SURFACE ROUGHNESS OF CALCIUM HYDROXIDE CEMENTS AFTER AND MECHANICAL AMALGAM CONDENSATION.

RUGOSIDADE SUPERFICIAL DE CIMENTOS DE HIDRÓXIDO DE CÁLCIO APÓS CONDENSAÇÃO MANUAL E MECÂNICA DO AMÁLGAMA.

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ABSTRACT

The effect on surface roughness of calcium hydroxide cements under manual and mechanical amalgam condensation was evaluated using a profilometer. The cements used were Dycal, Life, Renew, VLC Dycal and one zinc phosphate cement. Amalgam was condensed into matrices representing Class I cavity preparations lined with the cements studied 10 minutes after manipulation of the base materials. The surface profile was measured 24 hours after amalgam condensation. A group without amalgam condensation was used as control. It was found no significant modification on the cements surface profile in both manual and mechanical condensation groups. Renew was the only cement that showed surface roughness (Ra) statistically higher than the other cements. However, that was not significant at the clinical point of view. Zinc phosphate cement presented the higher roughness profile as compared to calcium hydroxide cements.

UNITERMS

Calcium Hydroxide, cement; Dental amalgan; Surface, roughness.

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INTRODUCTION

Minimizing pulp injury has been the main concern for preventive restorative dentistry. This is the reason for the use of different cement bases under restorations as an attempt to reduce thermal, electrical and chemical injuries to dentine-pulp complex [12,15,19,20,22,26].

Calcium hydroxide cements have been used as base materials due to their biological properties and their bactericidal and bacteriostatic effect. Otherwise, many authors believe that these cements, despite their low fracture strength, can resist to the pressures of amalgam condensation [3,4,7].

Others agree that these cements may show surface changes caused by amalgam condensation [8], specially when the cement layer is too thick [2,7]. The pressure average for amalgam condensation is 1,3kg and the resulting forces on the base may vary depending on the initial stress, the condenser diameter and condenser position, the volume of the material to be condensed and the characteristics of the particle alloy used[1].

The new generation of protective materials, such as the resin cements and ionomer cements, and the development of sophisticate composite formulations, have not displaced, up to these days, the clinical indications for calcium hydroxide cements and amalgam. This investigation aimed to analyze the roughness profile of several calcium hydroxide cements after manual and mechanical amalgam condensation.

MATERIAL & METHODS

Four calcium hydroxide and one zinc phosphate cements available in the market were used in this investigation (Table I). Zinc phosphate cement was used as control.

TABEL I - Cements used for specimens preparation

MATERIALS	MANUFACTURERS
Renew	S.SWhite
Life	Sybron-Kerr
Dycal	Dentsply
prisma VLC Dycal	Dentsply
Zinc Phosphate	S.S.White

Stainless steel matrixes simulating a Class I cavity preparation were constructed (figure 1). The upper matrix segment represented the surrounding walls, and the lower segment represented the pulp floor. The lower part of the matrix shows a 0.5mm undercut in order to allow a cement layer with standardized thickness.

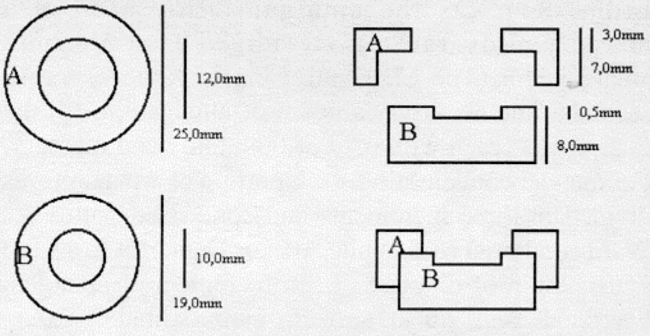


Figure 1 - Diagram of matrices:
A = frontal view, cross section and mounted matrix upper segment
B = frontal view, cross section and mounted matrix lower segment.

A total of 75 specimens were obtained and distributed as follow: 10 specimens for each studied cement, 5 for manual and 5 for mechanical condensation; 25 specimens were used as control, being 5 for each of the cements employed in this investigation. The cements were prepared according to manufacturers instructions, in a base/catalyst rate of 1:1, except for VLC Dycal and phosphate cement. VLC Dycal is a photo curing material presented in a single tube. Zinc phosphate cement was used in a proportion of 0,80g of powder and 0,3ml of liquid as to obtain a base consistence. Amounts of cement enough to fill the undercut on the lower matrix segment were prepared with all the materials used. Pressure was applied on the matrix filled with cement, with the aim of a clean glass slab until the material was completely cured, as to achieve a smooth surface. The VLC Dycal specimens were cured with a photo curing device (Translux - Kulzer Produtos Odontológicos Ltda., São Paulo, Br.) for 140 seconds, through the glass slab.

After curing, the specimens of the control groups were stored at room temperature for 24 hours and than submitted to the evaluation of surface roughness, using a profilometer (Hommel Tester T 1000 - Hommelwerk Gmbh, West Germany). The average roughness (Ra) of four measurements for each specimen was recorded for further comparison with the experimental specimens. These were prepared in the same way as with the control group, but submitted to manual or mechanical amalgam condensation after 10 minutes from the cements manipulation. Velvaloy (S.S.White Artigos Dentários Ltda., RJ) was the amalgam alloy used at a mercury/alloy rate of 1:1 mixed in a Varimix amalgamator (The LD Caulk Company, USA) for 12 seconds. The necessary amount of amalgam to fill the matrix was reach with 0,7g of both alloy and mercury. For manual condensation each portion of amalgam was divided in three increments and condensed with a #2 Ward condenser (S.S.White Artigos Dentários Ltda, Br) with 3.0mm of diameter. Each increment of amalgam was condensed with 10 strokes of approximately 2,0kg. Mechanical condensation was accomplished whit a Mechanical Condenser, model 272 (Dabi-Atlante, Br) using a 3,0mm condenser point, similarly to what was followed for manual condensation. After amalgam condensation, the specimens were stored at room temperature for 24 hours. The matrices were then disassembled and the roughness profile of cement bases measured [16]. The average roughness (Ra) of the experimental and control groups were evaluated statistically using ANOVA and Tukey-Kramer's tests.

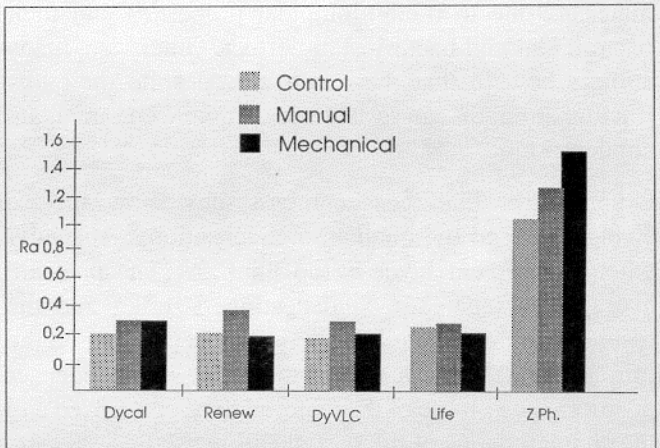
RESULTS

The results of these experiments are shown on Table II. It was found surface roughens significantly higher (p,05) for phosphate cement compared to all other cements from the control group (without condensation). Otherwise, amalgam condensation, either manual or mechanical, had no effect on surface roughness of cements, except for Renew. This cement showed an average of surface roughness (Ra) in the specimens from the group of manual amalgam condensation, statistically higher when compared to the control and the mechanical condensation groups.

EXPERIMENTAL CONDITIONS									
	control			manual condensation			mechanical condensation		
materials	N	Ra(um)	(S.D.)	N	Ra(um)	(S.D.)	N	Ra(um)	(S.D.)
Dycal	5	0,2180	0,0217	5	0,2855	0,0830	5	0,2835	0,0766
Renew	5	0,2285	0,0376	5	0,3520	0,0897	5	0,2105	0,0623
Life	5	0,2505	0,0453	5	0,2705	0,0603	5	0,2260	0,0277
VLC Dycal	5	0,2035	0,0913	5	0,2900	0,0605	5	0,2205	0,0712
Z. Phosphate	5	1,0810	0,3245	5	1,3345	0,1608	5	1,5640	0,4658

Bars indicate statistical significance

One can see through these data that the calcium hydroxide cements present a quite similar initial surface roughness and that they are much smoother than zinc phosphate cement. Also, amalgam condensation, either manual or mechanical, has no effect on the cements surface, except on Renew. However, the changes on surface roughness found on Renew specimens for manual condensation did not compromise the structure of the cement. That is, no cracks or fractures were seen when the cement surface was inspected. Graph 1 shows the profile of cements under the experimental procedures.



Graph 1 - Surface roughness (Ra) of cements in the control and experimental groups.

DISCUSSION

Condensation is one of the most important step for amalgam restorations. A good condensation ensures an amalgam restoration with proper adaptation at the cavity walls, lower microleackage and higher fracture and corrosion strength. A relatively high condensation pressure, which varies between 1,3 to 2,6 kg when condensed manually (Basker;Wilson[1],Plant;Wilson[23]) is required to reach such a good clinical performance, what demands the use of a base material with enough resistance to deformation. On the other hand, being the metallic restorations good thermal and electrical conductors, the base cements must also represent a barrier to these stimulus. Clinical experience with calcium hydroxide base cements has shown a very convenient behavior, much as do to their therapeutically and biological properties. However, their poor mechanical properties have been pointed out by many clinicians as an inconvenience, specially if layers thicker than 0,5mm are used (Farah et al [7]). When thick layers are used the cement base is displaced do to its low elasticity (Farah et al [7], Blanco [2], Hormaty; Fuller[13], Powers et al [24]). Other authors believe that calcium hydroxide cements have strength enough to resist amalgam condensation (Bryant;Wing[3], Chong et al [5], Galan Jr et al [11], Hwas; Sandrik [14], Lloyd et al [17], Pardini et al [21], Pereira et al [22], Shorer et al [25]).

In the present investigation the cement layer was 0,5mm thick and the results of surface roughness revealed that all the materials studied can be used under amalgam restoration without apparent risks of fracture. The cements surface structure presented just microscopic modifications revealed by the roughness profile, what means nothing from the clinical point of view. Even the cement Renew, which presented surface roughness statistically higher under manual amalgam condensation, did not show any visually detectable surface modification. It seams that the changes in surface profiles were caused by the amalgam particles pressed over the cements, leaving minute impressions on their surfaces.

Other investigations demonstrated that Renew has a low compressive strength in comparison with other calcium hydroxide cements(Hwas; Sandrik [14], McComb [18]). It seams, however, that the point hear is related to surface hardness instead of fracture strength. Almeida et al and Pardini et al showed that the resistance to penetration of Renew immediately after setting is relatively low and tends to increase after 24 hours. They also demonstrated that some situations, such as microleackage and solubility may affect the cement hardness.

It is also interesting that the only modification on surface profile was found in the specimens from the group of manual amalgam condensation. In fact, during manual condensation a heavy axial compressive stress is almost completely transmitted to the cavity floor or, in this case, to the cement base. It may cause damage to delayed seting base materials. Mechanical condensation, on the other hand, results in vibration and the amalgam condensation actually mean less compressive load.

Plant; Wilson [23],concluded that a cement base must have a fracture strength at least equal to the pressures resulting from amalgam condensation. It has been shown that the pressures required for amalgam condensation may, in many times, overcome the strength of Dycal, but this material is able to resist to condensation stress up to three times higher than its original strength (Lloyd et al [17]). This is possible because lateral cavity walls keep the material stable, both in Class I and Class II cavity preparations. In Class II cavity preparations, the pressures directed to the axial wall at the approximal box are dramatically reduced if the condensation starts from the gingival wall. That is why materials with low fracture strength do not fracture under amalgam condensation loads.

RESUMO

Avaliou-se o efeito da consensação manual e mecânica do amalgama sobre o perfil rugosimétrico de diferentes cimentos de hidróxido de cálcio. Os cimentos estudados foram Dycal, Life, Renew, Dycal VLC e o cimento de fosfato de zinco, utilizado como padrão. Matrizes representando cavidades de Classe I eram forradas com os cimentos e preenchidas com amalgama, condensado manual e mecanicamente, 10 minutos após a manipulação dos materiais. O perfil rugosimétrico era medido 24 horas após a consensação do amálgama e comparado com a rugosidade superficial das amostras de cimento não submetidas à condensação, que serviam, portanto, como controle. Não se observou alteração significante no perfil rugosimétrico dos cimentos, seja com a condensação manual ou com a mecânica. Apenas o Renew apresentou rugosidade superficial estatisticamente mais elevada entre os espécimes submetidos à condensação manual. Esta diferença não representa, entretanto, qualquer significado clínico, uma vez que não foram observadas alterações macroscópicas na superfície dos cimentos. O cimento de fosfato de zinco apresentou o perfil rugosimétrio mais elevado comparativamente aos demais cimentos, independentemente das condições experimentadas.

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Hidróxido de cálcio, cimento; Amálgama dentário; Superfície, rugosidade,

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