual-polymerized resin cement. Root canal was prepared according to the manufacturer's instructions for use. The ParaBond Non-Rinse Conditioner (ParaPost, Coltene Whaledent) was applied to the canal using a microbrush and massaged in for 30 seconds. The excess of conditioner was removed by paper points and followed by dried with a light jet of air. A mix of ParaBond Adhesive A/B (ParaPost, Coltene Whaledent) was applied using a microbrush and massaged in for 30 seconds. The excess of adhesive was removed by paper points and followed by dried with a light jet of air. Finally, the cement material was applied directly from the tip of syringe into the prepared Locator post space in the root canal. Locator post was also coated with the cement and then inserted into the canal using slight pressure. Excess cement was removed and then light polymerized same as group I.

Group VI: Locator post was luted with MultiCore® Flow (Ivoclar Vivadent) dual-polymerized resin cement. AdheSE Primer (Ivoclar Vivadent) was applied to the canal with an ultra thin applicator (Microbrush X, Microbrush International) for 30 seconds and then dried with air and paper points. Equal amounts of AdheSE Bond and AdheSE DC Activator (Ivoclar Vivadent) were mixed. The mixture was applied to the canal by using an ultra thin applicator (Microbrush X, Microbrush International). Excess adhesive was removed using paper points. The cement material was applied directly from the tip of syringe into the prepared Locator post space in the root canal, as well as the Locator post itself covered with thin layer of the cement and then light polymerized same as group I.

Group VII: Locators luted with zinc phosphate cement (Confi-Dental Products, Louisville, Co, USA). This group was considered as a control group. The cement was mixed as manufacture's recommendations with 2 scoops of powder and 10 drops of liquid on cold glass slap. Mixing was performed for 90 seconds and homogeneous consistency was formed. The cement was applied to the canal using a lentulo spiral and thin layer of mixed cement on Locator post. The post was then placed in the canal with finger pressure.

Bond Strength Testing Procedure

Specimens were stored in water at 37°C for 24 hours. Each tooth specimen was vertically secured in the universal testing machine (Instron, Model 8500 Plus Dynamic Testing System, Instron Corp, High Wycombe, UK). A customized, self-aligning testing assembly was used as shown in Figure 1. A tensile separating load was applied at a rate of 0.5 mm/min. Each specimen was tested to failure, and the maximum forces required for dislodgment of the Locator overdenture posts were recorded.

Statistical Analyses

Data were analyzed using a one-way ANOVA. A Tukey multiple comparison tests were performed to determine which group is significantly different. All statistical analyses were performed at 0.05 level of significance using the SPSS version 16 data processing software (SPSS Corp. Chicago, IL, USA).

RESULTS

A summary of the dislodging forces for all groups is given in Table 1. The highest mean bond strength value was recorded for group VI (MultiCore Flow) (mean = 550.1 N), while the lowest mean bond strength value was recorded for Locator posts of group IV that was luted with RelyX Unicem resin cement (mean = 216.8 N).

Fig. 1: Specimen mounted in Instron machine for bond strength test

Table 1: Means and standard deviations (SD) of forces required to dislodge Locator posts (Newton) (n=15)

Groups	Cement	Mean ± SD
I	Variolink II	383.5 ± 96.7^{A}
II	RelyX ARC	392.2 ± 89.7^{A}
III	Multilink N	253.4 ± 51.5^{B}
IV	RelyX Unicem	216.8 ± 72.8^{B}
V	ParaCore	532.1 ± 69.2^{C}
VI	MultiCore Flow	550.1 ± 100.1^{C}
VII	Zinc Phosphate	367.1 ± 76.7^{A}

Mean values designated with the same superscript are not significantly different (p > 0.05).

One-way ANOVA indicated that a statistically significant differences in mean Locator overdenture post bond strength between the seven cement types ($p < 0.0001$) (Table 2). Tukey multiple comparisons test showed that ParaCore and MultiCore Flow groups had significantly higher bond strength than all other groups ($p < 0.0001$). The retention of posts cemented with ParaCore were not statistically significant differed from those cemented with MultiCore luting agent ($p = 0.996$). Moreover, groups I, II and VII were significantly different from groups III, IV, V and VI ($p < 0.05$) but not significantly different from each other ($p > 0.05$). Group IV (Unicem cement) had significantly lower dislodgement force than groups I, II, V, VI, and VII ($p < 0.0001$); however, group IV was not significantly different from groups III ($p = 0.878$).

DISCUSSION

The results of this study led to partially rejection of the null hypothesis that there are no differences among the retention strengths of Locator overdenture posts cemented with different luting agents. In addition, the Locator posts were highly influenced by the type of luting agents. Clinically, it would seem prudent to choose the most retentive type of cement. In the present study, the greater resistance to traction of the Locator posts luted with MultiCore Flow and ParaCore resin cements may be explained by the physical characteristics of these cements. The luting agent's composition is an important variable, as it determines the bond strength of Locator posts to the dentinal walls. [9] These luting agents are indicated for the core build-ups as well as luting the posts in the root canals. ParaCore contains methacrylates, fluoride, barium glass and amorphous silica. However, MultiCore Flow is composed of dimethacrylates and fillers. The monomer matrix consists of Bis-GMA, urethane dimethacrylate and triethylene glycol dimethacrylate. The inorganic fillers are barium glass, Ba-Al-fluorosilicate glass, silicon dioxide and ytterbium trifluoride. Also, it may be explained by the differences in the surface energy characteristics of the Locator post and resin luting agents.[9]

In addition to that, using of adhesives could increase the bond strength to the dentine of the canal surface. Both MultiCore Flow and ParaCore were used with AdheSE (Shear Bond Strength to Dentin = 26 MPa) and Parabond adhesive (Shear Bond Strength to Dentin = 25 MPa), respectively. Fonseca et al[10] concluded that the best performance in terms of tensile strength among the tested conditions was obtained when the adhesive system was applied with a microbrush and the luting agent was taken into the root canal with lentulo spirals. In this study, lentulo spirals were used to carry the cement into the post spaces and a thin microbrush was also used for the application of adhesive.

In the present study, the very relatively low bond strengths provided by RelyX Unicem (3M) (mean = 216.8 N) and Multilink N (Ivoclar Vivadent) (mean = 253.4 N) is difficult to explain. The manufacturer of RelyX Unicem recommends no acid etching and adhesive bonding of the root canal, and claims that the self-adhesive composite luting agent has an acidic milieu and is able to etch the dentin surface. Also, the manufacturer of Multilink N recommends no acid etching of the root canal, and Multilink N primer A/B (Ivoclar Vivadent) is an effective, 1-step conditioning of cut dentin. The use of these 2 resin composites tested in the present study without acid etching the dentin may be the reason why the Locator posts luted with these resin cements had significantly lower retention than the other tested cements.

Locator posts luted with zinc phosphate cement showed greater retention than those cemented with RelyX Unicem, however, the difference was not statistically significant. This is in agreement with Balbosh et al [8] who concluded from their study that there was no significant difference between RelyX Unicem group and zinc phosphate group in the retentive bond strength of the titanium posts. However, this result was in disagreement with other studies. [11,12] Radke et al[11] found that zinc phosphate cement was one of the

Table 2: Summary of one-way ANOVA for Locator post retention

Source	Sum of squares	df	Mean square	F-value	p-value
Between groups	1423402.487	6	237233.748	36.062	<0.0001*
Within groups	644692.759	98	6578.498		

*p < 0.05, df; degrees of freedom

most retentive cements in comparison to polycarboxylate and composite resin cements. While, Piwowarczyk et al [12] found the self-adhesive universal resin cement (RelyX Unicem) exhibited stronger bond strength than zinc-phosphate cement. The use of different post materials and different methodology would give different results.

Zinc phosphate cement is the most commonly cement used due to its history of successes in luting procedures. In addition, it has easy mixing, convenient setting time and easy removal of excess cement.[5] On the other hand, the use of resin cements as post luting agents have shown a significant increase for post retention but with two potential problems. The cementation procedure is a technique sensitive because of their short working time. The resin cements are significantly affected by improper root canal preparation. [5] Moreover, zinc phosphate cement appears to provide a simpler and faster cementation approach than required for most resin cements, and the cement is relatively cheaper than resin luting agents.[5]

The mean retentive strength in this study for Locator overdenture posts luted with either resin or zinc phosphate cement (Range 216-550 N) was found to compare favorably or exceed values reported in the literature. [7,8] Duncan and Pameijer[7] reported that the retention of Titanium ParaPosts™ cemented with 6 different luting agents with the highest value reported was about 450 N compared with the value recorded in this study at 550 N (MultiCore) and 532 N (ParaCore). Hochman et al [13] reported 117 N for titanium posts cemented with Duo™ resin luting agent (Coltene/ Whaledent Inc). These differences might be due to the methods of post preparation or the type of luting agents or the type of posts being used.

In this study, in order to eliminate a possible variable from the study the root canals were left unobturated. Several studies found that the endodontic sealer affected the retentive strength of cemented posts.[14,15] Water storage at 37°C was chosen to simulate some factors presented in the oral cavity.

One limitation of this study is that the obtained results are true for the Locator overdenture attachment post system tested with various luting agents. Different overdenture post systems may record different results. Another limitation, specimens were not subjected to thermocycling. The direct pull-out test used in this study does not exactly correspond to what actually takes place in the oral environment. Locator posts would be subjected to repeated compressive loading that may lead to fatigue with subsequent failure. Nevertheless, it provides helpful information in ranking the retentive strength of the seven cements used.

CONCLUSION

Within the limitations of this *in vitro* study, the following conclusions can be drawn:

1. The type of cement significantly influenced the forces required to dislodge Locator overdenture posts 24 hours after cementation.
2. MultiCore Flow and ParaCore resin luting agents demonstrated the greatest bond strength for cementing Locator posts.
3. RelyX Unicem and Multilink N resin cements had the lowest retentive capacity in cementing Locator posts.
4. Zinc phosphate cement had bonding strength comparable to Variolink II and RelyX ARC, but greater than Multilink N and RelyX Unicem resin cements.

Clinical Significance

The type of luting agents had a significant effect on the retention of Locator posts. The use of Core build-up resin cements as luting agent with Locator post demonstrated the greatest retention.

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REFERENCES

1. Pavlatos J. The root-supported overdenture using the locator overdenture attachment. Gen Dent 2002;50:448-453.
2. Elsayed ME, El-Mowafy O, Fenton A. Retention of overdenture posts cemented with self-adhesive resin cements. Int J Prosthodont 2009;22:287-289.
3. Alwazzan KA, Alali K. Retention of cast post and core cemented with three luting agents. Egyptian Dent J 2005;51:1333-1339.
4. Mitchell CA. Selection of materials for post cementation. Dent Update 2000;27:350-354.
5. Stockton LW. Factors affecting retention of post systems: a literature review. J Prosthet Dent 1999;81:380-385.
6. Kimmel SS. Restoration and reinforcement of endodontically treated teeth with a polyethylene ribbon and prefabricated fiberglass post. Gen Dent 2000;48:700-706.
7. Duncan JP, Pameijer CH. Retention of parallel-sided titanium posts cemented with six luting agents: an in vitro study. J Prosthet Dent 1998; 80:423-428.
8. Balbosh A, Ludwig K, Kern M. Comparison of titanium dowel retention using four different luting agents. J Prosthet Dent 2005; 94:227-233.
9. Asmussen E, Attal J-P, Degrange M. Factors affecting the energy of adherence of experimental cements bonded to a nickel-chromium alloy. J Dent Res 1995;74:715-720.

10. Fonseca TS, Alfredo E, Vansan LP, Silva RG, Sousa YT, Saquy PC, Sousa-Neto MD. Retention of radicular posts varying the application technique of the adhesive system and luting agent. Braz Oral Res 2006;20:347-352.
11. Radke RA, Barkhordar RA, Podesta RE. Retention of cast endodontic posts: comparison of cementing agents. J Prosthet Dent 1988;59:318-320.
12. Piwowarczyk A, Lauer HC, Sorensen JA. In vitro shear bond strength of cementing agents to fixed prosthodontic restorative materials. J Prosthet Dent 2004;92:265-267.
13. Hochman N, Feinzaig I, Zalkind M. Effect of design of pre-fabricated posts and post heads on the retention of various cements and core materials. J Oral Rehabil 2003;30: 702-707.
14. Al Ali K. Effect of eugenol-based root canal sealers on retention of prefabricated metal posts luted with resin cement. Saudi Dent J 2009;21:69-73.
15. Bergeron BE, Murchison DF, Schindler WG, Walker WA 3rd. Effect of ultrasonic vibration and various sealer and cement combinations on titanium post removal. J Endodont 2001;27: 13-17.

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