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CIÊNCIAS DA SAÚDE 4

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APRESENTAÇÃO

A obra "*As Ciências da Saúde*" aborda uma série de livros de publicação da Atena Editora, em seus 17 capítulos do volume IV, apresenta a importância da higiene e o cuidado com a saúde bucal frente à instalação de doenças orais e a qualidade do perfil nutricional de pacientes.

A saúde bucal transcende a dimensão técnica da prática odontológica, sendo a saúde bucal integrada às demais práticas de saúde coletiva. As ações de promoção e proteção à saúde visam à redução de fatores de risco, que constituem uma ameaça à saúde das pessoas, podendo provocar-lhes incapacidade e doenças, desta maneira, a nutrição apropriada reflete na manutenção de uma dieta bem balanceada para que o corpo possa obter os nutrientes necessários para uma boa saúde e bem-estar. Se sua dieta é pobre em relação aos nutrientes de que seu corpo necessita, sua boca dificilmente resistirá a uma infecção. Isso pode contribuir para doenças periodontais, uma das causas principais da perda de dentes em adultos. Embora uma má nutrição não cause doenças periodontais diretamente, muitos pesquisadores acreditam que a doença avança com maior rapidez e pode ser mais grave em pessoas com dietas carentes de nutrientes.

Colaborando com essa transformação nutricional e de cuidados orais, este volume IV é dedicado ao público de profissionais odontólogos e nutricionistas, bem como estudantes e pessoas que se preocupam e manter uma nutrição adequada e a saúde bucal.

Desta forma, este volume apresenta artigos que abordam a avaliação da condição de saúde bucal das famílias indígenas; função mastigatória, movimentos mandibulares e atividade elétrica do músculo masseter em crianças e adolescentes respiradores oronasais; cárie precoce da infância em uma criança desnutrida; análise salivar dos pacientes transplantados renais e com doença periodontal; fatores que interferem na decisão da mudança alimentar em pacientes com diabetes.

Portanto, esperamos que este livro possa fortalecer e incentivar mudanças de hábitos alimentares, incentivando, assim, uma maior atenção à cavidade oral, desenvolvendo um plano de cuidado e caracterizar o consumo alimentar de pacientes hemofílicos, além de determinar os conhecimentos de profissionais envolvidos na área.

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CAPÍTULO 17

EFFECT OF DIFFERENT DESENSITIZING AGENTS ON THE SHEAR BOND STRENGTH USING TWO GENERATIONS OF RESIN CEMENTS

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INTRODUCTION

Dentin exposed to oral medium is in direct contact with thermal, osmotic, chemical, and physical stimulus. This scenario might lead to an acute and quick pain known as dentin hypersensitivity (DH), which is a frequent clinical issue. [1, 2] Literature shows that 14 to 30% of adult population are affected by this problem, being women more commonly affected. [3]

Exposure to stimulus potentially generating dentin hypersensitivity, might be resulted from caries activity, non-carious lesions like attrition, erosion and abfraction, and by tooth preparation for indirect restorations like total crowns, onlays, inlays and overlays. [4] Tooth preparation for indirect restorations involves 2 to 3 mm tooth wear, usually exposing dentin structure.[5]

Hypersensitivity and discomfort are one of the most frequent problems reported by clinicians after tooth preparation for indirect restoration.[6,7] The incidence of hypersensitivity after cementation of restoration is around 10%.[8] In most situations, post-cementation sensitivity recedes with no necessity of intervention, generally disappearing after 24 hours from cementation.[9] However, in some scenarios it might persist for a long period. Sensitivity presented after tooth preparation may be aggravated or triggered by several factors like tooth wear, use of improper burs, absence or insufficient water irrigation, use of irritant materials, and unsatisfactory marginal adaptation, which may lead to cement exposition, dissolution, and consequent bacterial contamination of dentin.[7,8,10]

There are many commercially available materials used to reduce/eliminate dentin hypersensitivity through dentin tubules obliteration or blockage of neural activity of the pulp.[11] The most widely used materials rely on tubules obliteration, which based on the hydrodynamic theory, they promote tubules occlusion, preventing fluids movement and consequent neural transmission that would result in painful sensation.[1,12]

Desensitizer treatments using fluoride varnish, potassium oxalate, and arginine have shown proper results regarding the decrease of hypersensitivity. [13-15] They are indicated for patients who report sensitivity after tooth preparation prior to cementation of the indirect

restoration.[11] However, the influence of these desensitizers with consequent tubules obliteration on bond strength after adhesive cementation is still not clear. The hybrid layer formation depends on the cleanliness and detritus removal of dentin surface. Those treatments might mainly influence recent cements, called self-adhesives, once they do not require the etching step for the bonding procedure.

Based on that, the aim of this study was to evaluate the shear bond strength between dentin and resin cements (self-adhesive and multi-steps) after different treatment protocols for dentin hypersensitivity reduction (potassium oxalate gel, arginine-based dentifrice, dentin adhesive and Fluor varnish).

The null hypotheses tested were:

$H_0$1: There were no differences on bond strength among the desensitizer treatment groups.

$H_0$2: There were no differences on bond strength between multi-steps and self-adhesive resin cements.

MATERIALS AND METHODS

Eighty freshly extracted bovine incisors (ISO 11405) were selected and had their root removed below the enamel-cement junction. Cylindrical specimens presenting 6mm in diameter were obtained from the buccal surface of the remaining crowns, using a trephine diamond bur.

Specimen was worn-out in a circular polisher (DP-10; Panambra), in order to standardize its thickness in 1 mm. Specimen surface was polished for obtaining adequate flat surface.

After, specimens were cleaned for 5 minutes in an ultrasonic bath (Ultrasonic Cleaner, Odontobrás, RiberãoPreto, SP, Brazil) containing distilled water in order to remove residues from the abrasive polishing discs, which could interfere with tubules obliteration.

Dentin specimen was included in self-cured Acrylic Resin (Jet-Clássico, Artigos Odontológicos Clássico, São Paulo, Brazil) resulting in a cylindrical shape. Then, specimens were cleaned in ultrasonic bath with distilled water for 10 min.

Eighty specimens were randomly divided into 5 groups (n=16), according to the corresponding desensitizer treatment, as follows:

CT – Control Groups: No desensitizer treatment was performed.

PO – Potassium Oxalate: A thin layer of Potassium Oxalate Gel (Oxa Gel, Kota, Cotia, São Paulo, Brazil) was activity applied over the dentin surface with a microbrush (Microbrush, KG Sorensen Indústria e Comércio, São Paulo, Brasil) for 3 minutes, according to manufacturer´s instructions. Excess was further removed with a clean brush.

CS – Colgate Sensitive Pro-Relief toothpaste: A layer of Colgate Sensitive Pro

Relief toothpaste (Colgate Palmolive, Sao Paulo, SP, Brazil) was activity applied for 1 minute over dentin surface with a brush, according to manufacturer´s instructions. Excess was further removed with a clean brush.

FV – Fluoride Varnish: A thin layer of fluoride varnish (Duraphat, Colgate Palmolive, Sao Paulo, SP, Brazil) was applied over the dentin surface with a brush and remained for 1 minute, according to manufacturer´s instructions. Excesses were removed after a period of 6 hours with a clean brush.

AD – Adhesive: Dentin surface was submitted to acid etching with 37% phosphoric acid for 15 seconds (Magic Acid, Vigodent, Rio de Janeiro, Brazil), washed and dried in accordance with the manufacturer's instructions. A thin layer of adhesive (Single Bond Universal, 3M ESPE, St Paul, MN, USA) was applied over the specimen surface with a brush and solvent evaporation was aided with air jet. A second layer of adhesive was applied over the first one, and the adhesive layer was light-cured for 20 seconds (LED Radii cal, SDI Dental Product *SDI,* Bayswater, Vitoria, Australia).

After the respective desensitizer treatment, all groups were subdivided (n=8) into 2 groups, according to the cement used:

MS –Multi-steps etch and rinse adhesive Resin Cement: Dentin specimens were etched for 15 seconds with 37% phosphoric acid (Magic Acid, Vigodent, Rio de Janeiro, Brazil), submitted to adhesive system protocol (Single Bond Universal), and light-cured for 20 seconds. To standardize diameter and height of the resin cement increment, a cylindrical Teflon mold presenting 3 mm in height and an internal diameter of 3.5mm was used. The Teflon mold hole was positioned over the dentin surface to ensure cement layer was in contact to dentin. Total etch resin cement Variolink II (Ivoclar Vivadent, Schaan, Liechtenstein) was manipulated according to manufacturer´s instruction, inserted into the teflon mold and light-cured for 40 seconds.

SA – Self-Adhesive Resin Cement: The same mold described above was used for the insertion of the self-adhesive resin cement. The automix syringe of RelyX U200 (3M ESPE, St Paul, MN, USA) was positioned into the Teflon device. The cement was inserted and light-cured for 40 seconds. After complete the chemical cure (2 minutes), the device was removed.

The shear bond strength test was performed in a universal testing machine EMIC model DI-1000 (EMIC – Curitiba – Brazil) at 1 mm/min speed with a 50 Kgf load cell, using a special device.

After shear bond strength test, all specimens were analyzed under Stereomicroscopy (Stemi 2000-C, ZEISS, Oberkochen, Germany). The fractured area of each specimen was classified as: Cohesive in resin cement: cohesive failure within resin cement; Cohesive in Dentin: cohesive failure within dentin; and Mixed: adhesive failure combined with cohesive failure within resin cement, Adhesive: within any of the interfaces (dentin-adhesive/ cement-adhesive).[16, 17] Cohesive failures were excluded from data analysis.

Two representative specimens of tested groups were analyzed under a Scanning

Electron Microscope (MEV *INSPECT S50 – FEI* Company – Brn, *Czech* Republic) after being sputtered with a conductive layer of gold alloy.

Data were analyzed by two-way analysis of variance (ANOVA). Multiple comparisons were performed by Tukey's test, both with significance level at 5%.

RESULTS

Two-way ANOVA showed differences for desensitizer treatment ($p<0.001$), and type of resin cement ($p<0.001$) after the shear bond strength test. The interaction between the variables (desensitizer treatment and type of resin cement) was also statistically significant ($p<0.001$). Mean values, standard deviations and results of Tukey's test (presented as homogeneous groups) are exposed in Table 1.

CEMENT	GROUP	MEAN SBS (Mpa)	±sd	HOMOGENEOUS GROUPS
MS	CT	14.52	1.96	A
MS	PO	13.06	2.89	A
MS	CS	10.73	2.67	AB
MS	AD	8.35	2.40	BC
MS	FV	6.75	2.61	BC
SA	AD	6.75	1.68	BC
SA	FV	6.60	1.48	C
SA	CT	6.53	1.94	C
SA	CS	6.45	0.97	C
SA	PO	6.19	2.31	C

Table 1 - Mean SBS values, standard deviations and results of Tukey test (5%) for bond strength between all groups tested.

According to Tukey's test, multi-steps resin cement showed the highest mean values of shear bond strength when compared to groups cemented with the self-adhesive resin cement, as shown in Table 1.

According to theTukey's test ($p=0.000028$) for desensitizer treatments, regardless of resin cement, CS group presented similar results to all other tested groups. CT group showed higher SBS results when compared to AD and FV. PO resulted in greater SBS in comparison to FV. Groups CS, AD and FV were statistically similar (Table 2).

Groups	Means	HomogeneousGroups		
CT	9.86	A		
PO	9.34	A	B	
CS	8.23	A	B	C
AD	7.33		B	C
FV	6.71			C

Table 2 – Results of Tukey's test (α=0.05) for desensitizer treatments.

The interaction between resin cement and desensitizer treatment is represented by Fluor Varnish (FV) and Adhesive (AD) treatments, in which the resin cements (MS and SA) behaved similarly.

Figure 1 shows the percentage of failures found in each group after desensitizer treatments and SBS testing. The highest proportion of adhesive failures occurredin FV groups regardless the resin cement used.

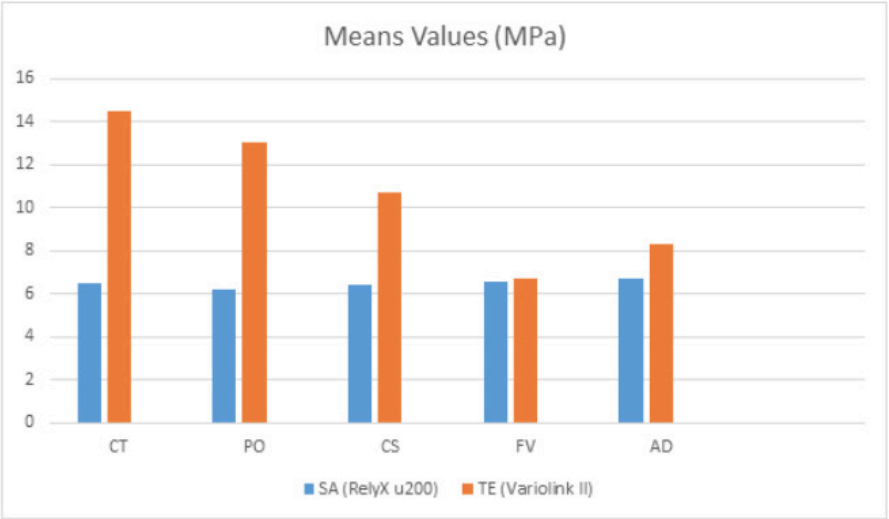

Figure 1 – Mean SBS values of self-etching (SA) and total-etching (TE) cements for all disensitizer groups.

Figure 2 displays representative SEM images of dentin tubules after each desensitizer treatment. CS treatment presents precipitates at the entry of tubules, while FV treatment shows material depositions over intertubular dentin and little tubule obstruction. The PO treatment presented relevant tubules obliteration, and AD shows expressive tubules obliteration zones.

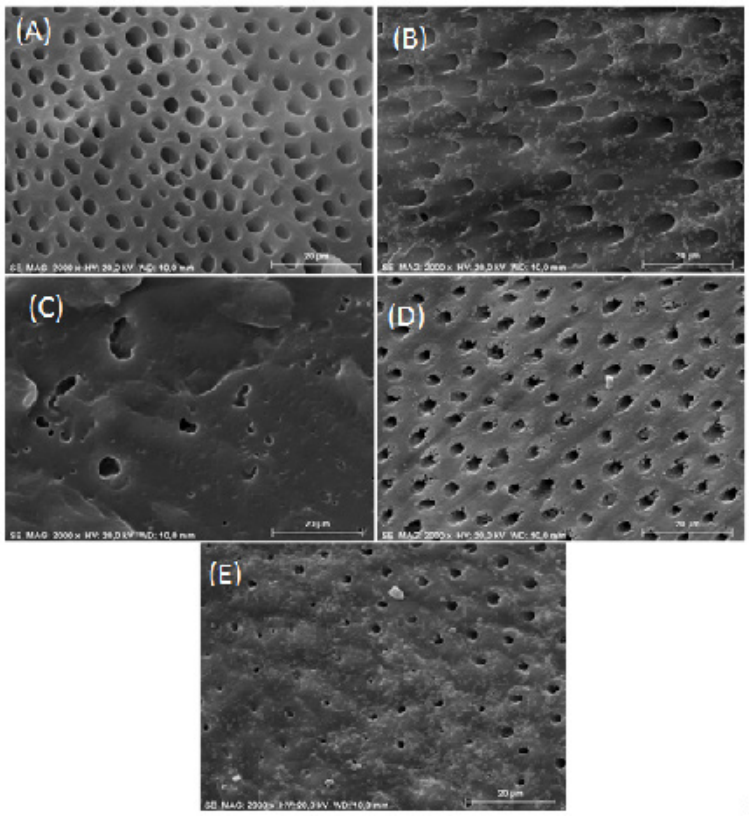

Figure 2 – (A-E) Representative SEM micrographs (2000X magnification) after dentin desensitizer treatments: (A) CT Surface; (B) FV surface; (C) AD surface; (D) CS surface; (E) PO surface.

DISCUSSION

One of the major clinical failures of indirect restorations is related to postoperative sensitivity.[6, 7] According to Wichgers and Emert, 1997, and based on the hydrodynamic theory, any substance that decreases dentin fluid conductance by tubules obliteration, is able to reduce clinical symptoms of dentin hypersensitivity.[18] Tubules obliteration was qualitatively analyzed by SEM images, aiming to verify a possible effectivity of the tested desensitizer treatments.

SEM images clearly show differences in tubules obliterations among treatments. CT group presented unobstructed tubules, confirming that tubules exposure after tooth preparation might be related to patient's sensitivity, corroborating with another recent study that found the same results.[19] Colgate Sensitive toothpaste (CS group), contains 8% of arginine and in this study showed partial tubules obliteration. This result was found before in a research in which SEM images also revealed partial tubules obliteration after the first application.[20] PO group, treated with potassium oxalate gel, presented high tubules obliteration, being totally or partially oblitered. Similary as describes by Huh et al., 2008, the use of potassium oxalate (Super Seal, Phoenix Dental Inc),resulted in small particles inside the tubules, when analyzed by SEM images.[21]

In FV group (5% NaF), SEM images showed material deposition over intertubular dentin and dentin tubules were partially or completely opened. This scenario is in

agreement with recent researches,[19,22] while other studies support that fluoride varnish is unable to obliterate dentin tubules with only in a single application.[23,24] Adhesive treatment (AD) presented complete tubule obliteration and material deposition over all dentin structure. The association of the adhesive with Nd:YAG laser can increase the tubule obliteration, but this treatment can be removed with erosive and abrasive challenges, not effective long-term.[19] A study applying the same adhesive treatment for DH found by longitudinal SEM image that the inner two thirds of hybrid layer into dentin were empty, resulting in a distance between dentin structure and the adhesive layer.[25] These results suggested that more images using longitudinal slices are necessary for further understanding of treatment efficiency (Figure 2).

Fluoride varnish has its beneficial action associated to formation of CaF_2 precipitates, which might occlude dentin tubules. In this study, fluoride varnish was applied only once in order to simulate clinical situation. The application excesses were removed after 6 hours. The employed fluoride varnish offers both mechanical (easily removed during tooth brushing) and chemical protections (in the long-term).[26] In case the superficial film was not removed before the adhesive procedures to resin cements, a false negative result would be founded. Even after film removal, the shear bond strength (MPa) of fluoride varnish groups was low for both resin cements (6.75 MPa (MS) and 6.6 MPa (SA)), and 100% were adhesive failures.

SEM images show (Figure 2) fluoride deposition over the entire dentin surface, which may have adversely affected the hybrid layer formation. A previous study that tested the microtensile bond strength between self-etching and total-etching adhesives in dentin treated with fluoride gel obtained results lower than the control group (any treatment).[27] The authors observed a distortion in hybrid layer by SEM images, fact that could be related to lower bond strength, agreeing with the present study.[27]

Infiltration of adhesive systems between dentin collagen fibers, if performed correctly, promotes sealing of dentin tubules.[27-29] The AD group when associated to MS resin cement (Variolink II) showed 8.35 MPa mean SBS and 37.5% of cohesive failures. These data suggest the desensitizer treatment with adhesive do not negatively influence bond strength at short-term. On the other hand, in a long-term scenario, the application of adhesive for DH treatment may become unfavorable due to thicker adhesive interface obtained, possibly leading to marginal leakage and secondary caries, determining the failure of restorative procedure.[30]

Potassium Oxalate activity is based on the chemical reaction from the contact of oxalate acids on tooth surface, releasing calcium from dentin and precipitating insoluble crystals of calcium oxalate, which are deposited over and inside dentin tubules, reducing DH.[21,31] SBS of PO groups was different according to resin cements (13.06 MPa for PO-MS and 6.19 MPa for PO-SA), and failures were prevalently mixed for MS (Variolink II), and adhesive for SA (Relyx U200) (Image 2). Those results indicate the type of resin cement directly influences the quality of bond strength, being apparently more critical than the desensitizing treatment itself. The present data agree with previous study in

which potassium oxalate based desensitizer used previously to direct restoration did not negatively influence its clinical performance after 1 year.[32]

The tested 8% arginine based toothpaste presents action mechanism based on the absorption of calcium carbonate from tooth surface, resulting in positively charged alkaline clusters. Those alkaline clusters have higher affinity for dentin, and depend on the deposition of salivary calcium-phosphate to occlude the tubules.[20,33] Regarding SBS results, CS groups differed according to resin cements (10.73^{AB} for MS and 6.45^{C}for SA). Failures on CS-MS group were proportional among adhesives, cohesive in dentin and mixed, while failures on CS-SA group were predominantly adhesive. These results corroborate with Yang et al., 2013, in which no significant differences between the control group and experimental groups treated with 8% arginine were found, regardless the adhesive system tested, being this last either composed of 2 or 3 steps.[34]

The null hypothesis H01 was rejected, since the results obtained in this study showed differences on SBS among the desensitizer treatments tested (Table 2). Possible explanations were discussed beforehand along with the SEM images. FV and AD groups presented worse results in comparison to CT probably due to a thicker adhesive layer in AD or the presence of interferents in FV. Groups CS and PO were similar to CT possibly as a consequence of the presence of tubule obliteration and the presence of intertubular dentin available for the adhesion process.

The null hypothesis H02 was also rejected. There were significant differences between SA and MS resin cements. RelyX U200 (SA) showed lower results when comparing to Variolink II (MS), except for FV groups, in which results were similar to RelyX U200.These results differ from Rodrigues et al., 2015, as SBS between RelyX U200 and dentin showed similar results compared to conventional resin cement.[35] These confronting results suggest interactions between desensitizers and self-adhesive resin cements may decrease bond strength to dentin structure.

Based on the present study results, it can be noticed Potassium Oxalate treatment is less influent on bond strength to resin cement, and showed efficient tubules obliteration on SEM images. In contrast, FV negatively influenced bond strength and showed no relevant tubule obliteration on SEM images. Conventional cementation could be more sensitive to technique than the self-adhesive cementation.

CONCLUSION

The multi-steps etch and rinse resin cement (Variolink II) presented better results than self-adhesive (U200) resin cement regarding shear bond strength after desensitizer treatments, except for fluoride varnish treatment.

Between the desensitizer treatments tested, fluoride varnish negatively influenced the most the bond strength to dentin.

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