Faculdade de Odontologia de Piracicaba
Universidade Estadual de Campinas

Vanessa Pardi

Selantes de fóssulas e fissuras: avaliação clínica e laboratorial

Tese apresentada à Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, para obtenção do título de Doutor em Odontologia, Área de concentração Cariologia.

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"Na seca conhecem-se as boas fontes e na adversidade, os bons amigos" (Provérbio chinês)

O futuro pertence àqueles que acreditam nos seus sonhos.

(Roosevelt)

Sumário

Resumo

Selantes de fissuras têm sido considerados eficazes na prevenção de cárie oclusal, entretanto há controvérsias na literatura quanto ao material de escolha para o procedimento de selamento. Desse modo, o presente trabalho composto por 4 artigos tem como objetivos: 1) descrever o desempenho dos selantes de fóssulas e fissuras ao longo dos anos e discutir sua importância como método preventivo; 2) avaliar clinicamente 3 diferentes materiais aplicados como selantes de fissuras (Vitremer, Dyract Flow e Revolution) após 2 anos de aplicação clínica; 3) comparar, *in vitro,* o desgaste e mudanças na rugosidade superficial de 4 materiais odontológicos (Delton, Filtek Flow, Dyract Flow e Vitremer) aplicados como selantes após abrasão por escovação e dentifrício; 4) avaliar, *in vitro*, a infiltração marginal em selantes de fissuras realizados com diferentes materiais odontológicos (Delton, Filtek Flow, Dyract Flow e Vitremer). Em relação à revisão sobre selantes, foi concluído que eles são eficazes na prevenção de cárie e suas indicações e contra-indicações devem ser cuidadosamente avaliadas pelos profissionais. Os resultados após dois anos de aplicação clínica permitiram concluir que a resina composta de alto escoamento Revolution apresentou a melhor taxa de retenção, embora não tenha havido diferença estatisticamente significante em relação à presença de cárie entre os grupos. Quanto à resistência à abrasão, não houve diferença estatisticamente significante entre os materiais Vitremer e Dyract Flow e nem entre Filtek Flow e Delton, entretanto os primeiros apresentaram maior taxa de desgaste. O material Vitremer apresentou o maior valor de rugosidade, enquanto o material Delton apresentou o menor valor após o teste de abrasão. Em relação ao teste de microinfiltração, embora todos os materiais estudados tenham apresentado um certo grau de microinfiltração, não houve diferença estatisticamente significante entre os mesmos. O contínuo estudo de materiais odontológicos para a aplicação como selantes de fissuras é recomendado, uma vez que avanços tecnológicos podem contribuir para a melhora das propriedades físicas dos materiais e, conseqüentemente, para a melhora de seu comportamento clínico.

Abstract

Fissure sealants had been considered efficacious on occlusal caries prevention, however there are controversies in the literature with regard to the material to apply. This present study, composed by four articles, has the following aims: a) to describe the performance of the fissure sealants and to discuss their relevance as a preventive method; b) to evaluate three different materials (Vitremer, Dyract Flow and Revolution) used as an occlusal sealant after 2-year clinical application; c) to compare the *in vitro* wear and changes on the superficial roughness of different materials (Delton, Filtek Flow, Dyract Flow e Vitremer) used as fissure sealant after abrasion with toothbrush and dentifrice and d) to evaluate the *in vitro* microleakage of different materials used as fissure sealants (Delton, Filtek Flow, Dyract Flow e Vitremer). Regarding the review (a), it was concluded that the fissure sealant is efficacious on caries prevention and the indications and contra-indications of this proceeding should be carefully evaluated by professionals. In the 2-year clinical evaluation (b) was verified that Revolution showed the best retention rate, however there was no statistically significant difference with regard to caries presence after the evaluated period among the groups (Revolution, Dyract Flow and Vitremer). With reference to the abrasion test (c), there were no statistically significant difference either between Vitremer and Dyract Flow or Filtek Flow and Delton, however the former showed the highest wear before the abrasion test. Vitremer showed the highest roughness measurement, while Delton showed the lowest measurement after the abrasion test. Regarding the microleakage test (d), although all the materials had exhibited some degree of microleakage, there were no statistically significant difference among them. A continuous study of dental materials to apply as fissure sealants is recommended, since that technological advances can contribute to the improvement of physical properties of dental materials and consequently to the improvement of their clinical behavior.

1. Introdução

Nos últimos anos, observou-se uma diminuição da prevalência da cárie dentária, devido, principalmente, ao uso, em larga escala, de compostos fluoretados em dentifrícios e água de abastecimento público. No entanto, na literatura, percebe-se que a superfície oclusal continua apresentando as maiores incidências de cárie (Manji *et al.*, 1986; Pinto, 1993; Pereira *et al.*, 1995; Ekanayake & van der Hoek, 2003). Estudos demonstram que apesar da superfície oclusal representar apenas 12,5% da área do dente, ela é responsável por cerca de 56 a 70% da experiência de cárie de crianças e jovens entre 5 e 17 anos (Kaste *et al.*, 1996; Meneghim *et al.*, 1999). Assim, métodos preventivos específicos para essa superfície devem ser implantados.

O desenvolvimento de materiais que pudessem ser utilizados como obliteradores de fóssulas e fissuras foi uma grande evolução dentro da Odontologia, já que o mesmo permite a manutenção de tecido dental sadio, pois retém-se ao dente sem a necessidade de preparo cavitário. Ao obliterarem as fissuras os mesmos impedem que haja retenção de restos alimentares e que os sulcos oclusais funcionem como nichos para bactérias, favorecendo o surgimento de lesões cariosas. Atualmente, os materiais utilizados como selantes de fóssulas e fissuras são: materiais resinosos, cimentos de ionômero de vidro convencionais, ionômeros modificados por resina e resinas modificadas por poliácidos.

Os selantes resinosos, à base de Bis-GMA, apresentam alta retentividade (Brooks et al., 1979; Li et al., 1981; Simonsen, 1991; Sundfeld et al., 1994; Forss et al., 1994; Koch et al., 1997; Boksman & Carson, 1998; Forss & Halme, 1998; Simonsen, 2002), e sua efetividade está diretamente relacionada à total permanência sobre os sulcos oclusais. Na década de 90, foram lançadas no mercado as resinas compostas de alto escoamento que, diferentemente das resinas compostas convencionais, apresentam quantidade de carga inorgânica menor e/ou modificadores reológicos, apresentando maior fluidez. Dentre as indicações desse material está a sua utilização como selantes de fissuras. As resinas utilizadas como selantes apresentam pouca ou nenhuma carga inorgânica e

apresentam bons resultados quanto à retenção (Ripa, 1993), sendo que as resinas compostas de alto escoamento têm apresentado bons resultados quando utilizadas como selantes (Swift, 2000). Segundo Bayne *et al.*, 1998, as resinas compostas de alto escoamento devem ser utilizadas apenas em situações onde não haja envolvimento de alta tensão mastigatória ou associação com desgaste. Alguns autores sugerem a utilização de agentes adesivos como selantes, os quais apresentam resultados promissores em relação à retenção (Grande *et al.*, 1998, 2000; Witzel *et al.*, 2000; Duangthip *et al.*, 2003).

Os cimentos de ionômero de vidro convencionais têm uma baixa retentividade (Seppä & Forss, 1991; Komatsu *et al.*, 1994; Arrow & Riordan, 1995; Pereira *et al.*, 1999), no entanto, são efetivos no controle da cárie dentária mesmo após sua perda macroscópica devido à pequenas porções de material que ficam nas partes mais profundas das fissuras e atuam como reservatórios de flúor (Mejäre & Mjör, 1990; Seppä & Forss, 1991; Birkenfeld & Schulman, 1999). Diversos estudos foram desenvolvidos utilizando materiais modificados (ionômero-resina) como selantes de fissuras, com o objetivo de estudar seu comportamento clínico e sua capacidade na prevenção da cárie (Aranda & García-Godoy, 1995; Winkler *et al.*, 1996; Smales & Wong, 1999; Pereira *et al.*, 1999, 2000; de Luca-Fraga & Pimenta, 2001; Pardi *et al.*, 2003).

Há controvérsias na literatura sobre a utilização dos diversos materiais disponíveis no mercado, os quais poderiam ser utilizados como selantes de fissuras, principalmente em relação à opção pelo uso dos materiais ionoméricos. Segundo Simonsen, 2002, os materiais especificamente fabricados para selamento de fissuras são praticamente os mesmos da década de 70, isto é, não houve desenvolvimento tecnológico como houve dos sistemas adesivos e resinas compostas, por exemplo.

Embora a eficácia dos selantes de fissuras seja bastante comprovada e seu uso tenha aumentado desde o desenvolvimento da técnica, esse procedimento, ainda não é amplamente utilizado pelos cirurgiões dentistas (Gilpin, 1997; Feigal, 1998; Dasanayake *et al.*, 2001) sendo que existe relutância por parte dos mesmos quanto à aplicação. As principais razões citadas para isso são a pobre taxa de retenção e desgaste excessivo dos

materiais (Pintado *et al.*, 1991), além de fatores ligados ao plano de saúde (participação de dentistas, valores do procedimento e abrangência da população) (Dasanayake *et al.*, 2001).

Muitos materiais restauradores são estudados quanto à taxa de desgaste, contudo há poucos trabalhos na literatura que tenham estudado diferentes materiais como selantes de fissuras, em relação ao desgaste, sendo que o selante é uma adição à superfície oclusal e suas características de desgaste podem ser um pouco diferentes daquelas encontradas para materiais restauradores que são colocados em cavidades (Pintado *et al.*, 1991).

A rugosidade de um material também é uma propriedade importante a ser estudada, uma vez que superfícies altamente rugosas permitem maior acúmulo de biofilme dental e podem levar ao desenvolvimento de lesões cariosas ao redor do material odontológico empregado. Os materiais odontológicos, tanto restauradores quanto seladores de fissuras, são diretamente afetados pelas condições da cavidade bucal como: saliva, alimentos, escovação dental e forças mastigatórias (Futatsuki *et al.*, 2001).

Assim, as avaliações *in vitro* do desgaste e da rugosidade de materiais seladores após escovação com dentifrício são relevantes, uma vez que a baixa resistência ao desgaste pode levar à desintegração mais rápida do material e eventual fratura do mesmo, além da alteração de rugosidade, que pode levar ao desenvolvimento de cárie ao redor do selante.

Como dito em alguns parágrafos anteriores, atualmente observa-se a diminuição na prevalência da cárie, o que requer maior precaução por parte do clínico para que o diagnóstico de lesões de cárie seja feito corretamente (Anusavice, 1995), uma vez que cáries ocultas (hidden caries) podem ser seladas. A capacidade de vedamento marginal do selante de fóssulas e fissuras é importante para que o mesmo seja efetivo na prevenção da cárie. A falta deste vedamento possibilita a ocorrência da infiltração marginal, isto é, a passagem de bactérias, fluídos, moléculas ou íons entre a parede cavitária e o material restaurador (Kidd, 1976), o que pode levar ao desenvolvimento ou progressão de uma lesão cariosa.

Desse modo, o presente trabalho composto por 4 capítulos, pretende abordar o tópico Selantes Oclusais, fazendo uma revisão sobre os mesmos e por meio de estudo clínico e laboratorial avaliar diferentes materiais odontológicos aplicados nesse procedimento preventivo.

2. Proposição

O presente trabalho, composto por 4 artigos, teve como objetivo geral avaliar o procedimento de selamento oclusal por meio de uma revisão e estudos *in vivo* e *in vitro* de diferentes materiais odontológicos. Os objetivos específicos foram:

1. Descrever o desempenho dos selantes de fóssulas e fissuras ao longo dos anos e discutir sua importância como método preventivo.

2. Avaliar a retenção e eficácia na proteção contra a cárie, dos seguintes materiais: uma resina composta de alto escoamento (Revolution), um cimento de ionômero de vidro modificado por resina (Vitremer) e uma resina modificada por poliácido (Dyract Flow) após 24 meses de aplicação clínica e estudar a relação entre algumas variáveis clínicas de risco à cárie na predição dessa doença;

3. Avaliar, *in vitro*, a taxa de desgaste devido à abrasão por escovação com dentifrício e avaliar alterações na rugosidade da superfície do selante após a abrasão dos seguintes materiais: Delton, Filtek Flow, Dyract Flow e Vitremer.

4. Avaliar, *in vitro*, a infiltração marginal dos seguintes materiais utilizados como selantes de fóssulas e fissuras: Delton, Filtek Flow, Dyract Flow e Vitremer.

3.1. Capítulo I

"Selantes de fissuras: um método eficaz na prevenção da cárie oclusal"

Artigo submetido à *Revista ABO Nacional.*

Selantes de fissuras: um método eficaz na prevenção da cárie oclusal

Fissure sealants: an efficacious method on occlusal caries prevention

Palavras chave: selantes de fossas e fissuras, cárie dentária, prevenção & controle

Key words: pit and fissure sealants, dental caries, prevention & control

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Resumo

Há muito tempo a Odontologia vem tentando controlar a doença cárie por meio de diversos métodos de prevenção, mas apenas nos últimos 50 anos, esses tornaram-se mais eficazes com o advento do flúor. Entretanto a superfície oclusal permanece, ainda, sendo muito atingida. O desenvolvimento de materiais que pudessem ser utilizados como obliteradores das fóssulas e fissuras, chamados selantes oclusais, foi uma grande evolução dentro da Odontologia já que o mesmo permite a manutenção de tecido dental sadio, pois retém-se ao dente sem a necessidade de preparo cavitário e impedem que haja retenção de restos alimentares e que esses sulcos oclusais funcionem como nichos para placa dental. Esse artigo pretende descrever o desempenho dos selantes e discutir sua importância como método preventivo.

Abstract

Dentistry has been trying to control the caries disease through different preventive methods for a long time. However, only on the last 50 years, these methods became more efficacious by the worldwide use of fluoride. Despite of this, fluoride compounds have shown more efficaciousness preventing smooth surfaces. So, occlusal surfaces continue to be affected. The development of materials which could be used as fissure obliterated – the fissure sealants, was a evolution within dentistry since these materials allow the maintaining of sound dental tissue, because they retain on teeth without needing cavity preparation and restrain pits and fissures to store plaque. This article intends to describe the performance of fissure sealants use and discuss their significance as a preventive method.

Introdução

A cárie dentária é uma doença infecto-contagiosa multifatorial que ainda afeta grande parte da população no mundo. Há evidências da diminuição da prevalência dessa doença em países desenvolvidos e também nos em desenvolvimento e se verifica uma mudança no padrão da lesão, sendo, atualmente, mais prevalente lesões em superfícies oclusais (NEWBRUN[21], 1992). Essa superfície tem sido a responsável por cerca de 56% a 70% da experiência de cárie de crianças de 5 a jovens de 17 anos (KASTE *et al.*[14], 1996; MENEGHIM *et al.*[19], 1999). Além disso, os dentes posteriores apresentam um maior risco de desenvolvimento de cárie durante a erupção devido à facilidade do acúmulo de placa.

A diminuição da incidência de cárie trouxe consigo três conseqüências clínicas: a) mudanças no padrão e velocidade de progressão da doença (NEWBRUN[21], 1992) b) concentração das lesões de cárie em alguns dentes (primeiros e segundos molares permanentes) e em algumas superfícies (oclusais); c) formação de um grupo de polarização. Desse modo, para esse grupo de risco, é necessária a aplicação de métodos realmente eficazes na prevenção da cárie dentária na superfície oclusal.

Assim, o uso conjunto de dentifrícios fluoretados, fluoretação de água de abastecimento público, aplicações tópicas de flúor, selantes oclusais, além do controle da dieta, permite que se tenha uma diminuição de cárie dentária (NEWBRUN[21], 1992).

A evolução

A preocupação com a cárie de superfície oclusal vem desde o século XIX. Diversos métodos foram propostos com o objetivo de diminuir a prevalência dessa doença em superfícies oclusais.

Entretanto, foi apenas a partir de 1955, após BUONOCORE[6] provar que, ao se fazer condicionamento com ácido fosfórico a 85% no esmalte, os materiais resinosos apresentavam um aumento da sua retenção devido às irregularidades na superfície do dente, aumentando a área de contato entre o esmalte e o selante, que a técnica de obliteração de fissuras se tornou eficaz. No entanto, os primeiros materiais utilizados, cianocrilatos e poliuretanos, apresentaram baixas taxas de retenção pois eram bastante solúveis no meio bucal.

A partir da década de 70, com a utilização de materiais resinosos à base de Bis-GMA, é que resultados mais eficientes na prevenção da cárie em superfícies oclusais foram observados (SIMONSEN[28], 1991; RIPA[27], 1993; FORSS, HALME[10], 1998; POULSEN *et al.*[25], 2001).

Materiais utilizados como selantes de fissuras

O material adequado para o selamento de fóssulas e fissuras seria aquele que apresentasse: ótima adesividade à superfície do esmalte, método de aplicação simples, biocompatibilidade, baixa viscosidade (penetração em fissuras mais estreitas) e baixa solubilidade no meio bucal (HANDELMAN, SHEY[11], 1996).

Os materiais à base de Bis-GMA têm demonstrado efetividade na prevenção da cárie oclusal, no entanto, essa efetividade está diretamente relacionada com a sua total retenção à superfície dental (SIMONSEN[28], 1991; FEIGAL[8], 1998).

Sabendo-se dos efeitos do íon flúor no processo de desmineralização e remineralização, o mesmo foi incorporado ao selante resinoso para que se tivesse um efeito adicional na prevenção da cárie oclusal. Entretanto, diversos autores relatam que a liberação de flúor pelos selantes resinosos, se dá, em sua maior parte, nos dois primeiros dias após a sua aplicação (COOLEY *et al.* [7], 1990; JENSEN *et al*[13]., 1990). Desse modo, a sua total retenção à superfície oclusal, promovendo uma proteção mecânica, é que impede que haja o desenvolvimento de lesão de cárie, não havendo, portanto, maior efeito preventivo devido ao flúor existente em sua composição.

A qualidade da retenção dos materiais resinosos é amplamente conhecida, assim como a sua capacidade em prevenir cárie dental (SIMONSEN[28], 1991; RIPA[27], 1993; FEIGAL[8], 1998).

Na década de 70, o cimento de ionômero de vidro começou a ser estudado como selante de fissuras, sendo que os primeiros estudos encontraram resultados bastante promissores de retenção total, entretanto, os pesquisadores escolhiam fissuras amplas (McLEAN, WILSON[17], 1974), ou, então, utilizavam brunidor esférico para adaptar o selante ao dente (McKENNA, GRUNDY[16], 1987). Todavia, estudos posteriores verificaram uma baixa taxa de retenção para esses materiais, sem, no entanto, haver

diminuição da eficácia na prevenção da cárie (MEJÀRE, MJÖR[18], 1990; ARROW, RIODAN[4], 1995; FORSS *et al.*[9], 1994).

Nos últimos anos, foram desenvolvidos os cimentos de ionômero de vidro modificados por resina e resinas modificadas por poliácidos, que, semelhantemente, ao ionômero de vidro convencional, possuem ação anti-cariogênica, no entanto, apresentam um melhor tempo de trabalho por serem fotoativados. Diversos estudos foram desenvolvidos utilizando esses materiais como selantes de fissuras com o objetivo de estudar o seu comportamento clínico e sua capacidade na prevenção da cárie (WINKLER *et al.*[32], 1996; RAADAL *et al.*[26], 1996; PEREIRA *et al.*[23], 1999; PEREIRA *et al.*[24] 2001; PARDI[22], 2002).

Dentre as resinas compostas, novos materiais também foram desenvolvidos e há no mercado, atualmente, resinas compostas de alto escoamento que, diferentemente das resinas específicas para selantes, apresentam em sua composição carga inorgânica que promovem uma maior resistência ao desgaste.

Diversos trabalhos compararam materiais resinosos, materiais ionoméricos convencionais e materiais modificados e de um modo geral os materiais resinosos apresentam melhor retenção em relação aos materiais ionoméricos convencionais (MEJÀRE, MJÖR[18], 1990; ARROW, RIODAN[4], 1995; FORSS, HALME[10], 1998) e aos modificados (WINKLER *et al.*[32], 1996; RAADAL *et al.*[26], 1996). Ao compararem materiais modificados e ionoméricos convencionais, pesquisadores verificaram que os modificados apresentaram melhores retenções (PEREIRA *et al.*[23], 1999; PEREIRA *et al.*[24] 2001). PARDI[22] (2002) verificou não haver diferenças nas taxas de retenção total e parcial entre materiais modificados e resina composta de alto escoamento.

Em relação à prevenção de cárie, alguns estudos observaram que não houve diferença no incremento de cárie entre os dentes que receberam o material resinoso ou o material ionomérico convencional (MEJARE, MJOR[18], 1990; FORSS *et al.*,[9] 1994) ou o material resinoso e o modificado (WINKLER *et al.*[32], 1996; PARDI[22], 2002). Já outros estudos verificaram que melhores resultados foram obtidos para o grupo selado com material resinoso (RAADAL *et al.*[26], 1996; FORSS, HALME[10], 1998; POULSEN *et al.*,[25] 2001) e outro para o material ionomérico convencional (ARROW, RIODAN[4], 1995).

PEREIRA *et al.*[24] (2001) verificaram melhores resultados na prevenção de cárie para material o modificado em relação ao ionomérico convencional.

A técnica

A técnica de selamento de fissuras consiste do isolamento do dente, profilaxia, lavagem e secagem, condicionamento ácido, lavagem e secagem e aplicação do selante resinoso ou do material modificado de acordo com a técnica do fabricante, utilizando-se sonda exploradora ou pincel.

A profilaxia pode ser feita com pasta de pedra-pomes e água, pasta fluoretada, jato de bicarbonato de sódio, uso de escova dental e até mesmo com o uso de sonda exploradora com jato de água. Mas, atualmente, a técnica que mostra melhores resultados é a de air-polishing (SIMONSEN[29], 2002) com o uso de Prophy-Jet ou Cavi-Jet, por exemplo (WAGGONER, SIEGAL[30], 1996). De acordo com WAGGONER, SIEGAL[30] (1996), não parece haver grandes diferenças nos resultados quanto à retenção dos selantes devido ao uso de diferentes métodos de profilaxia, portanto o mais prudente é utilizar aquele que requer o mínimo equipamento e tempo para remoção de debris da superfície.

Em relação ao isolamento do campo operatório sabe-se que a manutenção do campo seco é de extrema importância para a aplicação dos selantes, visto que a umidade pode resultar em falha na retenção do mesmo. Estudos demonstram não haver diferença na retenção dos selantes quando se utiliza isolamentos relativo ou absoluto tendo cada um deles suas vantagens e desvantagens no uso clínico (WAGGONER, SIEGAL[30], 1996).

Foram testados diversos tempos de condicionamento ácido para se verificar qual apresentaria como resultado melhor retenção do selante, sendo que a maior parte dos estudos verificou que, utilizando-se ácido fosfórico, não houve diferença nos tempos de 15 a 60 segundos (WAGGONER, SIEGAL[30], 1996). Desse modo, o preconizado é a aplicação por 15 segundos (SIMONSEN[29], 2002). Após o tempo decorrido, deve-se fazer a lavagem da superfície vigorosamente até que todo o ácido tenha sido removido. Para a aplicação de materiais ionoméricos convencionais, pesquisadores fizeram a aplicação de ácido poliacrílico (10, 20 ou 40%) por 20 a 30 segundos previamente à aplicação do material ou não utilizaram nenhum tratamento de superfície.

Segundo FEIGAL[8], 1998, há a melhora na retenção de materiais resinosos quando entre o esmalte condicionado, e que fôra contaminado com saliva, e o selante aplica-se uma camada de um agente adesivo. Apesar do aumento de um passo na técnica, isso auxiliaria o selamento de dentes em erupção que estão sob o risco de cárie e que, muitas vezes, não permitem um isolamento adequado. No entanto, para esses dentes poderia se indicar os cimentos de ionômero de vidro convencionais cuja retenção é menos sensível à umidade (POULSEN *et al.*[25], 2001).

BERNARDO *et al.*[5] (2000) verificaram que, com a aplicação de um agente adesivo sob um ionômero modificado por resina (Vitremer), houve uma melhora significativa na retenção desse material após 6 e 12 meses de aplicação clínica. Contudo, outros estudos devem ser realizados para comprovar essa técnica.

Como escolher a que paciente e dente selar?

Durante anos a utilização de selantes foi preconizada para todas as superfícies oclusais de dentes posteriores, entretanto, o conhecimento científico adquirido nos últimos anos a respeito do início e progressão da doença cárie permitiu que a sua aplicação fosse direcionada àquelas pessoas e àqueles dentes que realmente estivessem em risco de desenvolvimento de cárie.

Em 1985, a ADA[1] preconizou o uso de selantes oclusais em dentes com menos de 4 anos de erupção, sem presença de restaurações e em dentes que não apresentassem cáries nas superfícies proximais. Em 1987, esse protocolo foi complementado pela ADA[2], preconizando-se o seu uso em dentes recém-erupcionados, fóssulas e fissuras profundas e pacientes com alto risco à cárie. Em 1997, a ADA[3] padronizou a indicação de selantes para pacientes considerados de alto risco, portanto àqueles que apresentassem fóssulas e fissuras estreitas e profundas, dente suficientemente erupcionado com fóssulas e fissuras susceptíveis, admitindo-se o uso do selante em dentes com cárie incipiente (limitada ao esmalte).

A fase inicial de erupção é um significante fator de risco para falha do selante e é o período de maior risco de desenvolvimento de cárie. Nesse caso, o selamento deve ser realizado para que a superfície oclusal não fique desprotegida, sendo que o material de

escolha pode ser o cimento de ionômero de vidro convencional, já que a retenção do mesmo é menos susceptível à umidade (POULSEN *et al.*[25], 2001) em relação às resinas e, liberando flúor, atuará na dinâmica do processo carioso. Todavia, como dito anteriormente, selantes resinosos quando aplicados sobre um agente adesivo apresentam ótimas retenções mesmo quando há contaminação por saliva do esmalte condicionado, além de haver uma diminuição da microinfiltração (FEIGAL[8], 1998). Desse modo, essa técnica também seria uma opção quando houver necessidade de selamento de um dente que não permita um isolamento adequado. É importante salientar que o tratamento com selante de fissuras deve ser baseado, primordialmente, no risco de cárie do paciente.

E se selarmos cárie oculta?

O diagnóstico correto de cárie é primordial para que se estabeleça um plano de tratamento. Entretanto, com a mudança no padrão da lesão, a qual, atualmente, predomina em superfícies oclusais de molares e que apresenta velocidade de progressão mais lenta, o diagnóstico se torna difícil o que pode levar ao selamento de lesões de cárie em dentina.

Diversos estudos foram realizados e demonstraram que há uma redução do número de microrganismos viáveis na dentina e que não há progressão da lesão cariosa sob o selante (HANDELMAN *et al.*[12], 1976; MERTZ-FAIRHURST *et al.*[20], 1986).

Segundo HANDELMAN *et al.* (1976)[12] um número muito pequeno de microorganismos viáveis é incapaz de dar continuidade ao progresso da lesão. O número de microrganismos diminui nas primeiras semanas devido ao efeito bactericida do condicionamento ácido (KRAMER *et al.*,[15] 1993), sendo que a falta de nutrientes promovida pelo selamento leva a uma diminuição lenta das bactérias remanescentes (HANDELMAN *et al.*,[12] 1976; KRAMER *et al.*[15], 1993). Todavia, WEERHEIJM *et al.*[31] (1992) concluíram que não é desejável tratar lesões de cárie somente com selantes resinosos pois encontraram microrganismos vivos na dentina em dentes com cáries indetectáveis clinicamente ("hidden caries"). Esses autores acreditam que alguns fatores podem garantir a sobrevivência de microrganismos em cáries indetectáveis clinicamente e a progressão, mesmo que lenta, da lesão de cárie.

Desse modo, é importante salientar que para que se tenha o efeito benéfico do selamento de lesões incipientes, o material selador deve estar recobrindo totalmente as fóssulas e fissuras da superfície oclusal, sendo importante, então, a avaliação periódica da integridade do selante. Exames radiográficos ajudam a acompanhar a evolução dessas lesões.

Conclusões

1. O uso de selantes oclusais é um método eficaz na prevenção à cárie dentária;
2. Caso sejam seladas cáries incipientes, limitadas ao esmalte, parece não haver progressão da mesma desde que o selante seja periodicamente avaliado e reaplicado quando necessário;
3. Lesões em dentina quando detectadas devem ser removidas e o dente restaurado, diferentemente de lesões em esmalte;
4. Selantes resinosos apresentam taxa de retenção maior. No entanto, os selantes ionoméricos têm a vantagem de liberarem flúor;
5. Há diminuição das falhas de retenção do selantes resinosos quando se utiliza um agente adesivo anteriormente à sua aplicação;
6. As indicações e contra-indicações dos selantes devem ser cuidadosamente avaliadas pelo profissional para que não haja sobre ou sub-tratamento e para que o melhor custo-benefício seja alcançado.

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3.2. Capítulo II

"A 24-month clinical evaluation of different materials used as fissure sealant"

Artigo submetido ao Periódico *ASDC Journal of Dentistry for Children.*

Title: **A 24-month clinical evaluation of different materials used as pit and fissure sealant**

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Summary: *Objective*: To evaluate the retention and caries preventive effect of different materials used as fissure sealant after two years of clinical application: a resin modified glass ionomer (A), a flowable composite resin (B) and a polyacid-modified resin (C). *Materials and Methods:* 117 teeth were sealed with material A, 119 teeth with material B and 120 teeth with material C. Children were randomly assigned and each one received only one of the materials studied. Plaque index, dmft index and socioeconomic level were scored at baseline. The clinical exams were conducted 6, 12 and 24 months after application of the sealant. *Results:* Statistical analysis (Kruskal-Wallis) revealed that there were statistically significant differences between the retention rates of groups A and B and between groups B and C after 2 years, with material B showing better results. After 2 years, 3.1% of the teeth of group A, 4.3% of group B and 6.7% of group C were Carious+Filled. There was no evidence of association between caries presence after 2 years and plaque index, dmft index and socioeconomic level. *Conclusions*: These results suggest that flowable composite had a satisfactory retention after this period of evaluation and all three materials presented similar efficacious on occlusal caries prevention.

Introduction

In the last decades, numerous studies have shown a decrease in caries incidence,[1,2] due mainly to fluoride presence in dentifrices and fluoridation of water supply. However, these fluoride therapies benefit primarily smooth surfaces[3], while occlusal surfaces continue to be responsible for about 56% to 70% of caries in children 5-17 years of age.[4,5]

Nowadays, the modern principles of dentistry emphasize preventive procedures as a way to control caries disease. Under the preventive methods available, fissure sealant has been used to prevent occlusal caries.

Different materials can be used as fissure sealant. Unfilled resin-based materials are effective in preventing caries lesions since they have high retention rates. [6-8] Although glass ionomer cement is less dependent on moisture control during its application, [7] it presents a low retention rates. [9-14] However, the advantage in its use is the fluoride release. Modified materials such as resin modified glass ionomer and polyacid modified resin have

been tested as fissure sealants, [12-16] demonstrating retention rates that are better than GIC but worse than unfilled resin-based materials. Flowable composite resin is indicated as fissure sealant, since it presents lower quantity of inorganic filled and/or reological modifiers than conventional composites.

Based on these considerations, the aim of this study was to evaluate the retention and caries preventive effect of three different materials used as fissure sealant and to associate some clinical characteristics with the presence of caries lesions after 24 months of clinical application.

Material and Methods

1. *Sample selection:*

First, the project was submitted and approved by the Ethics Committee of the Dentistry College – University of Campinas.

The sample was composed of 113 children, ages 7 to 8 years, who were public school students in Piracicaba - São Paulo, Brazil. They presented at least one permanent first molar with no previous filling, sealant or clinical evidence of caries. Clinical procedures started after the adults responsible for the children signed an informed consent. The socioeconomic level of the children was determined using a questionnaire in order to associate this factor with caries presence after the evaluations.

The children were divided in groups of different dmft levels (dmft=1 to dmft=8) and then they were inserted in three experimental groups at random. In this way, it was possible to obtain the homogeneity of the sample in relation to this risk predictor (Table 1). Children received just one material as fissure sealant that was applied in permanent first molars.

Clinical procedures were carried out by three dentists using portable dentistry equipment (Proquest Delivery System, model nº4010, Compressor Technologies Ltd., Englewood, USA). Each dentist applied just one material. The plaque index (SOHI)[17] was scored after the application of fuchsine and accomplished by one operator. The following materials were used: a resin modified glass ionomer - Vitremer (A) (3M/ESPE – St Paul, MN, USA), a flowable composite - Revolution (B) (Kerr Corporation, Orange, CA, USA)

and a polyacid-modified resin - Dyract Flow (C) (Dentsply Caulk, Dentsply International Inc., Milford, DE, USA).The sealants were applied after pumice prophylaxis of the occlusal surfaces. The teeth were isolated with cotton rolls to avoid saliva contamination, conditioned for 15-20 seconds with 37% phosphoric acid gel and then rinsed with water. After this, the cotton rolls were carefully substituted to avoid saliva contamination.

The Vitremer material (A) was mixed in a powder/liquid proportion of 1:2 to obtain lower viscosity so that the mixture flows into the fissures (Pereira *et al.*[12], 1999). It was applied on occlusal surfaces after the application and light-curing of the *Primer* (3M) and at the end it was applied Finishing Gloss. The Revolution material (B) was inserted in fissures after the application and light-curing of the bond system OptiBond Solo (Kerr Corporation). The Dyract Flow material (C) was applied after the application and light-curing of the bond system Prime & Bond NT (Denstply). All the materials were inserted in fissures with an explorer. Occlusal contacts were verified and adjustments were made when necessary. One hundred seventeen teeth were sealed with material A, 119 teeth with material B and 120 teeth with material C.

2. *Clinical evaluation:*

Clinical evaluations were carried out 6, 12 and 24 months after the sealant application in the school where the children were studying. Portable dentistry equipment and artificial lighting were used. After drying, the teeth were examined by one calibrated dentist who used an explorer and a buccal mirror. The percentage of teeth that were examined can be observed in Table 2.

The following criteria were adopted to evaluate the retention of the sealant (Pereira *et al.*[12], 1999):

- ✓ Total Retention (TR): total retention of sealant on the occlusal surface;
- ✓ Partial Retention Type 1 (PR1): presence of sealant in 2/3 of the pit extension, with small fractures and losses of material.
- ✓ Partial Retention Type 2 (PR2): presence of sealant in 1/3 of the pit extension with fractures and losses of material.
- ✓ Total Loss (TL): absence of sealant on the occlusal surface of the teeth.

The caries evaluation criteria were (adapted from Thylstrup & Fejerskov[18] and Ketley & Holt[19]):

- No visible caries;
- presence of an active white spot lesion (translucent enamel alterations on occlusal surfaces of the teeth that received sealants);
- Presence of microcavity (diameter ≤ 1.5mm across fissure) and large cavities;
- Filled teeth.

3. *Statistical Analysis:*

The Kruskal-Wallis Test was employed to statistically evaluate the differences in the retention rates (TR, PR1, PR2 and TL) among the groups in each period of evaluation. The Friedman Test was employed to verify differences in the retention of each material among the three evaluations. It was used the following scores to retention: 0 (TR); 1 (PR1); 2 (PR2) and 3 (TL) to the employing the statistical analysis.

The Fisher Exact Test was used to compare caries experience (carious and filled teeth - C+F) in each evaluation among the groups.

The Chi-square Test or Fisher Exact Test was employed to associate plaque index, dmft index and socioeconomic level in the initial exam with caries presence after 24 months.

The Kappa Test was employed to verify intra-examiner reproducibility for clinical assessment of the sealant retention and for caries diagnosis.

Results

Intra-examiner reproducibility was 0.72 and 0.81 for clinical assessment of the sealant retention and for caries evaluation, respectively. The percentages of the different levels of retention after 6, 12 and 24 months of the materials are presented in Table 3. After 6 and 12 months the differences in retention rates (TR, PR1, PR2 and TL) were not significant, however, statistically significant differences after 24 months were verified among the materials. Group 3 (Revolution) shows the best retention rates in comparison to group 1 (Vitremer) and 2 (Dyract Flow).

Table 4 shows the mean rank of the Friedman Test. The difference in retention rates (TR, PR1, PR2 and TL) was significant ($p<0.05$) for Vitremer and Dyract Flow after 12 and 24 months. However, there was no difference in retention rates for Revolution after 12 and 24 months.

Means followed by distinct letters in the horizontal position differ from each other in the Friedman Test and non-parametric multiple comparison test ($p<0,05$).

There were no caries at the 6-month evaluation. Table 5 shows the number and percentage of carious and filled teeth. There were 7 teeth with white spot lesions after 12 months and no verification of a significant statistical difference among the groups (A, B and C). There were 7 teeth with a white lesion, 2 with a microcavity and 4 filled teeth after 24 months and there was no significant difference in caries increment among the groups after 24 months.

There were no association between dmft index, plaque index and socioeconomic level with caries presence in the teeth that were sealed (Fischer Exact Test, $p>0.05$) (Table 6).

Discussion

The morphology of the occlusal surfaces makes correct mechanical dental plaque removal difficult. For this reason, fissure sealant is the best preventive method for these surfaces since it acts as a physical barrier that restrains the exchange of metabolic products between fissure microorganisms and the oral environment.

Different materials, such as flowable composite resin, unfilled resin, glass ionomer cement and modified materials [7,10-11,13-16,20-21] have been studied as fissure sealants. In this study three different materials were used as fissure sealant – Vitremer (resin modified glass ionomer), Revolution (flowable composite resin) and Dyract Flow (flowable polyacid-modified resin).

The results show that after 6 and 12 months there were no statistically significant differences among the materials in relation to retention rates (total, partial 1, partial 2 and total loss). However, after 24 months, Revolution showed best retention results (Kruskal-Wallis Test, $p<0.05$).

These retention rate results are similar to those verified by a great number of studies using resin-based materials as fissure sealants. [6-7,15,22-24] The difference between flowable composite resin and resin-based sealant is that the former contains filler particles and the latter does not, since the former is more resistant to wear. However, flowable composite resin has less inorganic filler particles than conventional composite, in this way it can flow to all depths of the fissures.

The retention rates of Vitremer and Dyract Flow were not significantly different in this study. They are modified materials, although Vitremer is a resin modified glass ionomer (RMGI) and Dyract Flow is a compomer or polyacid-modified resin. There are not a great number of studies that have used these materials as fissures sealants.

Winkler *et al.*[15], 1996, verified a total retention rate of 51% for a RMGI after one year of clinical evaluation, while Pereira *et al.*[12], 1999, observed a percentage of 31% for a RMGI (Vitremer). de Luca-Fraga & Pimenta[21], 2001, verified a total retention rate of 85.7% for Vitremer after one year of evaluation, while our study verified a 77.4% total retention rate for the same material and time of evaluation. After two years, the total retention rate decreased to 47.4% in our study.

Regarding compomers, in the present study a 58.4% total retention rate for Dyract Flow was observed after a 2-year clinical evaluation. de Luca-Fraga & Pimenta[21], 2001 verified after 1 year a 95.9% total retention rate for Dyract. However, in our study the percentage was 75.7 in the same period of evaluation.

Ripa[6], in 1993, states that "the highest rate of sealant loss occurred during the 1st year following treatment" because of failures during the application. In this study a statistical difference in the retention rate was observed between the 1st year and 2nd year of clinical evaluation for Vitremer and Dyract Flow, a fact that did not occur when the retention rates for 6 months and 1 year were compared. The retention rates of Revolution were not significantly different among the three periods of evaluation. Studies show that composites are more wear resistant than RMGI and compomers, in this way this fact can be one reason for the difference among the retention rates of the materials.[25-27]

After 1 year of clinical application, 7 white spot lesions were verified in teeth that totally or partially lost the sealant. However, after 2 years, 7 teeth showed white spot

lesions, 2 showed microcavity and 4 teeth were filled. There were no statistically significant differences among the groups in regard to caries presence after 1 and after 2 years of clinical application. Occlusal surfaces of permanent first molars in erupting teeth show favorable conditions to plaque accumulation, so these surfaces are more susceptible to developing caries lesions (Carvalho *et al.*[28], 1992). Nevertheless, after the erupting period, the presence of the material that obliterates the fissures is not so important. (Forss & Halme[11], 1998). In this way, the teeth of the present study were not in a critical period for caries development. This can explain, together with the high retention rate that was verified for Revolution and the confirmed fluoride releasing of the resin modified glass ionomer and polyacid-modified resin [29-31], the low caries increment.

Determining the caries risk of children is extremely important in indicating fissure sealant. Therefore, caries history (dmf index), plaque index and socioeconomic level are factors that should be evaluated since they can be indicators in the development of future caries lesions. Any association between the indicators of caries that were evaluated in this study (dmft index, plaque index and socioeconomic level) and caries presence after the 2-year clinical evaluation was not verified. This association was not verified probably due to the low caries prevalence that has been observed in Piracicaba-SP/Brazil. A decrease of about 50.0% in the DMFT index in Piracicaba was observed from 1991 (DMFT=3.4) to 2001 (DMFT=1.7)[32]. Probably, the widespread use of fluoride dentifrice and the consumption of fluoridated water in this city, as well as the application of fissure sealant, decrease the risk of caries lesions even in children considered high risk for developing caries. Besides, it is possible that the period of evaluation was not long enough to verify a better preventive effect of the fissure sealants, or to verify an association between the caries indicators and caries presence.

Therefore, it can be concluded in the present study that the flowable composite resin (Revolution) showed better retention rates than RMGI and compomer. However, all of them showed similar efficacious in preventing caries lesions after a 2-year clinical evaluation.

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Table 1: Number of children who were sealed with each material in relation to dmft index.

	Materials		
dmft	**Vitremer**	**Revolution**	**Dyract flow**
1 e 2	9	9	10
> 3	27	30	28

Table 2: Percentage of teeth evaluated.

Materials	**Evaluation periods**		
	6 months	**12 months**	**24 months**
Vitremer	97.4%	90.6%	82.9%
Revolution	90.8%	90.8%	78.1%
Dyract Flow	94.1%	92.5%	74.1%

Table 3: Percentages of the retention rates of the materials used as fissure sealants 6, 12, 24 months after clinical application.

Materials	Retention Levels											
	TR			**PR1**			**PR2**			**TL**		
	6	12	24	6	12	24	6	12	24	6	12	24
Vitremer	97.4	77.4	47.4	0.9	12.3	20.6	1.8	4.7	16.5	0.0	5.7	15.5
Revolution	96.3	84.4	76.3	3.7	11.9	15.1	0.0	1.8	2.2	0.0	0.9	6.5
Dyract Flow	89.4	75.7	58.4	5.3	15.3	21.3	5.3	7.2	6.7	0.0	1.8	13.5

Kruskal-Wallis Test among the materials at 6-month evaluation ($p>0.05$).

Kruskal-Wallis Test among the materials at 12-month evaluation ($p>0.05$).

Kruskal-Wallis Test among the materials at 24-month evaluation ($p<0.05$).

TR – Total Retention

R1 – Partial Retention 1

R2 – Partial Retention 2

TL – Total loss

Table 4: Comparison of rank means of retention levels of the three groups after 6, 12 and 24 months of evaluation (Friedman Test).

	Rank Means		
Materials	6 months	12 months	24 months
Vitremer	1.64 B	1.90 B	2.45 A
Revolution	1.83 A	2.01 A	2.15 A
Dyract F	1.72 B	1.94 B	2.34 A

Table 5: Number and percentages of Carious + filled and sound teeth after 12 and 24 months of Vitremer, Revolution and Dyract Flow use.

Materials	**White lesion + Filling N (%)**		**Sound N (%)**	
	12 months	24 months	12 months	24 months
Vitremer	1 (0.9)	3 (3.1)	105 (99.0)	94 (96.9)
Revolution	3 (2.8)	4 (4.3)	105 (97.2)	89 (95.7)
Dyract flow	3 (2.7)	6 (6.7)	108 (97.3)	83 (93.2)

Fisher Exact Test (p=0.7068) – 12 months

Fisher Exact Test (p=0.4882) – 24 months.

Table 6: Number of sound and carious teeth associated with dmft index, plaque index and socioeconomic level.

	Carious lesions	
dmft	Yes	No
1 e 2	5	63
> ou = 3	8	203
Plaque index	Yes	No
0	2	48
1	11	179
2	0	39
Socioeconomic level	Yes	No
B	1	34
C	7	105
D	5	123
E	0	4

Fisher Exact Test (p>0.05).

3.3. Capítulo III

"*In vitro* evaluation of wear and superficial roughness of different materials used as fissure sealants after toothbrushing"

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"*In vitro* evaluation of wear and superficial roughness of different materials used as fissure sealants after toothbrushing"

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"*In vitro* evaluation of wear and superficial roughness of different materials used as fissure sealants after toothbrushing"

Abstract

Purpose: The aim of this study was to compare *in vitro* the wear and the changes on the superficial roughness of different materials used as fissure sealant after abrasion with toothbrush and dentifrice. *Material and Methods:* Delton (A), Filtek Flow (B), Dyract Flow (C) and Vitremer (D) were applied in 32 extracted human third molars. Impressions of each surface were made using addition silicone and the molds were filled with epoxy resin. The teeth were mounted in a toothbrushing machine. A total of 30,000 brushing cycles (frequency of 250 cycles/min) was carried out. Simultaneously, 32 circular specimens (5 mm in diameter and 3 mm in height) were prepared to analyze the roughness of the material before and after toothbrushing. The tooth replicas were observed in SEM to determine the superficial wear by comparing to the teeth before and after the abrasion test. *Results:* In relation to roughness, statistically significant differences among materials A, B, C and D were verified, however, between materials B and C there was no difference before and after the abrasion test. For each material, statistical differences were observed for roughness before and after the test. In relation to wear, there were no statistically significant differences either between materials A and B or between materials C and D. *Conclusion:* It was concluded that Delton showed the best results in relation to roughness and wear after toothbrushing with dentifrice.

Clinical Significance: Fissure sealant is an effective method for the prevention of caries lesions on occlusal surfaces. The knowledge about roughness and wear properties of different materials used as fissure sealant are relevant to understand their behavior on clinical practice.

Introduction

In the last years, there has been an observable decrease in caries incidence. [1,2] However, this disease concentrates on occlusal surfaces that are responsible for about 56% to 70% of the caries in children of 5-17 years of age.[3-4] A large number of studies have shown that the use of fissure sealant is efficient in preventing caries in these surfaces.

There are a lot of materials on the market that were made specifically to seal teeth. However, some materials used to fill teeth can be used as fissure sealant, i.e. flowable composite or flowable polyacid-modified resin composite. Some resin modified glass ionomers have been applied as fissure sealant,[5-9] although they are not indicated for this use by their manufacturer.

The retention and effectiveness of different materials applied as fissure sealant have been studied *in vivo*. However, dentists are unwilling to use this procedure in their clinical practice. Two of the main reasons cited are the low retention and high wear rates of these materials.[10]

The wear rate of a great number of restorative materials has been studied, nevertheless there are few studies about wear of different materials used as fissure sealant. This property is very important since sealant is an extra coronal addition to the occlusal surface and its wear characteristics might be a little different from those that are found in restorative materials that are placed in cavities.[10]

One important characteristic of materials applied as fissure sealant is their wear resistance because this leads to higher treatment longevity.[11-12] Dental materials, restorative or fissure sealants, are directly affected by oral cavity conditions, such as saliva, foods, toothbrushing and chewing forces.[11] Laboratory studies are useful in providing information on fundamental wear mechanisms, however devices used in wear tests simulate one or two of the wear mechanisms that simultaneously occur in the mouth.[13]

The aim of this study is to compare the *in vitro* wear and roughness of different materials used as fissure sealant after abrasion with toothbrush and dentifrice.

Materials and Methods

The materials tested in this study were:

- Unfilled resin-based sealant – Delton[a]
- Flowable composite - Filtek Flow[b]
- Flowable polyacid-modified resin composite - Dyract Flow[c]
- Resin modifed glass ionomer - Vitremer[b]

1. Wear evaluation

Thirty-two extracted human third molars without filling, evidence of caries or cracks were stored in distilled water after extraction. Following this, they were cleaned using periodontal instruments and pumice prophylaxis. Then, the teeth were maintained in distilled water at 4°C. The teeth were randomly distributed in the following groups: A-Delton; B-Filtek Flow; C-Dyract Flow and D- Vitremer.

The sealants were applied after pumice prophylaxis of the occlusal surfaces and after etching of the teeth with 37% phosphoric acid gel[a] (15 seconds). Then, the teeth were rinsed with a spray of air/water for 5 seconds.

Delton application:

- Manipulation of the material according to the manufacturer;
- Insertion of the material into the fissures with a brush along the entire extension;
- Autopolymerization of the material.

Filtek Flow application:

- Application, air drying and light-curing of the Single Bond[b] adhesive system for 10 seconds;
- Insertion of the material into the fissures with an explorer along the entire extension;
- Light-curing for 20 seconds.

Dyract Flow application:

- Application, air drying and light-curing of the Prime-Bond NT[a] adhesive system for 10 seconds;
- Insertion of the material into the fissures with an explorer along the entire extension;
- Light-curing for 20 seconds.

Vitremer application:

- Application of the Prime[b] for 30 seconds, air drying and light-curing for 20 seconds;

- Mixing of the material in a powder / liquid proportion of 1:2, to obtain lower viscosity so that the mixture flows into the fissures (Pereira *et al.*, 1999);[7]
- Insertion of the material into the fissures with an explorer along the entire extension;
- Light-curing for 40 seconds;
- Application of "Finishing Gloss"[b] followed by light-curing for 20 seconds;

Impressions of each tooth were made using addition silicone (Aquasil[a]) and filled with epoxy resin (Epoxide[d]) after the placement of the materials. The teeth were stored at 37°C at 100% relative humidity until the preparation with the toothbrushing machine.

2. Roughness evaluation

Eight circular specimens (2 mm in height and 5 mm in diameter) of each material were fabricated in an addition silicone mold to verify the roughness of the materials before and after the abrasion test. The instructions of the manufacturers were followed for handling the materials, except for Vitremer, which was prepared in a proportion of 1:2 powder/liquid.[7] The molds were filled with the material, covered with a polyester strip and a thin glass slab and when necessary, the specimens were light-cured (Photo Unit XL 1500[b]) following the exposure time recommended by the manufacturer. Then, the specimens were polished with sandpaper (600, 1000 and 1200 grids), and were stored at 37°C at 100% relative humidity until the abrasion test.

The initial roughness measurement of the specimens was carried out using a Profilometer (SurfCorder SE 1700[e]). Before the measuring, each specimen was gently dried with absorbent paper and air. The cut-off value was set at 0.25 mm and the surface roughness was characterized by the average roughness (Ra). The Ra value was used because it represents the arithmetical average value of all absolute distances of the roughness profile from the center line within the measuring length.[14]. Three readings were made on each surface using a stylus tip, which has a diameter of 2μm. Each reading was obtained after turning the specimen 120°. The measurements were carried out before and after the abrasion test.

Abrasion Test

The samples (sealed teeth and circular specimens) were submitted to mechanical toothbrushing, using a toothbrushing machine (Equilabor[f]) which can brush eight specimens concurrently.

Infantile toothbrushes with soft nylon bristles (Colgate Classic Infantil[g]) were used. The head was sectioned with a tungsten carbide bur and fixed in the toothbrush holder device of the machine using Super Bonder[h] fast setting adhesive. The samples were fixed on a plastic plate. The toothbrush was fixed perpendicular to the specimen surface. The test was made under a load of 200g, which was used to simulate the load of oral hygiene procedures.

Specimens were brushed in the presence of a dentifrice containing calcium carbonate (mean 6.5μm) as an abrasive (Sorriso[g]) mixed with distilled water at a ratio of 1:1 in weight. The dentifrice was weighed on a precision balance. The specimens were subjected to linear toothbrushing movements across the specimens, at a speed of 250 cycles/minute, considering a double pass of the brush head over the surface, for 2 hours, totaling 30,000 cycles per specimen. This number of cycles corresponds to approximately 2 years of toothbrushing.[15] After the test, the specimens were removed, rinsed with tap water and stored at 37°C at 100% relative humidity.

Analysis of wear and surface roughness

The sealed teeth were molded again as previously described. All the replicas in epoxy resin were observed in scanning electron microscopy (SEM[i]) (x 18) to evaluate the wear by comparison between the first and the second models. The area of assessment was the whole occlusal surface. The scores were: 0 – no change in the sealant surface; 1 – polishing of the sealant surface without changes in the border; 2 – polishing of the sealant surface with changes in the border and 3 – sealant loss in some pit or fissure. The images were observed by two examiners who were previously calibrated.

The roughness of the specimens was measured using the surface roughness instrument as previously described.

Statistical Analysis

The results of surface roughness were analyzed by means of the Analysis of Variance to repeated measures, followed by Tukey Test at the level of 5% significance. The Kruskal-Wallis test was applied to verify differences among the wear of the materials after the toothbrushing.

Results

The wear of the models was evaluated by 2 examiners and the inter-examiner reproducibility was 0.85.

The median and the mean rank of the wear of the materials can be observed in Table 1. There were no statistically significant differences either between materials A (Delton) and B (Filtek Flow) or between materials C (Dyract Flow) and D (Vitremer) with the former two showing the lower wear.

The means of roughness of the 4 materials before and after the abrasion test can be observed in Table 2. Statistically significant differences among materials A, B, C and D were verified; however, there was no difference between materials B and C before and after the abrasion test. Vitremer presented the highest roughness before the abrasion test followed by Delton, Filtek Flow and Dyract Flow. Vitremer presented the highest roughness measurement and Delton, the lowest, after toothbrushing. Materials B and C showed an intermediary roughness. For each material, statistical differences were observed for roughness before and after the test. The roughness of Delton after the abrasion test was lower than before the test, different from the other materials studied.

Discussion

Although fissure sealants have been considered effective in preventing occlusal caries[16] and a great number of clinical studies about this procedure have been published, there are few studies about the wear resistance and the roughness of the different materials used as fissure sealants.

In the present study, four different types of dental materials were submitted to abrasion test with toothbrush and dentifrice *in vitro*. Regarding wear, the sealed teeth with

Vitremer and Dyract Flow showed the higher wear and there was no statistically significant difference between them. Vitremer is a resin modified glass ionomer (RMGI) and most of its physical properties are inferior to those of resin-based materials[11,17] and according to Momoi *et al.*, 1997,[18] this material is less abrasion resistant because of the lower surface hardness. El-Kalla & García-Godoy, 1999,[19] studied mechanical properties of compomers and suggested that compomer restorative material is placement between RMGI and composite in their study, since the tested materials "displayed the same arrangement of strength in both stages of the three-point bending test, the yield and flexural strength". However, Braem *et al.*, 1995,[20] concluded that the strength and flexural fatigue values of compomers are similar to the composites.

Wear is the least understood property of the restorative materials, since it involves different processes that can interact with each other.[18] For this reason, in the present study just the abrasion with dentifrice and toothbrush was evaluated and for this reason, the results *in vivo* probably are different since the fissure sealant is also affected by saliva, food and masticatory forces.[11]

There was no statistically significant difference between Delton and Filtek Flow in regards to wear in the present study. Lugassy & Greener (1972)[21] showed that the pattern of wear is different between an unfilled resin and a filled resin. According to them, the abrasion of an unfilled resin is lower and the wear is more uniform than that of a filled one.

Regarding roughness, Delton showed the lower measurement after toothbrushing and this value was lower than the value before the abrasion test. This fact confirms that the wear of an unfilled resin is more uniform than that of a filled resin, since the roughness measurement of Filtek Flow increased after the test. The slurry used in this study had calcium carbonate as abrasive, however, particles of the filled resin detach and can act as an additional abrasive agent themselves, increasing the abrasion of the slurry.[22] Besides this, due to wear of the resin matrix, particles of the filled resin can protrude and make the surface more irregular. This can explain the high roughness of the Filtek Flow material after the abrasion test.

The polyacid-modified resin composite (Dyract Flow) and flow resin (Filtek Flow) showed the lower measurement before the abrasion test and there was no statistically

significant difference of the roughness between them before and after the abrasion test. The roughness of Vitremer was the highest before and after the test. According to El-Kalla & García-Godoy, 1999,[19] these data showed that hand-mixing materials do not produce the same surface as materials that are in paste form, such as composites and compomers. The low ratio of powder: liquid decreases the glass particles, which increases their susceptibility to erosion.[23] The high roughness measurement can be a result of porosity caused by air bubbles in the material setting or by the particles exposed during abrasion.[24]

Most clinical studies show that the resin-based material has the best retention rates[16,25-28] in comparison to PMRC, RMGI and glass ionomer cement. *In vitro* studies are useful to explain some conditions, separately, of the materials when they are exposed in the mouth. Therefore, the results can not be extrapolated to the clinical practice, since, as previously explained, several factors are acting on the dental materials at the same time. Although a dental material releases fluoride, its surface should be sufficiently smooth in order to not accumulate substrate and microorganisms.[29] In the clinical practice, teeth with incipient caries or those not totally erupted in patients with caries activity should receive fissure sealant. In these cases, ionomeric materials (GIC and RMGI) are indicated for this treatment, since their fluoride release is known. Despite the worst roughness and wear, the ionomeric material can arrest the caries lesion and this fact is quite valuable in clinical dentistry.

With the methodology employed in this study, it was verified that the modified materials Vitremer and Dyract Flow, showed similar wear to each other, as well as to Filtek Flow and Delton, however the wear of the modified were higher. Vitremer showed the worst results regarding roughness measurement, while Delton showed the best results. It was concluded that Delton showed the best results in relation to roughness and wear after toothbrushing with dentifrice.

[a] DENTSPLY De Trey, Konstanz.

[b] 3M/ESPE – St Paul, MN, USA.

[c] DENTSPLY Caulk, DENTSPLY International Inc., Milford, DE, USA.

[d] BÜHLER, Lake Bluff, IL, USA.

[e] Kosaka Lab, Tokyo, Japan.

[f] Piracicaba, SP, Brazil.

[g] Kolynos do Brasil, Ltda., Osasco, SP, Brazil.

[h] Loctite, SP, Brazil.

[i] LEO VP 435, Cambridge, United Kingdom.

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Table 1: Median and mean rank of the wear of the tested materials.

Materials	Median	Mean rank
Delton	1	8.75b
Filtek Flow	1	8.81b
Dyract Flow	2	20.5a
Vitremer	3	27.94a

Means followed by distinct letters are statistically different.

Table 2: Mean of the roughness of the tested materials before and after the abrasion using toothbrush and dentifrice.

Time	Materials			
	Delton	Filtek Flow	Dyract Flow	Vitremer
Before	0.34 Ba	0.21 Cb	0.23 Cb	0.50 Ab
After	0.21 Cb	0.37 Ba	0.29 Ba	1.51 Aa

Capital letters horizontally designate mean values with statistically significant differences for the material variable, while small letters vertically designate mean values with statistically significant difference for the time variable.

3.3. Capítulo IV

"*In vitro* evaluation of microleakage of different materials used as fissure sealants"

Artigo submetido ao Periódico *Journal of Clinical Pediatric Dentistry*.

"*In vitro* evaluation of microleakage of different materials used as fissure sealants"

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Abstract

The aim of this study was to evaluate the *in vitro* microleakage of different materials used as fissure sealants (Delton, Filtek Flow, Dyract Flow and Vitremer). Fifty-six extracted human third molar teeth were divided in 4 groups. All the groups were thermocycled in water (500 cycles among 5 °C, 37°C and 55°C) and were prepared to the microleakage test and immersed in 2% buffered methylene blue dye for 4 h. Each tooth was sectioned longitudinally in the bucco-lingual direction and the sections were observed in stereomicroscope. Four scores to penetration of the stain were established. All the materials exhibited some degree of microleakage and there were no statistically significant differences among the four groups (Kruskal-Wallis test). It can be concluded that all materials showed similar capacity of marginal sealing when applied as fissure sealants.

Introduction

During the last decades there has been a decline in caries prevalence, what led to changes in pattern (proportionately fewer smooth surface lesions than pit and fissure lesions) and in progression velocity.[1] Nevertheless, the occlusal surface is responsible for a range from 56% to 70% of caries in children from 5 to 17 years of age.[2,3] Fissure sealing is an established and efficacious technique for the management of pit and fissure caries.[4-7]

Nowadays the occlusal caries have become more difficult to diagnose, since the characteristic cavity in enamel is often not present.[8] This kind of lesion is called "hidden caries" and it is described as occlusal dentine caries that is missed on visual exam but detected radiographically or when fissure biopsy is undertaken.[9] Caries diagnosis is a pre-requisite when considering sealant applying, since hidden caries can be sealed when the clinician is unable to do a bitewing radiograph. In this way, the marginal sealing capacity of the sealant material is extremely relevant to lead to a successful treatment. The lack of sealing allows the occurrence of marginal leakage, that is defined as the passage of bacteria, fluids, molecules and ions between the teeth and the sealing material[10], what can prompt the progression of the caries lesion.

Since *in* vitro studies about microleakage can predict the marginal sealing capacity of the different materials used, [11] the purpose of this study was to evaluate the *in vitro* microleakage of different materials used as fissure sealants.

Materials and Methods

Fifty-six extracted human third molar teeth free of cracks, caries and restorations were stored in distilled water after the extraction. In following they were cleaned using periodontal instruments and pumice prophylaxis. After that, the teeth were maintained in distilled water at 4°C.

The teeth were randomly distributed in the following groups with 14 teeth in each:

A- Delton (Dentsply) – unfilled resin-based sealant;

B- Filtek Flow (3M) – flowable composite;

C- Dyract Flow (Dentsply) – flowable compomer;

D- Vitremer (3M) – resin modified glass ionomer.

No invasive technique (enameloplasty) was used prior to the application of the study materials. The sealants were applied after pumice prophylaxis of the occlusal surfaces in a low-speed rotary brushing and after the etched of these surfaces with 37% phosphoric acid gel (Dentsply). Then, the teeth were rinsed with a spray of air/water during 5 seconds and dried with oil-free compressed air.

The sequence of the applications is described below:

Delton:

- Manipulation of the material according to the manufacturer;
- Inserting of the material into the fissures with a brush along the entire extension;
- Waiting for the autopolymerization of the material.

Filtek Flow:

- Application, air drying and light-curing of the adhesive system Single Bond (3M), for 10 seconds;
- Inserting of the material into the fissures with an explorer along the entire extension;
- Light-curing for 20 seconds.

Dyract Flow:

- Application, air drying and light-curing of the adhesive system Prime-Bond NT (Dentsply), for 10 seconds;
- Inserting of the material into the fissures with an explorer along the entire extension;.
- Light-curing for 20 seconds.

Vitremer:

- Application of the Prime for 30s, air drying and light-curing for 20 seconds;
- Mixing of the material in a powder / liquid proportion of 1:2, to obtain lower viscosity so that the mixture flows into the fissures;[12]
- Inserting of the material into the fissures with an explorer along the entire extension;
- Light-curing for 40s;
- Application of "Finishing Gloss" followed by light-curing for 20s;

The teeth were stored at 37°C and 100% relative humidity until the thermocycling procedure (500 cycles). In each cycle of the thermocycling the teeth were

immersed in water at 5°C and 55°C, for 30 seconds each, with intermediary water bath at 37°C.[13]

Preparation for drying penetration test

All specimen root apices were sealed with an epoxy resin and all surfaces were coated with two layers of brown nail polish (CEIL, São Paulo, SP, Brazil) interposed by a layer of wax (Clássico, São Paulo, Brazil) with the exception of a 1.5-milimiter window around the sealant margins. Then, the specimens were immersed in 2% buffered methylene blue dye for 4 h. After this period, the specimens were rinsed with running water and the layers of nail polish and wax removed. Each tooth was sectioned longitudinally in the buccolingual direction using a diamond saw blade (Isomet, Buehler, Lake Bluff, IL, USA), and between 2 and 4 sections were obtained from each tooth. The sections were examined in a 40/60x binocular microscope (Leitz, Carl Zeiss do Brasil, Manaus, AM, Brazil), and the following scores were used:[14]

0 – no dye penetration;

1 – dye penetration restricted to the outer half of the sealant;

2 – dye penetration extending to the inner half of the sealant;

3 – dye penetration extending to the underlying fissure.

The worst score for each tooth was recorded and the non-parametric statistical techniques Kruskal-Wallis one-way ANOVA was used to test for statistically significant differences among the four groups.

Results

All 56 sealants that had been placed were presents at the time of the exam. The results are shown in Table 1 and 2.

All groups presented different degrees of microleakage. The most teeth sealed with Delton and Dyract Flow did not have any microleakage (Table 1), however these groups showed one tooth each one with the worst score (number 3). Meanwhile, the most teeth sealed with Vitremer and Filtek Flow showed score 1, just one tooth with score 2 and none showed score 3. There were no significant differences among the four groups tested regarding to microleakage ($p>0.05$).

Discussion

Fissure sealants have been considered effective in preventing occlusal caries.[7] Some properties of an ideal material for this purpose include biocompatibility, retention capacity, resistance to abrasion and to wear.[11] Other relevant property is the adhesion of the sealing material to the enamel, since microelakage at the material-enamel interface can lead to a failure of the treatment.

In the present study, four different dental materials were applied as fissure sealant to evaluate the microleakage *in vitro*. Dental materials specifically produced to be employed as fissure sealant have not been changed since in 1970's.[7] So, a resin modified glass ionomer, a compomer and a flowable composite resin was evaluated as fissure sealants, besides an unfilled resin-based sealant. All materials were applied without enameloplasty, since the objective of the present study was to evaluate the behavior of those materials without removing of dental tissue. The specimens were termocycled attempting to reproduce the different temperatures to which the teeth are subjected during the normal eating of food.

The result of the present study showed that there were no statistically significant differences among the four materials regarding the marginal sealing. Rego & Araújo[15] (1999) verified the higher microleakage to RMGI and they justified it because the enamel was not etched and this materials has a resin component. In our study all teeth were etched with phosphoric acid before the applying of the materials and there was a moisture control, since the study was an *in vitro* evaluation. These facts can suggest an explanation of why there were no differences among the materials. Güngör *et al.*,[16] 2003, verified that Dyract Flow provided microleakage results comparable to Delton-FS, similarly to the present study (Dyract Flow and Delton).

According to ADA (1997)[17] fissure sealants can be applied in incipient caries on enamel. Nowadays, it is possible the clinician finds teeth with an occlusal dentine lesion under an apparently sound enamel surface (hidden caries)[18] and in some cases one can seal these teeth. In this way, marginal sealing is important for sealant success because the microleakage of bacteria beneath a sealant may support caries initiation and progression.[19,20] According to Weerheijm & Groen,[21] 1999, in cases of removing caries as

completely is not possible, the sealing capacity of the filling material seems to be more important than its cariostatic properties.

A variety of studies was done to evaluate whether there was or not the arresting of the disease when caries dentin lesions were not removed completely and they demonstrated a reduction in the number of cultivable microorganisms from infected dentin after sealant application.[22-25] For having this favorable effect of the sealing of the dentin caries or of the incipient enamel caries, the dental material should be covering all pit and fissures.[21] The periodical evaluation is very important to the maintenance of the treatment and bitewing radiographs are useful to follow the evolution of these kind of lesions.[26, 27]

In this study was possible to verify that all materials showed similar marginal sealing and their indication as fissure sealant should be evaluated by each clinician oneself.

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Table 1: Distribution of microleakage scores (0 to 3) among the studied materials (n=14).

Materials	Scores (%)			
	0	1	2	3
Delton	64.3	14.3	14.3	7.1
Filtek Flow	28.6	64.3	7.1	0.0
Dyract Flow	57.1	14.3	21.4	7.1
Vitremer	42.9	50.0	7.1	0.0

Table 2: Median, score minimum and maximum of the microleakage verified to the studied materials (n=14).

Group	Median	Min	Max
Delton	0	0	3
Filtek Flow	1	0	2
Dyract Flow	0	0	3
Vitremer	1	0	2

Kruskal-Wallis Test – $p>0.05$.

4. Considerações Finais

É real a diminuição da prevalência de cárie dentária na maioria dos países desenvolvidos e em desenvolvimento, fato este ligado, segundo diversos autores, à métodos de utilização coletiva de flúor presente em dentifrícios e água de abastecimento público. É fato também que, atualmente, o perfil da doença cárie é bastante diferente das lesões extensas e de progressão rápida que atingiam praticamente toda a população durante grande parte do século XX. Nos dias de hoje, observa-se que poucas pessoas concentram grande parte das lesões cariosas diagnosticadas na população e, de um modo geral, a doença apresenta uma evolução mais lenta, sendo possível verificar-se lesões de cárie oculta, onde o esmalte permanece praticamente intacto e a dentina apresenta-se gravemente afetada.

Atualmente, outro ponto em relação ao perfil da doença cárie é que a mesma se concentra em superfícies oclusais, que apresentam anatomia bastante complexa. Os sistemas de fóssulas e fissuras muitas vezes permitem o acúmulo de biofilme dental, o qual é difícil de ser removido, por exemplo, por crianças em idade pré-escolar que não têm a coordenação motora totalmente desenvolvida ou pacientes com problemas motores. Desse modo, é importante que o cirurgião dentista tenha à mão um método preventivo que atue eficazmente sobre essa superfície.

Ainda hoje, os materiais fabricados especialmente para selamento oclusal têm sua composição muito semelhante àqueles da década de 70, período em que materiais destinados à obliterar fóssulas e fissuras foram desenvolvidos. Entretanto, diversos materiais utilizados para restauração têm sido avaliados como selantes, com a finalidade de verificar se há melhor comportamento clínico dos mesmos.

No primeiro artigo que compõe esse estudo, isto é, no artigo de revisão, a principal conclusão é que as indicações, contra-indicações e revisão periódica são o ponto chave do sucesso desse procedimento preventivo. Ao se fazer a avaliação do paciente e dos dentes com risco é possível fazer a escolha do melhor material indicado para o caso. Dentes em erupção que não permitem que se realize um isolamento adequado em pacientes com

alto risco à cárie e com atividade da doença podem ser selados com materiais ionoméricos, os quais atuarão de forma direta por liberarem flúor e obliterarem a fissura, pelo menos no período de maior risco, pois sabe-se de sua baixa taxa de retenção. Já materiais resinosos podem ser aplicados em pacientes com risco à cárie, em dentes que permitam adequado isolamento e em pacientes cooperadores com o tratamento. Ionômero de vidro modificado por resina (IVMR) pode ser indicado onde se deseja melhor retenção concomitantemente ao efeito terapêutico do flúor. Os cômpomeros, embora possuam liberação de flúor, não se assemelham ao cimentos de ionômero de vidro convencionais, entretanto os mesmos apresentam uma facilidade de aplicação quando comparados ao IVMR, já que se apresentam em pasta única, sendo vantajosos quando o paciente não é cooperador.

Na busca por se verificar o melhor material para ser usado na clínica, o estudo que corresponde ao capítulo 2 foi realizado. Constatou-se que o material resinoso Revolution apresentou melhor retenção após dois anos de aplicação clínica quando comparado aos materiais Vitremer (IVMR) e Dyract Flow (compômero). Entretanto, como verificado em alguns estudos, não houve diferença na prevalência de cárie entre os grupos. Embora esse resultado seja bastante satisfatório, seria interessante avaliações clínicas por um período de tempo maior, para se ter certeza que essa semelhança quanto à prevenção de cárie permanecerá.

Uma propriedade importante para os materiais seladores de fissuras é a resistência ao desgaste, uma vez que materiais menos resistentes podem ficar com uma espessura muito fina o que levaria à fratura do material e respectiva falha do selamento. Sabendo-se que os materiais odontológicos na cavidade bucal sofrem diretamente ação da saliva, alimentos, forças mastigatórias e escovação, no capítulo 3 foi avaliada a rugosidade e a taxa de desgaste de diferentes materiais aplicados como selantes oclusais após o teste de abrasão por escovação mecânica com dentifrício. O material Delton apresentou, de uma forma geral, os melhores resultados pois apresentou a menor taxa de desgaste juntamente com o material Filtek Flow e apresentou uma diminuição do valor da rugosidade após o teste de abrasão. O material Vitremer, embora apresente a propriedade de liberação de flúor, apresentou o maior valor de rugosidade antes e após a escovação, o que não é

interessante, visto que materiais rugosos permitem maior acúmulo de biofilme dental, fato que pode levar à desmineralização do esmalte dental ao redor do material. Entretanto, esse acúmulo de biofilme pode ser controlado se o paciente receber orientação de higiene bucal, orientação esta que é de grande importância para pacientes em qualquer idade. O material Dyract Flow apresentou taxa de desgaste semelhante ao material Vitremer e valor de rugosidade semelhante ao Filtek Flow, portanto ficando, juntamente com este último, numa posição intermediária quanto aos resultados obtidos.

Outra propriedade avaliada no presente trabalho foi a capacidade de vedamento marginal de diferentes materiais aplicados como selantes de fissuras, uma vez que, havendo falha, microrganismos e substratos podem se alojar na fissura existente entre o material selador e o esmalte dental, podendo levar à desmineralização nessa região. Os materiais avaliados foram, também, o Delton, Filtek Flow, Dyract Flow e Vitremer e observou-se não haver diferença em relação à infiltração marginal entre esses materiais após submissão dos dentes selados ao teste de termociclagem.

A partir do exposto, verifica-se que os materiais atualmente existentes no mercado apresentam resultados satisfatórios quando aplicados como selantes de fissuras. Entretanto, seria interessante se fossem aplicados à esses materiais a evolução que existiu, por exemplo, com os sistemas adesivos, a fim de se produzir um material com adesividade ótima, fácil e rápido de ser aplicado e com ótimas propriedades mecânicas. Além disso, outros trabalhos, não somente para verificar a retenção e efetividade na prevenção de cárie, devem ser realizados clinicamente, como por exemplo: avaliação de custo-efetividade, custo-benefício e a aplicação de programas de selamento em populações com alta prevalência de cárie para se verificar o verdadeiro potencial desse método preventivo.

5. Conclusões

A partir da revisão sobre selantes de fóssulas e fissuras pode-se concluir:

1. O uso de selantes oclusais é um método eficaz na prevenção à cárie dentária;

2. Caso sejam seladas cáries incipientes, limitadas ao esmalte, parece não haver progressão da mesma desde que o selante seja periodicamente avaliado e reaplicado quando necessário;

3. Lesões em dentina, quando detectadas, devem ser removidas e o dente restaurado, diferentemente de lesões em esmalte;

4. Selantes resinosos apresentam taxa de retenção maior. No entanto, os selantes ionoméricos têm a vantagem de liberarem flúor;

5. Há diminuição das falhas de retenção do selantes resinosos quando se utiliza um agente adesivo anteriormente à sua aplicação;

6. As indicações e contra-indicações dos selantes devem ser cuidadosamente avaliadas pelo profissional para que não haja sobre ou sub-tratamento e para que o melhor custo-benefício seja alcançado.

A partir das metodologias empregadas nos experimentos realizados conclui-se que:

1. A resina composta de alto escoamento (Revolution) apresentou as melhores taxas de retenção em relação ao ionômero de vidro modificado por resina (Vitremer) e ao compômero (Dyract Flow), entretanto não houve diferença na prevenção de cárie entre os grupos após dois anos de aplicação clínica dos materiais.

2. O material Vitremer apresentou o maior valor de rugosidade, enquanto o material Delton apresentou o menor valor após a abrasão por escovação com dentifrício fluoretado. Quanto ao desgaste, os materiais modificados Vitremer e Dyract Flow

apresentaram valores similares entre si, assim como os materiais Filtek Flow e Delton entre si, entretanto os primeiros apresentaram menor resistência ao desgaste.

3. Os materiais Delton, Filtek Flow, Dyract Flow e Vitremer apresentaram semelhante capacidade de vedamento marginal após realização de termociclagem seguida pelo teste de microinfiltração.

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* De acordo com a norma utilizada na FOP/UNICAMP, baseada no modelo Vancouver. Abreviatura dos periódicos em conformidade com o Medline.

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Anexo 1: Certificado do Comitê de Ética em Pesquisa do artigo "A 24-month clinical evaluation of different materials used as fissure sealant".

UNICAMP

COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE ESTADUAL DE CAMPINAS

FACULDADE DE ODONTOLOGIA DE PIRACICABA

CERTIFICADO

Certificamos que o Projeto de pesquisa intitulado "Comparação entre diferentes materiais utilizados como selantes de fissuras após 24 meses de aplicação clínica", sob o protocolo nº **041/2002**, da Pesquisadora ***Vanessa Pardi***, sob a responsabilidade do Prof. Dr. **Antonio Carlos Pereira**, está de acordo com a Resolução 196/96 do Conselho Nacional de Saúde/MS, de 10/10/96, tendo sido aprovado pelo Comitê de Ética em Pesquisa – FOP.

Piracicaba, 06 de novembro de 2002

We certify that the research project with title "Comparison among different materials used as fissure sealants after twenty-four year of clinical application", protocol nº **041/2002**, by Researcher ***Vanessa Pardi***, responsibility by Prof. Dr. **Antonio Carlos Pereira**, is in agreement with the Resolution 196/96 from National Committee of Health/Health Department (BR) and was approved by the Ethical Committee in Research at the Piracicaba Dentistry School/UNICAMP (State University of Campinas).

Piracicaba, SP, Brazil, November 06 2002

Prof. Dr. Pedro Luiz Rosalen
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Antonio Bento Alves de Moraes
Coordenador
CEP/FOP/UNICAMP

Anexo 2: Certificado do Comitê de Ética em Pesquisa do artigo "*In vitro* evaluation of wear and superficial roughness of different materials used as fissure sealants after toothbrushing".

UNICAMP

COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE ESTADUAL DE CAMPINAS

FACULDADE DE ODONTOLOGIA DE PIRACICABA

CERTIFICADO

Certificamos que o Projeto de pesquisa intitulado "Avaliação *In vitro* do desgaste e rugosidade superficial de diferentes materiais utilizados como selantes de fissuras pela abrasão da escovação com dentifrício", sob o protocolo nº **042/2002**, da Pesquisadora ***Vanessa Pardi***, sob a responsabilidade dos Profs. Drs. **Antonio Carlos Pereira** e **Mário Alexandre Coelho Sinhoreti**, está de acordo com a Resolução 196/96 do Conselho Nacional de Saúde/MS, de 10/10/96, tendo sido aprovado pelo Comitê de Ética em Pesquisa – FOP.

Piracicaba, 16 de agosto de 2002

We certify that the research project with title "*In vitro* evaluation of the wear and surface roughness of different materials used as fissure selants after abrasion for toothbrushing with dentifrice", protocol nº **042/2002**, by Researcher ***Vanessa Pardi***, responsibility by Prof. Dr. **Antonio Carlos Pereira** and **Mário Alexandre Coelho Sinhoreti**, is in agreement with the Resolution 196/96 from National Committee of Health/Health Department (BR) and was approved by the Ethical Committee in Research at the Piracicaba Dentistry School/UNICAMP (State University of Campinas).

Piracicaba, SP, Brazil, August 16 2002

Prof. Dr. Pedro Luiz Rosalen
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Antonio Bento Alves de Moraes
Coordenador
CEP/FOP/UNICAMP

Anexo 3: Certificado do Comitê de Ética em Pesquisa do artigo "*In vitro* evaluation of microleakage of different materials used as fissure sealants".

UNICAMP

COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE ESTADUAL DE CAMPINAS

FACULDADE DE ODONTOLOGIA DE PIRACICABA

CERTIFICADO

Certificamos que o Projeto de pesquisa intitulado "Avaliação *in vitro* da infiltração marginal de diferentes materiais utilizados como selantes de fissuras", sob o protocolo nº **043/2002**, da Pesquisadora ***Vanessa Pardi***, sob a responsabilidade dos Profs. Drs. **Antonio Carlos Pereira** e **Mário Alexandre Coelho Sinhoreti**, está de acordo com a Resolução 196/96 do Conselho Nacional de Saúde/MS, de 10/10/96, tendo sido aprovado pelo Comitê de Ética em Pesquisa – FOP.

Piracicaba, 27 de agosto de 2002

We certify that the research project with title "*In vitro* evaluation of the marginal leakage of different materials used as fissure sealants", protocol nº **043/2002**, by Researcher ***Vanessa Pardi***, responsibility by Prof. Dr. **Antonio Carlos Pereira** and **Mário Alexandre Coelho Sinhoreti**, is in agreement with the Resolution 196/96 from National Committee of Health/Health Department (BR) and was approved by the Ethical Committee in Research at the Piracicaba Dentistry School/UNICAMP (State University of Campinas).

Piracicaba, SP, Brazil, August 27 2002

Prof. Dr. Pedro Luiz Rosalen
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Antonio Bento Alves de Moraes
Coordenador
CEP/FOP/UNICAMP

Anexo 4: Comprovante de recebimento do artigo "Selantes de fissuras: um método eficaz na proteção da cárie oclusal" para avaliação.

Vanessa

De: Antonio Carlos Pereira <apereira@fop.unicamp.br>
Para: Vanessa Pardi <vpardi@uol.com.br>; Vanessa <vanpardi@hotmail.com>
Enviada em: quinta-feira, 8 de maio de 2003 10:27
Assunto: Fw: Artigo Cientifico 809 - protocolo + carta + DISQUETE

----- Original Message -----
From: ABO Nacional
To: Antonio Carlos Pereira
Sent: Wednesday, May 07, 2003 3:35 PM
Subject: Artigo Cientifico 809 - protocolo + carta + DISQUETE

Dr. Antonio Carlos Pereira,

A mesma tem por objetivo comunicar-lhe que o artigo enviado por Vossa Senhoria cujo título e autores seguem:

SELANTES DE FISSURAS: UM METODO EFICAZ NA PREVENÇÃO DA CÁRIE OCLUSAL.

Vanessa PARDI
Antonio Carlos PEREIRA
Andréa Videira ASSAF
Lidiany Karla Azevedo RODRIGUES

Foi recebido pelo Conselho Editorial da Revista ABO Nacional, em 22/04/2003, tendo sido protocolado sob **o número809** que passa a ser seu referencial para quaisquer contatos futuros (favor citar o numero).

Seguindotramita ção convencional, o mesmo está agora com o Conselho Consultivo para análise.

OBS: Solicitamos o envio de carta assinada pelos autores (coforme Normas de Publicação), informando que o Artigo protocolado sob o numero 809 (favor citar o numero) enviado à Revista ABO Nacional é inédito, a qual não é permitido a apresentação simultânea em outro periódico. Solicitamos também o envio **do artigo em disquete.**

Enviar para o endereço:
ABO Nacional
Rua Vergueiro, 3.153 - sala 82 - Vila Mariana
CEP: 04101-300 - São Paulo - SP
A/C Mônica Martins
Agradecendo sua deferência para com a nossa Revista, subscrevemo-nos.

Atenciosamente,

José Carlos Ribeiro - C.D.
- Secretário Geral -

02/12/03

Anexo 5: Comprovante de recebimento do artigo "A 24-month clinical evaluation of different materials used as fissure sealant" para avaliaçãо.

AMERICAN ACADEMY OF PEDIATRIC DENTISTRY
211 EAST CHICAGO AVENUE ~ SUITE 700 • CHICAGO, ILLINOIS 60611-2663
312-337-2169 FAX: 312-337-6329 www.aapd.org

May 20, 2003

Prof. Dr. Antonio Carlos Pereira
Faculdade de Odontologia de Piracicaba-UNICAMP
Avenida Limeiro 901 CEP: 13414-903
Piracicaba, SP Brazil

Dear Dr. Pereira:

Thank you for submitting your manuscript, "A 24-month Clinical Evaluation of Different Materials Used as Fissure Sealant" (2003-066) to the *Journal of Dentistry for Children*.

Your manuscript will shortly be sent for review. As soon as Dr. Paul S. Casamassimo, our Interim Editor, receives the comments, he will notify you of its acceptability for publication. Please note that the review process generally takes two months to complete.

All correspondence regarding your paper should be sent to: AAPD Publications Department, Attn: Kristin McComas, 211 East Chicago Avenue – Suite 700, Chicago, IL 60611-2663; phone 312-337-2169, fax 312-337-9428, or e-mail kmccomas@aapd.org.

Thank you for allowing us to consider your manuscript for publication in *the Journal of Dentistry for Children*.

Sincerely,

Kristin A. McComas

Kristin A. McComas
Publications and Layout Associate
AAPD

Anexo 6: Comprovante de recebimento do artigo "*In vitro* evaluation of wear and superficial roughness of different materials used as fissure sealants after toothbrushing" para avaliação.

Vanessa

De: Mario Alexandre C. Sinhoreti <sinhoret@fop.unicamp.br>
Para: <vpardi@uol.com.br>
Enviada em: segunda-feira, 1 de dezembro de 2003 08:33
Assunto: ENC: Submision paper

-----Mensagem original-----
De: godoy@nova.edu [mailto:godoy@nova.edu]
Enviada em: domingo, 30 de novembro de 2003 23:48
Para: sinhoret@fop.unicamp.br
Assunto: Re: Submision paper

I received your paper and will send it to two reviewers for their comments.

I will contact you immediately after I hear from them.

Sincerely,

Prof. Dr. Franklin Garcia-Godoy
Editor

Quoting "Mario Alexandre C. Sinhoreti" <sinhoret@fop.unicamp.br>:

> Dr. Franklin García-Godoy, Editor
> American Journal of Dentistry <?XML:NAMESPACE PREFIX = O />
>
> College of Dental Medicine
>
> Nova Southeastern University
>
> 3200 South University Drive
>
> Fort Lauderdale, FL 33328
> U.S.A.
>
> I would like to submit my manuscript: "In vitro evaluation of
> wear and superficial roughness of different materials used as fissure
> sealants after toothbrushing" to American Journal of Dentistry. This
> manuscript has not been published in any form or any language and is only
> submitted to the American Journal of Dentistry.
>
> Sincerely,

Anexo 7: Comprovante de recebimento do artigo "*In vitro* evaluation of microleakage of different materials used as fissure sealants" para avaliação.

Yahoo! Mail - vanpardi@yahoo.com.br Página 1 de 1

YAHOO! Mail Yahoo! - Meu Yahoo! - Ajuda Imprimir - Fechar janela

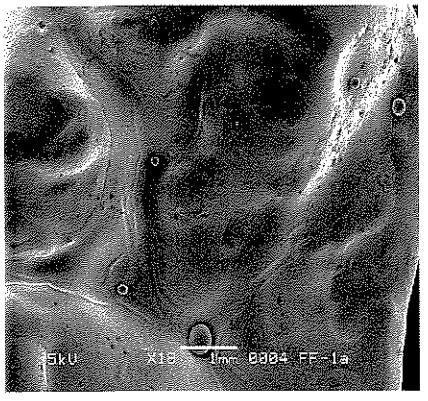
Data: Thu, 8 Jan 2004 10:11:02 -0500
De: "George White" <george.white@tufts.edu>
Para: "Vanessa Pardi" <vanpardi@yahoo.com.br>
Assunto: Re: Manuscript submission

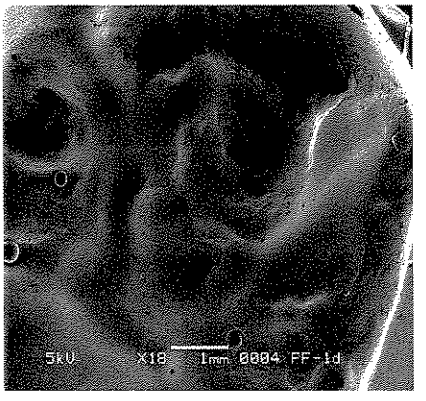
We have received your email and will send it to the reviewers.
Quoting Vanessa Pardi <vanpardi@yahoo.com.br>:

> Dear Dr. Geroge White
> I would like to submit the article "In vitro evaluation of microleakage of
> different materials used as fissure sealants" to The Journal of Clinical
> Pediatric Dentistry.This manuscript has not been published in any form or any
> language and is only submitted to JCPD.
> Best wishes
> Vanessa Pardi
>
>
>
>
>
> ---
> Central anti-spam do Yahoo! Mail: com dicas, dúvidas e curiosidades!
>

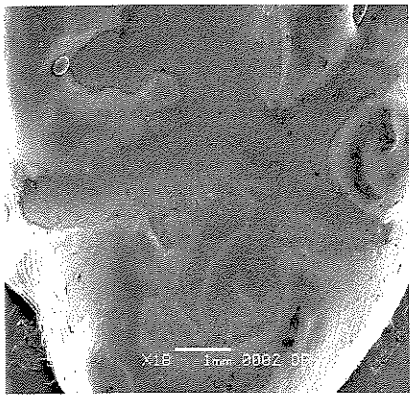
Anexo 8: Escores relacionados à avaliação de desgaste (Capítulo 3).

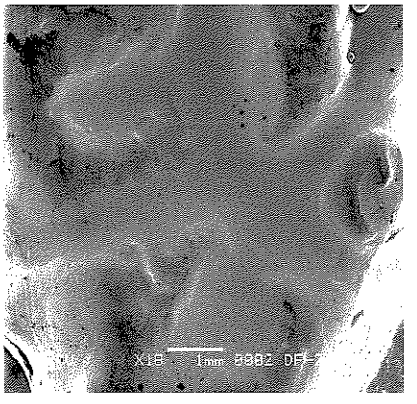
Escore 1: Polimento da superfície sem alteração das margens.





Escore 2: Polimento da superfície com alteração das margens.





Escore 3: Perda de material em algum ponto das fóssulas e fissuras.