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Comparing the Retention of Cast Posts Cemented with Three Different Kinds of Cement

Comparação da Retenção de Pinos Fundidos Cimentados com Três Tipos de Cimento

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RESUMO

Objetivo: Verificar e comparar a retenção de pinos fundidos cimentados com três diferentes tipos de cimento.
Método: Quarenta e cinco incisivos superiores permanentes humanos foram divididos aleatoriamente em três grupos de 15 dentes cada um. Os canais radiculares foram preparados para receberem pinos fundidos de até 8,5 mm de comprimento. Os pinos foram cimentados com um dos três tipos de cimentos a seguir: cimento de fosfato de zinco, cimento de ionômero de vidro e cimento de ionômero de vidro modificado por resina (híbrido). Após a cimentação, as amostras foram armazenadas em solução salina durante 7 dias, e então submetidas à análise da força de retenção em máquina universal de ensaios (Zwick num. 112627, Ulm-Germany).
Resultados: O cimento híbrido apresentou o maior valor médio de retenção (312.90 N), seguido do cimento de ionômero de vidro (272.40 N) e do cimento de fosfato de zinco (312.90 N). A análise estatística mostrou diferença estatisticamente significante nos valores de retenção entre o cimento de fosfato de zinco e o cimento de ionômero de vidro (p<0,01), e entre o cimento de fosfato de zinco e o cimento híbrido (p<0,01).
Conclusão: Não houve discrepância significativa entre o cimento de ionômero de vidro e o cimento híbrido, embora a diferença na força de retenção entre os dois materiais tenha sido de aproximadamente 40 N.

ABSTRACT

Objective: To check and compare the retention of cast posts cemented with three different kinds of cement.
Method: Forty five 45 human permanent maxillary incisors were randomly divided into three groups of 15 teeth. Root canals were prepared for the cast posts up to 8.5mm in length. The cast post obtained randomly were cemented with the help of the three cements (Zinc Phosphate, Glass-ionomer and resin modified Glass-ionomer [hybrid] cement). After cementation, the samples were stored in a physiological solution for seven days, after which we concluded the measure of retentive strength with the help of the universal testing machine (Zwick num. 112627, Ulm-Germany).
Results: The hybrid cement has the greatest means value for retention and it is 312.90 N. It is followed by the Glass-ionomer cement with 272.40 N, while the Zinc Phosphate has the least, at 312.90 N. The statistical analysis shows that there is a statistical difference in the retention strength between the Zinc Phosphate cement and the Glass-ionomer (p<0.01), between the Zinc Phosphate cement and the hybrid cement (p<0.01).
Conclusion: A significant statistical discrepancy was not manifested between the Glass-ionomer cement and the hybrid cement even though the difference in retention strength for these two cements was around 40 N.

DESCRITORES

Cimentos de ionômeros de vidro; Cimento de fosfato de zinco; Técnica para retentor intra-radicular.

KEYWORDS

Glass ionomer cements; Zinc phosphate cement; Post and core technique.
INTRODUCTION

A dentist is often confronted with the problem of restoring endodontically treated teeth. Adequate restoration is just as important as the success of the endodontic treatment itself. The development of new materials and technology concerning them has made new approaches possible in treating lost or significantly damaged tooth tissue. Previous authors identified the following ideas and views in literature concerning the restoration of endodontically treated teeth: [a] restoring form and function, [b] preventing fractures in root residue, [c] aesthetics, [d] preventing caries and [e] retaining final restoration1.

If a crown is required because of extensive coronal destruction, a dowel core is needed. A dowel is placed to provide the retention for a crown that ordinarily would have been gained from coronal tooth structure2.

Cast dowel cores have been reported to provide excellent service for endodontically treated teeth with moderate to severe damage3. Cast dowel lies intimately in the root canal where it follows the root canal's morphology and evenly transfers occlusal forces on the remaining part of the root and periodontal apparatus4.

Laboratory studies that researched the retention of various posts stress that the following factors influence retention: length, diameter, post design, canal shape and preparation, position in the dental arch and finally, cement and cementing technique5.

All posts reach their ultimate retention with cement in the prepared root canal6-7. The cement’s ability to strengthen the post can influence the prosthodontic restoration prognosis1,8. Concerning the post retention efficiency, there are controversial opinions about the various kinds of cements. A large number of researchers have questioned the bond strength of the different cements that are commonly used in fixed prosthodontics3,5,9-14. Every category of cement has distinct advantages and inherent disadvantages5. The ability for post retention of different cements is connected to its mechanical attributions and the durability of the cement, the ability of the cement to bond to the surface with which it is inculcating, post configuration, canal preparation and the dentin structure5.

For the cementation of the endodontical post the following is used: Zinc Phosphate cement, Glass-ionomer cement, Resin modified Glass-ionomer cements (hybrid cement) and resin cements. With the overview of various studies that have dealt with the correlation of post retention and the type of cement used it can be noted that results are different. No cement manifested a significant advantage. Such results of course leave room for further research with the goal of achieving greater success in prosthodontic therapy.

The aim of this research is to examine and compare the retention of cast posts cemented with three different types of cement: Zinc Phosphate, Glass-ionomer, and Resin modified Glass-ionomer (hybrid) cement.

MATERIAL AND METHODS

For experimental material, freshly extracted human permanent maxillary incisors with similar root lengths are used. The teeth are extracted due to periodontal reasons, according to the dental specialist’s directions. The teeth are kept in a physiological solution at a temperature of 22 °C until the carrying out of the experiment. In total, 45 teeth are chosen at random and divided into three experimental groups, each having 15 teeth.

The tooth crowns are separated from the roots with diamond disk under water spray, 1 mm above cemento-enamel junction at 90 ° to the long axis of the root. After that, root canals are prepared using a step-back method. All canals are filled with the technique of lateral gutta-percha condensation in the customary clinical way. After being filled, the samples are kept dry for 48 hours.

The root canals are prepared for cast post up to 8.5 mm deep from the cut surface using a bevel drill (39, RA L, ISO 310205210002, Hager & Meisinger, GmbH, Germany) with a new drill used for every 10 specimens. The canal is prepared in the shape of a cone, having a narrower apical part (1 mm), and a wider coronal part (1.6 mm). After that, they are washed with water and dried with compressed air. The impression of every prepared root is taken. By pouring the impression into a firm cast, we get a working model on which, with the help of blue modeling wax, (Modeling wax, Interdent, Celje) we model the cast post. On the tip of the crown part of the restoration, a loop is made from the same wax, which is crucial for measuring.

After it is cool, the wax model is taken from the model in the most convenient way. The wax model is put in with a one-phase method of investing using investment material (Intervest K+B speed, Interdent, Celje). The investment material is prepared with the help of a vacuum mixer (Motava SI; BEGO). The samples are cast using an induction machine for casting (Fornax 35K-F; BEGO). For casting a metallic alloy composed of 60.5 %Co, 28%Cr and 9%W (Remanium star, Dentaurum, Germany) is used. After that, the castings are cooled at room temperature while the object is emptied of the investment material by abrasion with small particles of aluminum oxide (250 μm). The finished cast posts are tried in root canals.
Before cementing the post, micro retainers are made on the tooth root for the auto polymerizing acrylic resin with the aid of a double-sided diamond washer (919, ISO 806 104346524, GEBR. BRASSELER GmbH & Co. KG, Germany). The micro retaining grooves are turned under the opposite corner of the towing force. The cast posts are cemented with one of the three kinds of cement.

In the first group, the 15 cast posts are cemented with Zinc Phosphate cement (Harvard Cement, Richter & Hoffmann Harvard Dental-gesellschaft, Berlin, Germany). In the second group the 15 cast posts are cemented with Glass-ionomer cement (Ketac-Cem radiopaque 3M Espe AG, Germany). In the third group the 15 cast posts are cemented with Resin modified Glass-ionomer-hybrid cement (GC Fuji Plus Radiopaque reinforced Glass-ionomer cement GC Corporation Tokyo, Japan).

The root canals are washed with water and dried with compressed air before cementation. The cast posts are disinfected with alcohol and dried. The cements are prepared and used in accordance with the directions from their producer. The mixed cement is put in the root canal with a lentulo spiral (Dentsply Maillefer) on a low speed. Each cast post is coated with cement and seated to the root canal. During the time the cement hardens, the post is pressed by fingers. The same procedure for cementation is repeated for every post. Excess cement is removed with a dental probe. After cementation, the samples are kept in a physiological solution for seven days after their measurements are completed.

All samples are prepared for measurement in the following way: auto polymerizing acrylic resin (ProBase Cold, Ivoclar Vivadent AG Liechtenstein) is dripped into a cylinder cast with dimensions r=0.7 mm and l=15 mm in which the tooth root with its cemented post up to the cemento-enamel border is put. For the measuring of the retention value universal testing machine (Zwick num.112627, Ulm-Germany) is used to apply a tensile force parallel to the long axis of the post. The force in N (Newton) required to dislodge each cemented post is recorded in the universal testing machine.

To process the recorded data we used the statistical program SPSS and the following: Descriptive Statistics, One-sample Kolmogorov-Smirnov Test, Parametric test (One-way Analysis of Variance ANOVA) and Sheffe’s Test.

### RESULTS

The maximal, minimal and mean values of retention for the analyzed cements are shown in Table 1.

The statistical analysis showed that there is a significant statistical difference in the strength of retention between Zinc Phosphate cement and Glass-ionomer cement (p<0.01) while between Glass-ionomer cement and the hybrid cement, there is essentially no significant statistical difference (Table 2.), even if the mean value for strength retention for these two cements is about 40 N.

<table>
<thead>
<tr>
<th>Type of Cement</th>
<th>N</th>
<th>Arithmetic Mean (N)</th>
<th>Standard Deviation</th>
<th>Minimum Value</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc Phosphate cement (Harvard)</td>
<td>15</td>
<td>182.20</td>
<td>31.03</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>Glass-ionomer cement (Ketac-Cem)</td>
<td>15</td>
<td>272.40</td>
<td>66.05</td>
<td>208</td>
<td>440</td>
</tr>
<tr>
<td>Hybrid cement (Fuji Plus)</td>
<td>15</td>
<td>312.90</td>
<td>60.76</td>
<td>198</td>
<td>420</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Quadrant Sum</th>
<th>Df</th>
<th>Average Quadrant</th>
<th>F- ratio</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>132762.744</td>
<td>2</td>
<td>66381.372</td>
<td>22.086</td>
</tr>
<tr>
<td>Within a group</td>
<td>126237.263</td>
<td>42</td>
<td>3005.649</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>259000.006</td>
<td>44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
the final restoration. The ability of the cement to retain
the post can significantly influence the prognosis for
complete restoration\textsuperscript{17-20}. The retention value is used as
a conventional method for comparing posts. Posts that
have a greater retention are less functional concerning
normal chewing functions\textsuperscript{21}.

The wearing away of cement occurs as a result of
the constant burden of tension. The clinical post and
crown are put under repeated tension, compression,
torsion and torque. The posts will be dislocated when the
cement wears away and the connection with the dentin
is finally lost.

Unfortunately, there is not a practical method that
can simulate the conditions in the mouth cavity. Though
this study does not directly reflect an intra-oral strength
which leads to the dislocation of a post, it can address
their retentive value.

Although many authors have conducted studies of
the retention strength of different cements, the ideal
retentive strength for cementation posts in endodontically
treated teeth is yet to be found.

In this experimental study, the hybrid cement
showed the greatest means of retention value, followed
by Glass-ionomer cement, while the Zinc Phosphate
cement had the least retention value.

The significant difference in the retention value
between the Zinc Phosphate, the Glass-ionomer and
the hybrid cement can be attributed to the fact that the
Zinc Phosphate cement does not connect chemically
to even one substrate and achieves retention only
mechanically\textsuperscript{22}. On the other hand, the cements with a
base of Glass-ionomer have adhesive material since they
create a chemical connection with the surface of the
tooth tissue and the surfaces of high-noble alloys and
base metal alloys. Adhesion of Glass-ionomer for tooth
tissue has similar bond strength as adhesion of composite
dentin, with the aid of the third generation of dentin
adhesives\textsuperscript{23}.

The retention value of Zinc Phosphate cement in our
research corresponds to the results obtained by other
investigators in their in vitro researches\textsuperscript{19,24-26}.

The average retention value obtained in other study
which it was compared the retention of cast posts made
of gold alloys and four kinds of cement was significantly
less than our results\textsuperscript{19}, that can be explained by the better
chemical cement connection with base metal alloys used
in our research than for gold alloys used in his mentioned
research. The stronger connection is formed with base
metal alloys and after sand blasting, is enhanced with the
help of Smelter-grade particles, 50 μm in size. Remaining
evenly distributed layer cement is often noticed on the
uncemented crown\textsuperscript{23}. It should be kept in mind that after
cementation, the authors kept their sample in damp
surroundings for 24 hours while our samples were kept in
a physiological solution for 7 days. Glass-ionomer needs
more days or weeks to reach its maximal strength\textsuperscript{3,4}, that
is another possible cause for the greater retention value
of Glass-ionomer in our research.

Previous research\textsuperscript{25} compared the strength
connecting post products cemented with three different
kinds of cement; for Glass-ionomer and hybrid cement
he got lower values than we did. The way of keeping the
cementation samples differed, which probably influenced
the difference in the retention values of these cements.
Others authors got results for Glass-ionomer which
matched ours\textsuperscript{5,7,20,26}.

On the other hand, for the hybrid cement it was
found a low average retention value\textsuperscript{20} (Vitremer 53.90 N
and Fuji DUET 25.97 N) compared to our results, which
is hard to explain. The cements were mixed according to
their producers’ instructions, but there is a possibility for
inaccuracy or inconsistency concerning the quantity of
powder and liquid needed and distributed with a little
spoon and drops. One other possibility is that producers
lessened the ratio of powder and liquid in the material
products responding to the consistency for cement and
thus, they got weaker cement compared to the relatively
thick cement for fillings. The cement stayed on the post
before cementation with Fuji DUET and Vitremer, which
supports the hypothesis suggesting that the cohesion
failure occurred truly because of the cement. In order
to lessen the quantity of powder in the hybrid cement,
increasing the proportion of HEMA would be necessary,
which further implies that this hydrophilic material
absorbs more water and generates a weaker cement
structure\textsuperscript{27}. The samples of this experiment were kept in
water for six weeks, which could cause a lower retention
value of these cements.

Even though the statistical analysis showed
significant differences in retention value between the
Zinc Phosphate and other tested cements, that does not
lessen the clinical importance of using this cement. Its
adaptable retention value, along with effectual preparation
principles and adequate technical cementation still keeps
it as the cement of choice in many clinical situations.
In addition, its affordable price and simple technical
work and manipulation should be mentioned. It should
also be mentioned that the standard deviation in our
research was the least for Zinc Phosphate cement, which
demonstrates the reliability of this cement and its ability
to secure consistent retention.

Glass-ionomer and hybrid cement showed a greater
range of retention value in our research, as well as a
greater variability in different studies, which brings us to
the conclusion that these two cements are technically much more sensitive that Zinc Phosphate cement.

On the other hand, there are numerous factors that are on the side of the new cements, such as the continuous release of fluoride, thus giving protection to caries, the ability of chemical connection with adamantine, dentin and metal posts, as well as having greater retention value.

**CONCLUSIONS**

1) The hybrid cement (Fuji Plus) manifested the greatest retention value;
2) The Zinc Phosphate Cement had the lowest means of retention value;
3) The statistical analysis proved that there is a significant statistical difference in retention strength between the Zinc Phosphate cement and the Glass-ionomer cement (p<0.01), and between the Zinc Phosphate cement and the Hybrid cement (p<0.01);
4) A significant statistical difference between the Glass-ionomer and the hybrid cement was not proven; the difference in retention strength of these two cements is around 40N.

**REFERENCES**


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