EFFICIENCY IN BRACKET BONDING WITH THE USE OF PRETREATMENT METHODS TO TOOTH ENAMEL BEFORE ACID ETCHING: SODIUM HYPOCHLORITE VS. HYDROGEN PEROXIDE TECHNIQUES

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ABSTRACT

Bond failures are produced by the existence of biofilm on the tooth surface. Because biofilm is impermeable, it prevents contact in many areas, reducing the etching effect which selectively dissolves calcified tissues but does not seem to eliminate biofilm from the tooth surface, and thus the bond between the tooth and the bracket is not strong enough.

The aim of this study is to compare bracket bonding efficiency with two dental surface pretreatments: sodium hypochlorite vs. hydrogen peroxide techniques.

This was a cross-sectional, comparative, in vitro study. Seventy-five premolars extracted for orthodontic purposes were evaluated. They were divided into three groups of 25 teeth and assigned randomly toone of the pretreatment techniques (5.25%sodium hypochlorite or 3.5% hydrogen peroxide) or to a control group.

The most efficient pretreatment technique for bonding to brackets was sodium hypochlorite, with an average of 17.15 (kg/F). Significant differences were observed between groups (p=0.0001). The post hoc bond strength test showed statistically significant differences between the sodium hypochlorite technique and the control group (p=0.0001).

The sodium hypochlorite technique improves bracket adhesion to tooth enamel.

Key words: *dental enamel; dental etching; sodium hypochlorite.*

EFICIENCIA EN LA ADHESIÓN DE BRACKETS CON EL EMPLEO DE MÉTODOS DE PRE TRATAMIENTO AL ESMALTE ANTES DEL GRABADO ÁCIDO: TÉCNICA HIPOCLORITO DE SODIO VERSUS TÉCNICA PERÓXIDO DE HIDRÓGENO

RESUMEN

Las fallas de adhesión se producen por la existencia de la biopelícula en la superficie del órgano dental, ya que es impermeable y no permite el contacto en muchas áreas, de manera que disminuye el efecto del grabado ácido; el cual tiene la capacidad de disolver selectivamente los tejidos calcificados, pero no parece eliminar la biopelícula en la superficie dental, por lo tanto, no se lleva a cabo la suficiente fuerza de adhesión en la interfase diente-bracket.

El objetivo es comparar la eficiencia en la adhesión de los brackets con el empleo de dos métodos de pre-tratamientos de la superficie del esmalte, el hipoclorito de sodio vs. peróxido de hidrógeno.

Estudio comparativo, transversal, in vitro. Se evaluaron 75 premolares extraídos con fines ortodóncicos, tres grupos de 25 dientes, asignados aleatoriamente con alguna de las dos técnicas de pre-tratamiento al esmalte, hipoclorito de sodio al 5.25%, peróxido de hidrógeno al 3.5% y un grupo control.

La técnica de pre-tratamiento al esmalte más eficiente para la fuerza de adhesión a los brackets fue el hipoclorito de sodio, con una media de 17.15 (Kg/F), se observaron diferencias significativas inter-grupos (p= 0.001). Las pruebas post hoc para las fuerzas de adhesión mostraron diferencia estadísticamente significativa para la técnica de hipoclorito de sodio/ grupo control (p=.001).

La utilización de hipoclorito de sodio ayuda a mejorar la adhesión de los brackets en la superficie del esmalte.

Palabras clave: *esmalte dental; grabado dental; hipoclorito de sodio.*

INTRODUCTION

Problems with bonding, such as bracket detachment, are common in clinical practice, delaying the treatment and ultimately causing enamel demineralization[1].

Bonding quality is diminished by the presence of biofilm on the tooth surface, therefore it is important to use mechanical or chemical prophylaxis on teeth before etching the enamel, in order to remove the

biofilm and thus increase the surface energy of the substrate[2,3].

There are different opinions regarding whether enamel should be pre-treated, and many different preferences regarding the agent to be used for conditioning the enamel before any treatment[4,5]. The conventional technique for bracket placement consists exclusively of enamel etching, which can be achieved by demineralization with acid. Nowadays, pretreatment is recommended using physical abrasive methods such as pumice stone to eliminate biofilm and prevent continuous bracket detachment, or the use of sodium hypochlorite by depolarization or hydrogen peroxide to prepare the enamel surface[6-10].

The solvent and antimicrobial activity of sodium hypochlorite is principally due to its ability to oxidize and hydrolyze cell proteins, to release chlorine to form hypochlorous acid in the long term, and its osmotic ability to draw fluids out of cells[1,11-14].

Deproteinization is the removal of collagen from the previously conditioned surface by the use of substances capable of dissolving the protein content (NaOCI). It has been demonstrated as a way to minimize the sensitivity of the hybridization technique, consequently fostering adequate marginal seal without altering bond strength[2-4,13-16]. NaOCl is a non-specific proteolytic agent which removes organic components from the dentin, such as superficial destabilized collagen and the remnant smear layer from the etching, changing the chemical composition and leaving many exposed hydroxyapatite crystals in this deproteinized substrate[1,17,18].

Another enamel pretreatment method is hydrogen peroxide application, as a result of which oxygen and bleaching agents are retained in the enamel. Little is known about the effects of one application on the bonding to enamel [1, 19,20].

MATERIAL AND METHODS

This study was approved by the Master's Program in Stomatological Science in Orthodontics at the Faculty of Stomatology of the Benemeritus Autonomous University of Puebla and the Ethics Committee. The study was conducted at the dental biomaterials laboratory of the Faculty of Stomatology of the Autonomous University of Puebla, México, in February 2012.

It was a cross-sectional, comparative, *in vitro* study. Seventy-five premolars extracted for orthodontic purposes were evaluated. They were divided into three groups of 25 teeth, which were randomly assigned toone of the pretreatment techniques (5.25%sodium hypochlorite or 3.5% hydrogen peroxide)orto a control group.

A pilot test was performed before the definitive procedure, in order to adjust the shear test technique. The teeth indicated for orthodontic extraction were collected, kept in plastic containers of bidistilled water in a 41x35x30cmculture oven at 36°C, in order to replicateoral moisture and temperature conditions. The teeth were placed in transparent acrylic cubes (Nictone) with parallel walls, leaving the cervical third of the root free. Three groups of 25 teeth each were formed, by assigning them randomly to one of the pretreatment techniques: 5.25%sodium hypochlorite, 3.5% hydrogen peroxide, or to a control group with37% phosphoric acid, each for 15 seconds.

A thin layer of primer (3M McMark) was applied to the pretreated surface with a microbrushand spread with air from a triple syringe for about 3 seconds. A metallic MBT Gemini prescription bracket (3M Unitekal) was used and Transbond Xt resin (3M Unitek) applied on its mesh. A bracket was placed on the vestibular surface of each tooth using forceps (Ormco), and excess resin carefully removed. Theresin was immediately photopolymerized with a CuringLight XL 300 lamp (3M) for 20 seconds (10 on the mesial side and 10 on the distal side of the bracket).

Thetreated teeth were kept in the 41x35x30cm culture oven at 36°C inplastic containers with bidistilled water for 72 hours, after which the shear test was performed using a universal testing machine (Instron model 4465, InstronCorp.; Canton MA, USA) (Fig. 1) at a speed of 2.5mm per minute. The results were recorded and plotted in Kg/cm^2 by the machine software.

RESULTS

The results were analyzed by the statistical software SPSS version 20. Descriptive statistics, average, standard deviation of the numeric variables, percentages, proportions of the ordinal variables and inferential statistics ANOVA were performed.

Average bond strengths according to placement technique are shown in Table 1.

The models with sodium hypochlorite, hydrogen peroxide and control group are shown in Figs. 1 and 2.

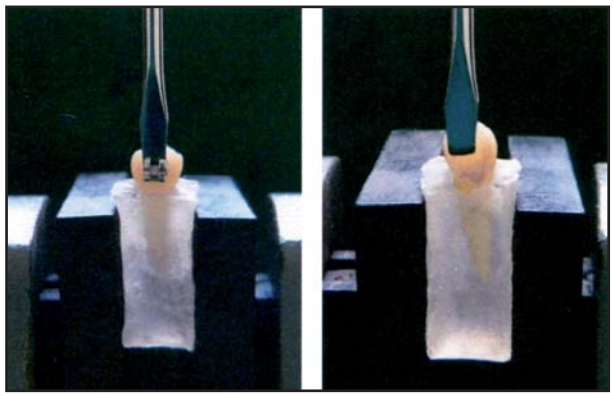

Fig. 1: Shear test using the Instron universal machine.

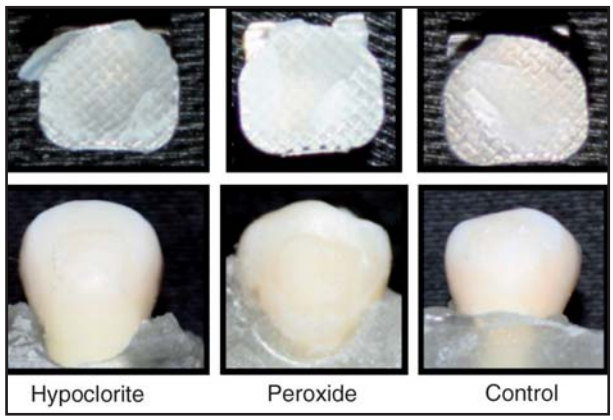

Fig. 2: Sample of pre-treatment according to the different enamel conditioning techniques.

The results of the analysis of variance (ANOVA) are shown in Table 2. Statistically significant differences are observed between groups.
Results of the *post hoc* test for bond strength showed that the 5.25% sodium hypochlorite pretreatment differs significantly from the other groups. Tables 3 and 4.

DISCUSSION

The group treated with sodium hypochlorite had the highest bond strength. Previous studies[1,3,18,20-23],have concluded that the use of 5.25% sodium hypochlorite for 30 seconds to eliminate the superficial collagen layer from the enamel surface as a pretreatment method improves bond strength[24]. Espinosa R et al.[23] ,showed that the use of 5% sodium hypochlorite for one minute followed by phosphoric acid, improves bond strength, a result which is consistent with this research. The sodium hypochlorite technique for one minute was found to be the most efficient[1].

Table 1: Average bond strength for both placement techniques.

Technique	s	Median(Kg/P)	SD	CI (95%)
Hypochlorite / Phosphoric Acid	25	17.15	3.28	15.79-18.50
Peroxide/ Phosphoric Acid	25	14.27	3.13	12.98-15.56
Phosphoric Acid	25	12.99	5.13	10.87-15.11

s=sample, Kg/P=kilograms/Power, SD=Standard Deviation, CI=Confidence Interval.

Table 2: Average differences between groups using ANOVA (analysis of variance).

	Sum of Squares	df	Quadratic Media	F	Significance (p)
Between groups	226.181	2	113.090	7.220	*0.001
Within groups	1127.771	72	15.663		
Total	1353.952	74			

df=degrees of freedom, F=statistic, p=significance

Table 3: Results of post hoc tests for membership.

	Group	Group	Significance
TestTukey	Hypochlorite	Peroxide	0.033
		Control	***0.001***
	Peroxide	Hypochlorite	0.033
		Control	0.492
	Control	Hypochlorite	***0.001***
		Peroxide	0.492
Scheffé	Hypochlorite	Peroxide	0.043
		Control	***0.002***
	Peroxide	Hypochlorite	0.043
		Control	0.525
	Control	Hypochlorite	***0.002***
		Peroxide	0.525
Bonferroni	Hypochlorite	Peroxide	0.037
		Control	***0.001***
	Peroxide	Hypochlorite	0.037
		Control	0.773
	Control	Hypochlorite	***0.001***
		Peroxide	0.773

Table 4: Results of *post hoc* tests for membership.

			Significance (p)
Dunnett´s t (bilateral)	Hypochlorite	Control	0.001
	Peroxide	Control	0.418

Our study observed lower bonding efficiency with peroxide; however, little is known of the effects on bonding to enamel when it is applied once, even when the amount is minimum in quantity, which turns out to be dependent on the time elapsed. Peroxide was used for its antiseptic and biofilm stripping action at a 3.5% concentration, which is why no article about the use of peroxide as pretreatment method for the bracket cementation was found.

Based on the results of this study, it may be concluded that 5.25% sodium hypochlorite as a pretreatment agent for the enamel significantly increases the bond strength for brackets and any type of resins on the surface of the enamel. Therefore, this method is recommended for better etching outcomes. Further studies are required to assess the use of hydrogen peroxide accurately before it is used as an alternative pretreatment method.

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REFERENCES

1. Moyaho-Bernal A, Vaillard-Jiménez E, Soberanes-De la Fuente E, Franco-Romero G, Montiel-Jarquín AJ, Martínez-Fernández RG. Dos técnicas para la retención de selladores dentales. Rev Med Inst Mex Seguro Soc 2011;49:13-16.
2. GómezDe Ferraris ME, Campos Muñoz A. Histopatología y Embriología e Ingeniería Tisular Bucodental. México Ed. Médico Panamericana, 2000;235-315.
3. Tormo J, Bolaós R, Miranda Z. Ultraestructura superficial del esmalte dental humano observado al microscopio electrónico de rastreo. Rev Cost Cienc Méd 1986;7:23-28. URL: http://www.binasss.sa.cr/revistas/rccm/v7n1/art4.pdf
4. Bhaskar SN. Histología y embriología bucal de Orban. México, Ed. Prado, 2000;39-90.
5. Marcanti M. Caries dental. Antimicrobianos y vacunas para su control. In: Negroni M. Microbiología estomatológica. México Ed. Panamericana, 2001;220-247.
6. Perez-Luyo AG. La Biopelícula: una nueva visión de la placa dental. Rev Estomatol Herediana 2005;15:82-85. URL: http://revistas.concytec.gob.pe/scielo.php?script=sci_arttext&pid=S1019-
7. Levine M, Goldman GC. Saliva y cutícula dentales en periodoncia. México Ed Mc Graw Hill, 1994;125-129.
8. Brown MR, Foreman FJ, Burgess JO, Summitt JB. Penetration of gel and solution etchants in occlusal fissures. ASDC J Dent Child 1988;55:265-268.
9. Bogert TR, García-Godoy F. Effect of prophylaxis agents on the shear bond strength of a fissure sealant. Pediatr Dent 1992;14:50-51.
10. Cua-Benward GB, Luna-Naim JJ, Kapala J. A comparative study of pumice versus hydrogen peroxide as pretreatments for acid etching for resin bonding. Pediatr Dent 1993; 15: 353-354.
11. Ellis RW, Latta MA, Westerman GH. Effect of air abrasion and acid etching on sealant retention: an in vitro study. Pediatrics Dent 1999;21:316-319.
12. Caspersen IVAR. Residual acrylic adhesive after removal of plastic orthodontic brackets: A scanning electron microscopic study. Am J Orthod 1977;71:637-650.
13. Buonocore MG. A simple method of increasing the adhesion of acrylic filling materials to enamel surfaces. J Dent Res 1955;34:849-853.
14. Johnson BR, Remeikis NA. Effective shelf-life of prepared sodium hypochlorite solution. J Endod 1993;19:40-43.
15. Cunningham WT, Balekjian AY.. Effect of temperature on collagen-dissolving ability of sodium hypochlorite endodontic irrigant. Oral Surg Oral Med Oral Pathol. 1980; 49:175-177.
16. Pişkin B, Türkün M. Stability of various sodium hypochlorite solutions. J Endod 1995;21:253-255.
17. Badilla A, Tijerino S. Adhesión a esmalte después del blanqueamiento. Odontología Vital 2009;1:41-45. URL:http://es.scribd.com/doc/176652525/Curva-Tura#scribd
18. Cohen MA, Burns RC. Vías de la pulpa. Madrid Ed. Harcourt, 1999;650-666.
19. Patusco VC, Montenegro G, Lenza MA, Alves de Carvalho A. Bond strength of Metallic Brackets After Dental Bleaching. Angle Orthod 2009;79:122-26.
20. Türkkahraman H, Adanir N, Güngör AY. Bleaching and desensitizer application effects on shear bond strengths of othodontic brackets. Angle Orthod 2007;77:489-493.
21. Bernal-Quintana JL, Palma-Calero JM, Guerrero-Ibarra J, Espinosa-Fernández R. Valoración de la resistencia al desprendimiento de brackets cementados con ionómero de vidrio a esmalte con y sin grabado previo. Rev Odontol Mex 2010; 14:145-150. URL: http://www.medigraphic.com/pdfs/odon/uo-2010/uo103b.pdf
22. Ballesteros-Pinzon C, Bermúdez-Lozano JA, Coronel-Corzo N, De León-Goenaga E, Delgado LP, Báez-Quintero L. Comparación de la fuerza de adhesión de brackets utilizando dos métodos de acondicionamiento para porcelana. Rev Nac Odontol 2011;7:12-19. URL: http://revistas.ucc.edu.co/index.php/od/article/view/288
23. Espinosa R, Valencia R, Uribe M, Ceja I, Saadia M. Enamel deproteinization and its effect on acid etching: an in vitro study. J Clin Pediatr Dent 2008;33:13-19.
24. Bayona-Marin AE, Fonseca-Cano M, Macías-Leguizamón CM. Comparación de la resistencia adhesiva de brackets cementados, efectuando o no un pretratamiento al esmalte dental con hipoclorito de sodio al 5.25%. Especial ortodoncia. Odontos 2010;12:10-17.