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EFFECT OF SEALER, CEMENT TYPES AND TIME OF CEMENTATION ON CUSTOM - CAST POST RETENTION

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ABSTRCAT:

Objective: The purposes of this in vitro study were to evaluate and compare the retention ability of custom-made metal posts using two types of cements, and determine the effect of two types of sealers and different cementation times on posts retention.

Materials & Methods: A total of eighty extracted human teeth randomly divided into two groups; all roots prepared using step-back technique & obturated by cold lateral compaction technique but first group (40 roots) with Zinc oxide eugenol sealer and the second group (40 roots) with resin sealer; each group was subdivided randomly into two groups (A & B) of 20 roots for each; in group A- posts cemented by Zinc polycarboxylate cement, and in group B- posts cemented by resin cement. Groups A & B were further divided into two groups; one with immediate cementation and other with delayed cementation with 10 roots for each. All post space preparations were done by using Peeso reamer. The posts were fabricated by direct waxing of the canals of 7mm length; base metal post & ring-like core were obtained. The ring was grasped by the clamping apparatus in Universal Testing Machine until dislodgement of the post from the root.

Results: By using t- test, there were highly significant differences between the delayed and immediate cementation time groups, the resin and zinc polycarboxylate cement groups and also between the resin sealer and zinc oxide eugenol sealer groups at $p< 0.01$

Conclusion: As conclusion, the delayed cementation time and resin cement type had better retention. The use of eugenol-containing sealer had bad effect on the retention of cemented posts.

الملخص العربي:

تأثيرالسدادة،نوع الإسمنت وتوقيت التثبيت على قدرة ثبات الدعامات المعدنية المصبوبة

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الهدف :كانت أغراض هذه الدراسة المختبرية لتقييم ومقارنة قدرة ثبات الدعامات المعدنية المصبوبة باستخدام نوعين من الإسمنت، وتحديد تأثير نوعين من السدادات و تأثير أوقات مختلفة في المعالجة على ثبات الدعامات. **الطرق و النتائج** :ثمانين سن بشري مخلوع قسمت عشوائيا الى مجموعتين، كل جذور تلك الأسنان تم إعدادها باستخدام تقنية خطوة إلى الوراء وسدت بتقنية الضغط الجانبي البارد ولكن المجموعة الأولى 40 جذر (مع زنك اوكسايد ايوجنول) والمجموعة الثانية 40 جذر (مع سداده الراتنج) ثم قسمت كل مجموعة عشوائيا إلى مجموعتين اضافيتين أ و ب، 20 جذرلكل مجموعة , المجموعة أ وفيها تثبت الدعامة بواسطة سمنت زنك بولي كاربوكسليت والمجموعة باستخدام سمنت الراتنج للتثبيت، كل من أ و ب تم تقسيمهما إلى مجموعتين من عشرة جذور لكل مجموعة، في المجموعة الأولى ثبتت الدعامات فوريا وفي الثانية ثبتت بعد فترة متأخرة. التحضير الفراغي للدعامات باستخدام مخرطة بيسو ، تم صناعة الدعامات عن طريق اذابة الشمع مباشرة في قوات الجذور وكانت بطول 7مم. وباستخدام اختبار T الإحصائي كان هناك فروق معنوية عالية بين المجموعات المتأخرة والفورية التثبيت، وبين نوعي الاسمنت ونوعي السدادة .

الخلاصة:كان هناك ثبات أفضل للدعامات مع تأخيرا التثبيت واستخدام سمنت الراتنج وكان هناك تأثير سيء على ثبات الدعامات مع استخدام سدادة مع الايوجنول

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INTRODUCTION:

Intraradicular posts are commonly used to restore the endodontically treated teeth when their remaining coronal tissue can no longer provide an adequate support and retention for the restoration[1]. Retention and stability of the intraradicular posts in relation to the roots that house them are fundamentally dependent on their anatomic characteristics, post space preparation and the physicochemical properties of the luting agents[2]. With the development of adhesive materials, such as resin cements, a new perspective has arisen in relation to the increase of post retention, due to the adhesion potential of these materials both to the metal alloy and to the dentin[3]. According to Gomes, et al[4] (2006), the adhesion of resin compounds to the root canal and post retention can be affected by the type of endodontic sealer. Additionally, many of the sealers used for root canal obturation contain eugenol, which has been shown to inhibit the polymerization of resins in a number of studies [5, 6]. This study will investigate the effect of immediate versus delayed post cementation using resin cement and polycarboxylate cement with eugenol-based zinc oxide eugenol and non eugenol-based AH26 sealers. It is possible that the constituents of the unset sealers may have an effect on the post retention compared with set sealers and most previous studies evaluate retention of readymade post, but this study will evaluate the effect of different variables (sealer, cement and time) on custom-cast post retention.

MATERIALS AND METHODS:

Eighty extracted human teeth were selected. All selected teeth with roots of similar shape, with straight single root and canal, all were evaluated preoperatively for unusual morphology, pulp size, or dilacerations using a digital radiography system. These teeth were collected in a special container containing ionized water with thymol solution until use. The collected teeth had been subjected to de-coronation process by using sectioning machine (Jeanwirtz, Cuto20, Germany), the crowns were sectioned transversally close to the cementoenamel junction leaving a root length of 13 mm, measured by digital vernier (Electronic Digital Caliper, China). Root canals were instrumented to a working length of 12 mm by using #25 up to # 40 K-file (MANI, INC. UTSUNOMIYA, TOCHIGI, JAPAN) which was considered the master apical file. Flaring of the canal was then started by K-file according to step back technique. During instrumentation, the canals were irrigated with 1ml of 5.25% NaOCl solution. The selected root were divided randomly into 2 groups: 1st group (40 roots): were obturated by cold lateral compaction technique, using gatta-percha (Meta-Biodent,UK), with non eugenol-based endodontic resin sealer, AH26 (Detrey, Dentsply, USA) (40 roots). The second group (40 roots): were obturated by cold lateral compaction technique with eugenol-based zinc oxide eugenol sealer, Endofil, (Promedica, Germany). Then each group was subdivided randomly into 2 subgroups: 2o roots in which post cemented by resin cement, Multilink (ivoclar, vivadent, Liechenstein), & other 20 roots cemented by Zinc polycarboxylate cement, Dorifix-C (Dorident, Austria), each group was further subdivided randomly into: 10 roots with immediate cementation (post space preparation & post cementation within 24 hours after obturation) & 10 roots with delayed cementation (post space preparation & post cementation 7 days after obturation). Sealers and cements which were used in this study mixed according to the manufacturer instructions of each type. Before post space preparation, all roots were notched with carbide bur (SPDENT, CE). Specimens were then mounted with self-cure resin with in aluminum molds (16 x 16 x 30 mm) and maintained 2 mm of root length extending beyond the top of the acrylic resin, using a dental surveyor (Dental farm, Italy) to orientate the post space to the vertical axis later on. post space preparations were done by using Peeso reamer (Komet, Germany) of specific standardization, (a stopper was positioned at its active tip to delimit a 7-mm length; 1.2 mm diameter) attached to modified dental surveyor to standardized the lateral movement of the Peeso drill that attached to the slow speed conventional hand-piece (NSK low speed conventional hand piece, Japan) & had constant vertical movement that was limited to 7 mm guided on the drill previously without horizontal mobility, fig.1. All post space preparations were irrigated with saline and measured to a uniform 7 mm depth and drying with absorbent paper points (Orca, Netherlands). Radiographs were taken of all root specimens to ensure that a proper space were prepared & to confirm the quality of root canal obturation using a dental

x-ray equipment set at 70 Kvp and 8 mA (E-WOO technology Co, Korea). The canal entrance of all roots was superficially sealed with a temporary filling material (Cavit, 3M ESPE, St Paul, Minn) until luting procedure at the end of post fitness checking. The posts were fabricated by direct waxing of the canals of 7mm length, a plastic ring of 8mm diameter on the waxed post was soldered with sprue wax, fig2.The patterns were cast in copper-aluminum alloy, according to the manufacturers' instructions & base metal post & ring-like core were obtained. The cast posts were cleaned & washed in running water and blasted using an aluminum-oxide air abrasion device with the following parameter settings: 250-µm particle size, distance of 20 mm and 20-s blasting time. The cement was spun into the canal and for better adaptation Lentulo spiral (Dentsply, Germany) was used, and the posts were evenly coated with the cement & the post-ring setting was seated into the post space preparation to the pre-measured line and held in place with finger pressure until an initial set take place, kept under digital pressure, for1min and excess material was removed flush with the top of the root, fig3. After cementation the specimens were stored in distilled water at 37°C and 100% humidity for 24 hrs then submitted to tensile bond strength (TBS) testing, by using instron universal testing machine (Gunt, Germany).

Samples testing: The roots were individually attached to a custom device to be held secure in a vertical position and minimize the incidence of non-axial forces, so that traction forces could be applied parallel to their long axis. The ring was grasped by the clamping apparatus in universal testing machine running at a crosshead speed of 0.5 mm/min until dislodgement of the post from the root, (fig.4). Maximum force required for post removal was recorded (N) for each specimen and means was calculated and analyzed statistically. The resultant posts space was 1.2 mm in diameter and 7 mm in depth. Maximum force required for post removal was converted to MPa by dividing the force in N to the surface area in mm2.

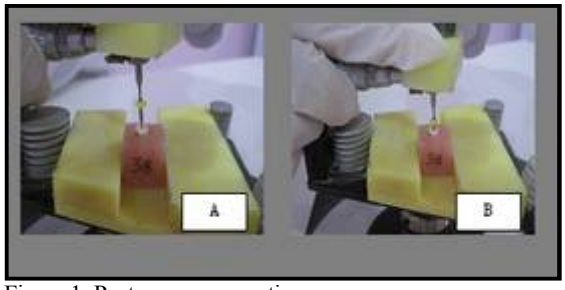

Figure.1. Post space preparation.


Figure.2. Waxing of the post with its ring.

Figure.3. Custom-made metal post cementation.

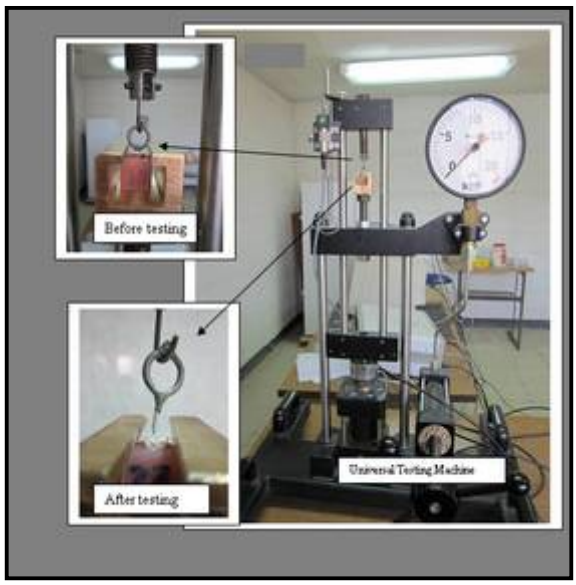

Figure. 4. Sample testing with Universal Testing Machine.

RESULTS:

Table (1) revealed the delayed cementation time group with higher retention than the immediate cementation time group. By using t- test, there was highly significant difference between the delayed cementation time & immediate cementation time groups at $p< 0.01$, with in favor of the delayed cementation time over immediate cementation time.

Table1. The descriptive statistic and t-test of the immediate & delayed cementation time groups.

Groups	No. of samples	Mean	Variance	SD	Groups differences	df	t-statistic	P-value	Sign.
Immediate cementation time	40	12.53	46.22	± 6.798	Immediate to Delayed	67	-2.997	0.002	HS
Delayed cementation time	40	18.41	107.54	± 10.37					

Table 2. The descriptive statistic and t-test of the two types of luting cement groups.

Groups	No. of samples	Mean	Variance	SD	Groups differences	Df	t-statistic	P-value	Sign.
Immediate cementation time plus ZPC	20	7.02	15.03	± 3.87	Immediate ZPC - immediate resin cement	38	-8.851	(0.000) 4.52E-11	HS
Immediate cementation time plus resin cement	20	18.04	15.94	± 3.99					
Delayed cementation time plus ZPC	20	11.83	12.63	± 3.55	Delayed ZPC - delayed resin cement	23	-5.169	(0.000) 1.53E-05	HS
Delayed cementation time plus resin cement	20	24.99	116.96	± 10.81					
ZPC (Immediate & Delayed cementation times)	40	9.43	19.4	± 4.40	ZPC - resin cement	57	-7.781	(0.000) 7.93E-11	HS
Resin cement (Immediate&Delayed cementation times)	40	21.51	77.12	± 8.78					

From table2, the delayed cementation time plus resin cement group had the higher mean value of the TBS which was (24.99 MPa), while immediate cementation time plus zinc polycarboxylate cement group had the least mean value of the TBS which was (7.02 MPa), i.e., delayed cementation time plus resin cement group gave higher retention than the other groups. The resin cement group as whole had the higher mean value of the TBS (21.51 MPa)

than the zinc polycarboxylate cement group (9.43MPa). By using t- test, there was highly significant difference between the resin cement groups & zinc polycarboxylate cement groups at p< 0.01, with in favor of the resin cement over zinc polycarboxylate cement. From table3, the delayed cementation time plus AH26 sealer group had the higher mean value of the TBS which was (22.4 MPa), while immediate cementation time plus zinc oxide eugenol sealer group had the least mean value of the TBS which was (9.72 MPa), i.e., delayed cementation time plus AH26 sealer group gave higher retention & had lesser bad effect on the cements used than the other groups. The immediate cementation time plus zinc oxide eugenol sealer group had higher adverse effect on the cements used. The AH26 group as whole had the higher mean value of the TBS (18.87 MPa) than the zinc oxide eugenol sealer group (12.07 MPa). By using t- test, there was highly significant difference between the resin sealer groups & zinc oxide eugenol sealer groups at p< 0.01, with in favor of resin sealer over zinc oxide eugenol sealer, table3.

Table 3. The descriptive statistic of the two types of sealers groups and t-test for difference between them.

Groups	No. of samples	Mean	Variance	SD	Groups differences	df	t-statistic	P-value	Sign.
Immediate cementation time plus AH26	20	15.34	31.85	± 5.643	Immediate AH26 - immediate ZOE	37	2.840	0.003	HS
Immediate cementation time plus ZOE	20	9.72	46.4	± 6.812					
Delayed cementation time plus AH26	20	22.4	130.81	± 11.437	Delayed AH26 - delayed ZOE	33	2.612	0.006	HS
Delayed cementation time plus ZOE	20	14.41	56.31	± 7.504					
AH26 Immediate & Delayed	40	18.87	92.04	± 9.593	AH26-ZOE	74	3.541	0.000	HS
ZOE Immediate & Delayed	40	12.07	55.68	± 7.462					

DISCUSSION:

An important controversy in post cementation is: Is it best to make it at the time of canal obturation or wait until the sealer has set? While some authors indicate an immediate one[7], others recommend different time intervals[8]. The delayed cementation time group gave higher retention than the immediate cementation time group. The difference was highly significant at p< 0.01. These results agreed with many studies [9,10,11]. According to Morgano et al [12] (1994), in the restoration of endodontically treated teeth, complete setting of the sealer is mandatory for success. This might be explained by that the sealer setting had an effect on the retention of the post due to incomplete setting might affect on the luting cement. The retention is greatly affected by the cement type & properties. In the present study, delayed cementation for post produced

numerically better results in retention with statistical significance compared to immediate one. In addition, these results are in agreement with findings by other authors using various methodologies[13,14]. The capacity of different cements to retain posts is related to their mechanical properties, their capacity of interlocking to metal and dentin, and their durability15. Grit blasting of base metal alloys produces some surface roughening for mechanical adhesion in addition that the resin cement can provide a durable bond to the gritblasted metal surface, so there will be also a strong chemical adhesive bond between metal alloy and acid etched tooth tissue, while with zinc polycarboxylate cement bond strengths are not especially high because of low cohesive strength of this cement[16]. So although the polyacrylic-based cements which bond chemically to tooth structure and claimed to have some affinity for metal[16,17], they do not provide adequate bond strengths. While the use of resin-based cements has been recommended to improve retention of posts in endodontically treated teeth[18]. Many studies [19,20,21] found high retention values for resin-based cements in comparison to other cements, the combination of dentin bonding agents and resin-based cements has been shown to increase retention .Also Alfredo et al[22] improved that resin-based cements contain 4-methyl-acrylate-ethyl-trimethyl-anhidride that react chemically with oxide metallic layer increasing post retention compared to non adhesive resin cement. With the advent of predictable dentin bonding, the resin cements can bond to both tooth structure and restorative material. Resin to dentin adhesion is obtained by infiltration of resin into etched dentin producing a micromechanical interlock with partially demineralized dentine, which underlies the hybrid layer[23]. Few studies have addressed the effects of endodontic sealers and their components on post retention[22].From the results of this study, there was highly significant difference between the resin sealer groups & zinc oxide eugenol sealer groups at $p< 0.01$, with in favor of resin sealer over zinc oxide eugenol sealer. The result agreed with the results of several reports[20,24,25,22]. Those authors found that the eugenol based sealers reduce the post retention, while others [26,27] showed that posts cemented in teeth obturated with Gutta-percha and eugenol-free (AH26) sealer demonstrated significantly greater resistance to dislodgement, compared with teeth obturated with Gutta-percha and eugenol-based sealer. However, the result disagreed with the results of Boone et al [2] , Burns et al [28] and Kurtz et al [29] . Those authors found that the eugenol based sealers did not affect the post retention. The use of different resin cements and different eugenol-based sealers could give different results. The result of this study may be explained by the fact that the diffusion of eugenol through dentin occurs rapidly within the first 24h, decreasing slowly and reaching a concentration of 10-2 mol/L in the zone immediately adjacent to the material, where it remains constant for more than 1 week [4,30]. The occurrence of this phenomenon has been supported by some studies that stated that acid etching and post space preparation may demineralize and remove part of dentin surface, which would be sufficient for eliminating cement excess from the dentinal tubules, according to these studies mechanical and chemical processes may limit the amount of free eugenol, reducing its interference in resin cement polymerization, regardless of the contact time of the cement with the dentin surface[2,20,28.] Nevertheless, Hagge and coworkers [24] found that the longer the obturation time of the root canal with zinc oxide and eugenol-based cement, the greater the negative influence on the retention of intraradicular posts, probably due to the greater penetration of eugenol in the dental tubules. In this way, some questions related to the behavior of resin compounds when come in contact with eugenol-based materials remain unclear, mainly with respect to the time interval between canal obturation and its preparation to receive an intraradicular post[31].Further research is needed since these materials are widely used and the time elapsed between endodontic and prosthetic procedures varies considerably in clinical practice, possibly leading to implications that may culminate in unsuccessful treatment.

CONCLUSIONS:

Within the limitation of this in vitro study, the following conclusions can be with drawn;1) The delay in cementation time for metal post gave better results of retention than immediate one with highly significant difference;2)The resin cement had higher TBS values than the zinc polycarboxylate cement with highly significant difference and 3)The use of eugenol-containing sealer had adverse effect on the retention of cemented posts than the use of resin non-eugenol sealer.

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