RESISTENCIA ADHESIVA Y NIVEL DE FRACASO EN ESMALTE, UTILIZANDO ESTRATEGIAS ADHESIVAS DE AUTOGRABADO VS. GRABADO TOTAL EN CEMENTACIÓN DE DIFERENTES TIPOS DE BRACKETS. REVISIÓN SISTEMÁTICA

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“La Universidad El Bosque, no se hace responsable de los conceptos emitidos por los investigadores en su trabajo, solo velará por el rigor científico, metodológico y ético del mismo en aras de la búsqueda de la verdad y la justicia”.

GUÍA DE CONTENIDO

RESUMEN

RESISTENCIA ADHESIVA Y NIVEL DE FRACASO EN ESMALTE, UTILIZANDO SISTEMAS DE AUTOGRABADO VS. GRABADO TOTAL EN CEMENTACIÓN DE DIFERENTES TIPOS BRACKETS. REVISIÓN SISTEMÁTICA

Antecedentes: En la literatura existe controversia sobre los adhesivos que se deberían usar en el protocolo de cementación. Estudios afirman que los sistemas de grabado total producen mejores patrones de grabado sobre esmalte; otros reportan que los adhesivos autograbadores no suelen ser efectivos cuando se adhieren sobre esmalte. Contrario a lo anterior, también se menciona que ambos sistemas producen una adecuada adhesión a esmalte.

Objetivo: Evaluar la resistencia adhesiva y el nivel de fracaso en diferentes tipos de brackets, al utilizar estrategias adhesivas de grabado total y autograbado.

Metodología: Revisión sistemática. Se realizó una búsqueda en las bases de datos PubMed, Cochrane, LILACS, Google Scholar, Science Direct y EMBASE. Se utilizaron términos MeSH, DeCS, palabras clave y operadores booleanos; se incluyeron ensayos clínicos aleatorizados que evaluaran la resistencia adhesiva y/o nivel de fracaso en diferentes tipos de brackets, utilizando sistemas de autograbado y grabado total en humanos con dentición permanente y esmalte sano. Sin restricción de idioma, publicados a partir del 2010 hasta marzo de 2021. Los artículos fueron seleccionados por título, resumen y texto completo. La calidad metodológica de los artículos fue evaluada utilizando la herramienta RoB2. Se diseñó una tabla para extraer la información más relevante de cada artículo.

Resultados: La estrategia de búsqueda inicial arrojó 1.830 artículos, se leyeron en texto completo 82 artículos, finalmente, se incluyeron 8 artículos. Un artículo mostró bajo riesgo de sesgo, seis moderado, y uno alto. Dos artículos analizaron la resistencia adhesiva, el artículo de mejor calidad metodológica no encontró diferencias entre ambos sistemas. Siete artículos evaluaron el nivel de fracaso, tampoco encontraron diferencias estadísticamente significativas. Dos artículos evaluaron el índice de remante adhesivo, el adhesivo residual en esmalte fue menor con autograbador.

Conclusiones: El autograbador tiene la misma eficacia que el grabado total, teniendo en cuenta que la resistencia adhesiva necesaria en esmalte puede ser suficiente para mantener los brackets temporalmente. El sistema autograbador podría generar menor daño durante la descementación, ya que el adhesivo remanente fue menor en esta superficie. Basado en las limitaciones y la calidad metodológica de los estudios, se recomienda tomar con cautela los resultados presentados.

Palabras clave: resistencia adhesiva, nivel de fracaso, brackets, autograbador, grabado total

ABSTRACT

ADHESIVE RESISTANCE AND FAILURE LEVEL OF ENAMEL USING SELF-ETCHING SYSTEMS VS TOTAL ETCH ON CEMENTATION OF DIFFERENT TYPES OF BRACKETS. SYSTEMATIC REVIEW

Background: There is controversy regarding adhesives used for cementation. Studies report that total etch systems generate better patterns on the enamel, others report that self-etching adhesives are not as effective and some report that both have adequate adhesion. **Objective:** to evaluate adhesive resistance and failure level on different types of brackets using total etch and self-etching systems. **Methodology:** It was a systematic revision with a database search in PubMed, Cochrane, LILACS, Google Scholar, Science Direct and Embase, using MeSH, DeCS, key words and Boolean operators. It included randomised clinical trials that evaluated the objective on humans with permanent dentition and healthy enamel, no language restriction and published between 2010 and March 2021. The articles were selected by title, abstract and full text. The methodological quality was evaluated using RoB2 and a table was designed for the relevant information of each article. **Results:** The initial search yielded 1830 articles, 82 with full text were read and finally eight were included. Once had low bias risk, six moderate and one high. Two analysed adhesive resistance, seven-failure level but did not present statistically significant differences, two evaluated remnant adhesive index and it was shown to be less on the enamel with the self-etching. **Conclusions:** The self-etching has the same efficacy as total etch, taking into consideration that the resistance may be enough to hold brackets temporarily. The self-etching system could generate less damage during de-cementation due to the less amount on the surface. Based on the limitations and methodological quality of the studies, the results presented should be taken with caution.

Key words: adhesive resistance, failure level, brackets, self-etching, total etch.

1. Introducción

El concepto de adhesión al esmalte fue introducido por Michael Buonocore en 1955, es a partir de esto que los materiales adhesivos han empezado a revolucionar muchos aspectos de la odontología. En 1979, se describió por primera vez la adhesión de los brackets al esmalte dental por medio de diferentes técnicas de adhesión (Monteiro, J. B., et el., 2018).
Con el tiempo los adhesivos dentales han ido evolucionando desde sistemas de grabado total hasta sistemas de autograbado, que han ido simplificando sus pasos operatorios, dando como resultado la disminución en el tiempo clínico de los procedimientos odontológicos. Sin embargo, se desconoce si al utilizar sistemas simplificados se pueda obtener buenos resultados en la adhesión (Sofan, E, et al., 2017) (Monteiro, J. B., et el., 2018).

Se sabe que la colocación de brackets en ortodoncia requiere de un adecuado protocolo adhesivo, para que estos se mantengan en el tiempo unidos a la superficie del esmalte y se pueda llevar a cabo un correcto tratamiento, sin embargo, existen ciertos hallazgos que generan controversia sobre la fuerza de unión. Varios estudios confirman que el grabado total produce un mejor patrón de grabado sobre esmalte cuando los comparamos con autograbadores; mientras que otros estudios informan que los autograbadores y el grabado total producen buena adhesión a esmalte, así mismo, se afirma que los autograbantes no suelen ser tan efectivos sobre esmalte (Dallel, I., et al, 2019) (Muñoz, C. S., 2014) (Villarreal, L. A.,2018).

Por todo lo mencionado anteriormente, hasta la fecha, no se sabe con claridad qué técnica es mejor para lograr una correcta unión del bracket al diente, debido a que existen diferentes materiales adhesivos que han venido simplificando sus pasos y que se encuentran disponibles en el mercado. Si bien es cierto, existe literatura que ha investigado sobre el tema, pero no existen estudios actualizados que informen sobre el mejor sistema de adhesión en ortodoncia. Por lo que, sigue siendo difícil para el ortodoncista elegir el mejor sistema adhesivo para que los brackets se mantengan adheridos durante el tratamiento, y que además, estos soporten las fuerzas producidas durante el tratamiento ortodóntico o cualquier otro tipo de fuerza que tenga que soportar la aparatología fija como las inducidas por los alimentos durante la masticación. (Dallel, I., et al, 2019) (Ferreto, I., et al, 2016).

2. Antecedentes

Historia de la adhesión:

La odontología adhesiva comenzó en 1955 por Buonocore sobre los beneficios del grabado ácido. Con las tecnologías cambiantes, los adhesivos dentales han evolucionado desde sistemas de no grabado al grabado total (cuarta y quinta generación) a sistemas de auto-grabado (sexta, séptima y octava generación) (Sofan, E., et al., 2017).

Actualmente, la unión a sustratos dentales se basa en tres estrategias diferentes: 1) lavado fuerte, 2) autograbado y 3) enfoque de ionómero de vidrio modificado con resina para poseer las propiedades únicas de autoadherencia al tejido dental. Más recientemente, se ha introducido una nueva familia de adhesivos de dentina (adhesivos universales o multimodales), que se pueden usar como adhesivos de grabado y enjuague o como adhesivos de autograbado (Sofan, E., et al., 2017).

Definición de la adhesión:

Los brackets de ortodoncia están sujetos a una gran cantidad de fuerzas en la boca, lo que resulta en una distribución compleja de tensiones dentro del adhesivo y sus uniones con la superficie del diente y la base del bracket (Mandall, N. A., et al., 2016).

Idealmente el adhesivo debe ser:

- Lo suficientemente fuerte como para mantener los brackets unidos a los dientes para la duración del tratamiento y no tan fuerte como para que la superficie del diente se dañe cuando se retira el bracket.
- Fácil de usar clínicamente.
- Proteger contra la caries dental.
- Estar disponible a un costo razonable (Mandall, N. A., et al., 2016).

Con los avances de las técnicas adhesivas, los odontólogos han sido capaces de ser mucho más conservadores con los procedimientos odontológicos, antes de que se conozca sobre adhesión, los odontólogos se veían obligados a ser menos conservadores, ya que se necesitaban cavidades muy grandes para lograr retención. Todos estos avances han sido útiles e indispensables para el área estética y restauradora, ya que se puede hablar de una odontología mucho más moderna.

(Sofan, E., et al., 2017).

Componentes de la adhesión:

La composición química de los adhesivos incluye iniciadores de curado, inhibidores o estabilizadores, disolventes y, en algunos casos, rellenos inorgánicos (Sofan, E., et al., 2017).

Los adhesivos actualmente disponibles para la unión de brackets a los dientes son aquellos con una composición de resina / matriz, y materiales compuestos o modificados que pueden fijarse por reacción química dentro del adhesivo (autocurado) o esto puede activarse al aplicar una luz azul al adhesivo (fotocurado) (Mandall, N. A., et al., 2016).

Grabado total:

Definición de Grabado total:

La evolución de los sistemas adhesivos se ha enfocado en simplificar los protocolos disminuyendo el tiempo y los pasos de aplicación. Con base a esto, existen actualmente dos tendencias sobre el manejo del smear layer o capa residual, la técnica de grabado total, es la técnica más popular, en donde se utiliza acondicionamiento ácido y lavado con agua para desmineralizar el sustrato dental y eliminar el smear layer. Posteriormente, una combinación de agentes imprimadores y adhesivos en un solo componente conllevan a la formación de la capa híbrida (Van Meerbeek,B., et al.,2011).

Descripción de la técnica:

El grabado total utiliza ácido fosfórico, el proceso de grabado se realiza tanto en el esmalte como en la dentina. Se aplica gel de ácido fosfórico al 37% a la superficie del esmalte que se unirá durante 30 segundos, seguido de un enjuague con agua de 10 segundos y un secado al aire de 5 segundos. Después del ataque químico, se aplicó una capa delgada y uniforme de imprimación hidrófila a la superficie del esmalte grabado, posterior a esto se aplica el adhesivo a la base del soporte de los brackets , luego se posicionan los brackets en los dientes. El operador puede hacerlo con un posicionador de brackets, luego se polimerizaron durante 20 segundos en la superficie mesial y 20 segundos en distal. (Dorminey, J.,et al.,2003).

Unión a esmalte:

Cuando ya se completa la desmineralización del esmalte, los primers se encargan de transformar la superficie dental hidrofílica en hidrofóbica para lograr la unión de la resina adhesiva. Estos agentes tienen en su composición monómeros polimerizables con propiedades hidrofílicas disueltos en acetona, agua y/o etanol, los cuales, sirven para transportar los monómeros a través del tejido grabado.
Aquellos sistemas adhesivos que tienen solventes orgánicos volátiles como acetona y etanol, tienen la capacidad para apartar el agua remanente, facilitando la penetración de los monómeros polimerizables a través de las microporosidades generadas por el grabado ácido en esmalte, dentro de los túbulos dentinarios abiertos y a través de los nanoespacios de la red colágena en la dentina (Mandri, M., et al, 2015).

Algunas de las ventajas incorporadas con el grabado total mediante ácido fosfórico fueron: incrementar el área de contacto superficial, aumentar la energía superficial para mejorar la humectabilidad sobre la superficie del adherente, facilitar la formación de las interdigitaciones de resina (resin tags) y aumentar la retención micromecánica, logrando valores de resistencia de unión de aproximadamente 31 MPa (Parra Lozada, M., 2012).

El ácido fosfórico se encarga de activar la superficie del esmalte, desmineraliza y disuelve la matriz orgánica de hidroxiapatita, formando microporos y microsurcos. Una técnica de grabado adecuada produce mayor adaptación a paredes cavitarias, disminución de filtración marginal, disminución en pigmentación superficial. La desmineralización producida por ácidos ataca estructuras inorgánicas por una relación ácido base, forman sales solubles de fosfato cálcico posteriormente eliminadas por agua. (Henostroza, H.,2003). Este tipo de grabado es un método efectivo de adhesión, que se encarga de diluir los cristales de hidroxiapatita y formar dos tipos de micro-tags: el primero, alrededor de los prismas y el segundo, por infiltración de resina dentro de los pequeños poros del prisma (Manuja N, 2012).

La unión micro-mecánica es la base de la mayor parte de la odontología adhesiva contemporánea, ésta, depende del relieve de las superficies de esmalte para permitir la penetración del adhesivo que lo entrelaza en los espacios de la superficie. El relieve de la superficie se crea mediante grabado ácido. La penetración se produce en dos niveles, el primero implica la formación de micro-tags de resina alrededor de los prismas del esmalte; el segundo implica una penetración mucho más fina de los nano-tags entre los cristales de esmalte. Los nano-tags parecen ser mucho más importantes para la retención general y se pueden imaginar como un mecanismo de nanointerdigitación (Marshall, S. J., et al, 2010).

Ventajas:

La principal ventaja de esta técnica es que incrementa el área de contacto superficial, aumenta la energía superficial, mejora la humectabilidad sobre la superficie del diente, facilita la formación de las interdigitaciones de resina y aumentar la retención micro-mecánica (Vinagre, A., et al, 2016)

Desventajas:

La principal desventaja de esta técnica es la sensibilidad postoperatoria después de colocar restauraciones compuestas posteriores ha sido un problema experimentado. También se tiene que tener en cuenta la pérdida irreversible del esmalte y además es una técnica de múltiples pasos lo cual nos indica que si falla alguno de estos, falla la adhesión (Van Meerbeek,B., et al.,2011).

Autograbado

Historia:

El concepto de autograbado se introdujo a finales del año 1990, sin embargo, la primera y la segunda generación de agentes de unión se pueden considerar materiales de autograbado porque no se usó ninguna etapa de grabado ácido, enjuague o acondicionamiento. Estas primeras generaciones de adhesivos de dentina utilizaron dimetacrilato de ácido glicerofosfórico, cebadores a base de éster halofosporoso de Bis-GMA o HEMA, que se aplicaron a dentina no condicionada (Giannini, M., et al., 2015).

La sexta generación de sistemas de adhesivos dentales que se introdujeron a fines de la década de 1990 y principios de la década de 2000, eliminaron el paso de grabado con ácido. Surgieron dos tipos de adhesivos pertenecientes a esta generación, aquellos con un primer autoestable y otro con adhesivo y los que combinan acondicionador, primer y adhesivo, pero requieren mezcla (Bagherian, A., 2016).

Sistemas de séptima generación que fueron introducidos en 2002, se basan en un sistema de botellas individuales en el que el grabado, la imprimación y la adhesión se producen en un solo paso. La reducción en el número de pasos puede conducir a menores posibilidades de errores de procedimiento, menos tiempo junto al sillón y resultar en una mayor comodidad para el paciente (Bagherian, A., 2016) (Aman, N., et al., 2015).

Definición de autograbadores:

Los sistemas autograbadores, eliminan el paso del grabado ácido, realizando el grabado simultáneo del sustrato dentario y su acondicionamiento para recibir el adhesivo, empleando imprimadores auto-grabadores y mezclas de adhesivos con imprimadores, generando retención micromecánica en los tejidos duros, permitiendo la unión directamente sobre el smear layer que cubre la dentina. Este nuevo sistema se diferencia de los adhesivos de grabado y lavado en varios aspectos como su pH inicial, el tipo de monómeros acídicos, el número de frascos, y pasos, la concentración de agua y solventes e hidrofilicidad de la capa de unión.

En esta técnica se utilizan diversos ácidos para modificar, romper o solubilizar el smear layer y, aunque los restos no se lavan como en los sistemas de grabado total, todavía permiten una interacción adhesiva directa con el sustrato de dentina y esmalte. Para ambos enfoques, la retención micromecánica es el mecanismo básico de adhesión al esmalte y la dentina (Sofan, E., et al., 2017).

Materiales utilizados en la técnica

Los sistemas adhesivos de autograbado en dos etapas incluyen el uso de un imprimador de grabado hidrofílico, que combina monómeros ácidos que graban simultáneamente e imprimen al sustrato dental y después de la evaporación del solvente, una capa de agente hidrófobo y adhesivo sella la dentina. Los sistemas adhesivos de autograbado en un solo paso son adhesivos todo en uno, que combinan el grabado, la imprimación y la adhesión que contienen monómeros funcionales ácidos, monómeros hidrófilos e hidrófobos, agua y disolventes orgánicos en una sola solución (Giannini, M., et al., 2015).

Ventajas:

La principal ventaja de estos autograbadores es la eliminación de los pasos de enjuague y secado, lo que reduce la posibilidad de humedecimiento o secado excesivo, ya que cualquiera de estos puede afectar la adhesión (Bagherian, A., 2016).

Debido a que los sistemas de adhesivo de autograbado no requieren realizar acondicionamiento ácido separado con un enjuague posterior, se consideran materiales adhesivos simplificados. Ofrecen algunas ventajas sobre los sistemas convencionales de grabado y enjuague, como la reducción de la sensibilidad postoperatoria y la técnica menos sensible. Otra ventaja es que la infiltración de la resina adhesiva tiende a ocurrir simultáneamente con el proceso de autograbado, aunque existen algunas controversias (Giannini, M., et al., 2015).

Desventajas:

La principal desventaja de los autograbadores es que no graban el esmalte al igual que el ácido fosfórico, y el sellado de los márgenes del esmalte puede verse comprometido (Bagherian, A., 2016).

Una de las principales desventajas del sistema de séptima generación es que utiliza una mezcla de componentes hidrófobos e hidrofílicos en un mismo frasco lo que hace que los componentes sean susceptibles a la separación de fases y a la formación de burbujas dentro de sus capas adhesivas (Bagherian, A., 2016).

Unión a esmalte:

El esmalte dental es un tejido de origen ectodermal altamente calcificado y con un elevado contenido de materia inorgánica (95%), está constituido por cristales de hidroxiapatita, fluoruro y formas carbonatadas, a su vez posee calcio y fosfato en altas concentraciones. El contenido orgánico es de un 3% y el de agua aún menor un 2%. La naturaleza inorgánica del esmalte le confiere un aspecto translúcido, debido a ello el color adamantino proviene de la dentina subyacente (Zambrano, F. R. R., 2008).

El esmalte se constituye micro-morfológicamente de los llamados “prismas mineralizados del esmalte”, éstos poseen una zona central y una zona periférica compuesta por el material interprismático, existen zonas del diente carentes de prismas como lo son la capa superficial, ya que no todos los prismas alcanzan esta zona, la región cervical de los dientes permanentes y también en las fosas y fisuras de los dientes temporales (Zambrano, F. R. R., 2008). El ácido está contenido en el adhesivo ácido. No se aplica ni se lava grabador de ácido fosfórico.

Grabado ácido sobre el esmalte dental:

La adhesión al esmalte se logra a través del grabado ácido, este procedimiento aumenta sustancialmente el área de superficie para la adhesión, transformando una superficie lisa en irregular con una alta energía superficial. Además, crea una microcapa porosa de unos 5 a 50 um de profundidad, este proceso genera tres patrones de grabado: tipo I: en donde existe predominante disolución de los cuerpos del prisma, tipo II: en el cual hay predominante disolución de la periferia de los prismas y tipo III: en el cual no son evidentes ningunas estructuras prismáticas. Los patrones tipo I y tipo II se pueden dar en un mismo diente y en una misma zona bien sea superpuestos o separados, lo cual ocurre de manera arbitraria (Zambrano, F. R. R., 2008).

El efecto del grabado ácido sobre el esmalte depende de múltiples factores: el tipo y la concentración del ácido usado, el tiempo de grabado y de lavado del ácido, la forma del agente de grabado (gel, semigel o solución acuosa), composición química y condición del esmalte, si el esmalte es de dientes temporales o permanentes, si el esmalte es prismático o aprismático y si el esmalte esta fluoridizado, desmineralizado o pigmentado, también puede influir si el esmalte es cortado antes del grabado. El tejido adamantino superficial e intacto provee de un sustrato insuficiente para la adhesión, ya que esta recubierto por una superficie aprismática, con una capa orgánica y cubierta por placa bacteriana, ello hace necesaria su remoción antes de la fase de grabado ácido, de esta manera se logra solubilizar los prismas superficiales y se crea una superficie excelente para la adhesión (Zambrano, F. R. R., 2008).

En la actualidad se utiliza generalmente el ácido ortofosfórico como agente de grabado, en una concentración que varía del 32 al 37% y aplicado por 15-60 seg. Si el tiempo de grabado supera los 60 segundos se genera un patrón de grabado adamantino inadecuado, ya que la precipitación mineral del esmalte eliminado provoca una disminución en la profundidad de los microporos a unos 2-8 um, esto interfiere de manera negativa con la adhesión. El tiempo de grabado ácido es un factor determinante en el éxito clínico de la adhesión al esmalte. Al día de hoy, la técnica de grabado ácido sobre el esmalte dental, ha demostrado ser un procedimiento clínico confiable y duradero, utilizado rutinariamente en la odontología restauradora contemporánea (Zambrano, F. R. R., 2008).

Adhesivos de autograbado:
La necesidad de reducir el número de pasos clínicos y así disminuir las probabilidades de error en la manipulación y en la aplicación de los adhesivos dentales, ha dado lugar al desarrollo de los sistemas adhesivos de autograbado, los cuales pueden comercializarse en múltiples presentaciones (Zambrano, F. R. R., 2008).

Los sistemas adhesivos de autograbado poseen monómeros de resina polimerizables que no ameritan del lavado con spray de agua, estos monómeros incluyen grupos ácidos como ésteres de fosfato o ácidos carboxílicos, unidos a los componentes del agente imprimador (HEMA). La función de los monómeros ácidos consiste en ejercer la acción del grabado ácido y del imprimador, produciendo la desmineralización de los tejidos dentales a la vez que humecta el sustrato y prepara los tejidos para la posterior infiltración de los monómeros de resina (Zambrano, F. R. R., 2008).

Existen dos presentaciones comerciales de los adhesivos de autograbado según sea la estrategia de adhesión, pueden ser de dos pasos o de un paso. En la primera generación de sistemas de autograbado que se introdujeron en el mercado, se utilizaban siguiendo dos pasos clínicos. El primero consistía en la aplicación de un agente acondicionador no lavable sobre el tejido dental que generalmente se deja actuar durante 15 - 30 segundos y el segundo paso clínico consistía en la aplicación propiamente del adhesivo (Zambrano, F. R. R., 2008).

La segunda generación de adhesivos de autograbado son los denominados todo en uno, en donde el agente acondicionador, el primer y el adhesivo se presentan en dos envases, los cuales se deben mezclar antes de su aplicación para activar química y físicamente los componentes. Por lo tanto, desde el punto de vista clínico, amerita solo un paso, que consiste en la aplicación directa de una o múltiples capas del adhesivo sobre el tejido dental a tratar (Zambrano, F. R. R., 2008).

Dependiendo de la agresividad de los monómeros ácidos contenidos en los adhesivos de autograbado, recientemente han sido clasificados como “fuertes” y “medios o moderados”. Los fuertes poseen un pH de 1 o menor, éstos poseen una alta capacidad desmineralizadora de los tejidos similar a la conseguida con el sistema de grabado ácido. Los moderados poseen un pH de +/- 2, en donde la profundidad de la desmineralización que provocan es menor, 1 micra, sin embargo, crean suficiente superficie microporosa capaz de brindar una adecuada microrretención (Zambrano, F. R. R., 2008).

Situación actual de los sistemas adhesivos:

Hoy en día, los brackets se unen rutinariamente a los dientes con las mejoras continuas en las características adhesivas, se sabe que la adhesión es fuerte, pero requiere de varios pasos en la ejecución. El grabado total en el esmalte se realiza con ácido ortofosfórico al 37%, y es un paso importante en la unión directa de los brackets al esmalte. Sin embargo, la técnica adhesiva igualmente requiere de tiempo y un control adecuado de la humedad, por esto se vio la necesidad de hacer sistemas de unión que sean más simples, confiables, biocompatibles y fáciles de usar. Por lo que, sirvió como precursor para el desarrollo de materiales que podrían grabarse, imprimarse y adherirse en un solo paso (Velo, S., et al, 2002).

Se han introducido y reemplazado varios productos, con el objetivo de lograr materiales adhesivos superiores con enfoques de unión más efectivos (Soares, F. Z. M., et al, 2016). Para minimizar el número de pasos y reducir el tiempo en el sillón, se desarrollaron los autograbadores, que combinan el acondicionamiento y el primer en un solo paso, evitando el grabado con ácido. El sistema autoadhesivo no solo tiene monómeros ácidos que desmineralizan e infiltran el sustrato dental, lo que produce una retención micromecánica, sino que también es capaz de formar una adhesión química con el esmalte, los metales y los materiales compuestos (Velo, S., et al, 2002).

Actualmente, se sabe que aún existe controversia debido a que el ortodoncista no sabe qué sistema adhesivo utilizar en su práctica profesional para obtener buenos resultados adhesivos y así poder generar fuerzas sobre los brackets sin que estos se descementen durante el tratamiento. Ahora bien, al comparar la fuerza de adhesión de los sistemas de autograbado en esmalte y en dentina, también existe debate al respecto, ya que es bien conocido que los adhesivos autograbantes funcionan muy bien en dentina, pero al utilizarlos en esmalte sus propiedades de adhesión disminuyen, debido a la profundidad del poro logrado por el grabado en un solo paso, el cual es notoriamente menor que el logrado en el grabado total, siendo esto totalmente desfavorable para un ortodoncista que únicamente realiza adhesión de brackets sobre esmalte dental. (Hara, A. T., et al, 1999).

Por otro lado, se conoce que los adhesivos convencionales conocidos como grabado total proporcionan una alta fuerza de unión en esmalte. Sin embargo, debemos recordar que en Ortodoncia la correcta adhesión es necesaria, pero, se debe considerar que esta unión es temporal y los brackets deberán ser removidos al final del tratamiento (Boruziniat, A., et al, 2015).

Ha sido establecido en la literatura que el valor promedio de la fuerza adhesiva requerida para que exista una retención micro-mecánica suficiente que permita la unión física entre el adhesivo y el esmalte sin lesionar el tejido adamantino en el momento de la remoción de los brackets es de 20MPa (Keizer, et al, 1976, Pickett, et al, 2001). Sin embargo, diferentes autores han establecido para la adhesión ortodóntica valores menores, de 5.9 – 7.8 MPa y de 6-9 MPa para soportar fuerzas biomecánicas (Scougall, 2010). En los artículos que evalúan la fuerza adhesiva al usar diferentes métodos de grabado se han obtenido diversos resultados, en todos se observa una menor fuerza de adhesión con el uso de autograbadores en comparación con el grabado con ácido ortofosfórico al 37%, así como la extensión en que la resina penetra en el esmalte es menor pero la mayoría coinciden en que la fuerza adhesiva, a pesar de ser menor, alcanza los niveles requeridos para establecer una unión adecuada, incluso cuando algunos autores afirman que el uso de auto grabadores disminuye hasta 30-65% con respecto al grabado acido, la mayoría de la literatura establece como grandes ventajas tener menor esmalte dental disuelto, disminución en la sensibilidad, menor tiempo de trabajo en consulta, menos requerimientos de aislamiento por los componentes hidrofílicos del ácido del auto grabador y un valor de fuerza adhesiva promedio adecuado para lograr una correcta adhesión (Chu C.H., et al., 2010) (Bhandari D., et al., 2019) (Aguilar, A.G., et al, 2013).

Para el nivel de fracaso, no hubo diferencias estadísticamente significativas en los dos sistemas, lo cual sugiere una eficacia similar entre ellos. A pesar de no encontrar diferencias estadísticamente significativas (Ousehal, L., 2016) recomienda usar autograbado ya que presenta ciertas ventajas ergonómicas y ahorro de tiempo en silla; sin embargo, también refiere que su inconveniente principal sería el costo de este frente a un sistema de grabado total

La mayoría de estos artículos como Mirzakouchaki, B., 2016 y Farhadian, N., 2019 han realizado pruebas experimentales in vitro, con parámetros no estandarizados, utilizando en pocas ocasiones variables que simulen el ambiente oral y el tiempo de tratamiento promedio de un tratamiento ortodóntico, razón por la cual deben realizarse mayores investigaciones que tengan en cuenta estos aspectos y de ser posible, estudios in vivo que comparen los dos métodos de grabado (Mirzakouchaki, B., et al., 2016) (Farhadian, N., et al., 2019)

Actualmente, existen gran variedad de casas comerciales promocionando diferentes sistemas adhesivos, supuestamente con las mejores características. Lamentablemente, la mayoría de ortodoncistas no cuentan con los conocimientos suficientes sobre las características que debería tener un sistema para producir óptimos resultados de adhesión; por lo que, resulta complejo para ellos elegir la técnica correcta. Por lo tanto, eligen sistemas que les brindan ventajas como menor tiempo de aplicación; sin que esto esté directamente relacionado con que sea la mejor técnica adhesiva. Esta revisión sistemática tiene como finalidad ayudar al ortodoncista a elegir un sistema que brinde la mayor cantidad de ventajas posibles, donde, la principal característica tenga que ver con una excelente resistencia adhesiva que permita que el tratamiento ortodóntico no se vea afectado. Es por esto, que este estudio pretende evaluar la resistencia adhesiva y el nivel de fracaso en diferentes tipos de brackets, al utilizar las estrategias adhesivas de grabado total y autograbador .

3. Objetivos

Objetivo general:

Evaluar la resistencia adhesiva y el nivel de fracaso en diferentes tipos de brackets, al utilizar las estrategias adhesivas de grabado total y autograbador, a través de una revisión sistemática de la literatura.

Objetivos específicos:

1. Comparar la resistencia adhesiva en diferentes tipos de brackets, al usar grabado total vs. autograbador.
2. Comparar el nivel de fracaso en diferentes tipos de brackets, al usar grabado total vs. autograbador.

4. Metodología para el desarrollo de la revisión:

a. Tipo de estudio:

Revisión sistemática para encontrar la mejor evidencia disponible y resolver la pregunta sobre qué estrategia adhesiva (grabado total o autograbado) genera mayor resistencia adhesiva en esmalte.

b. Métodos

1. *Pregunta de la revisión:*

¿Existen diferencias en la resistencia adhesiva a esmalte, al utilizar estrategias adhesivas de grabado total y autograbado y cuál es su nivel de fracaso al cementar diferentes tipos de brackets?

2. Estructura de la revisión:

- Introducción / Objetivo
- Materiales y métodos
  - Criterios de selección
  - Medición de resultados
  - Estrategia de búsqueda
  - Selección de estudios y extracción de datos
  - Evaluación de la calidad metodológica de los estudios
  - Síntesis de datos
- Resultados
- Discusión
- Conclusiones

3. Búsqueda de información:

Protocolo y registro:

Esta revisión se estructuró de acuerdo a las directrices de PRISMA, Cochrane Handbook for Systematic Reviews of Interventions y el Check Review checklist. El protocolo de esta revisión sistemática fue registrado en el Instituto Nacional de Investigaciones en Salud PROSPERO, Registro Internacional Prospectivo de Revisiones Sistemáticas (https://www.crd.york.ac.uk/prospero/#myprospero, bajo el número de registro CRD42021234212).

Estrategia de búsqueda:

Los artículos fueron buscados sin restricción de lenguaje, se aplicaron filtros de fecha de publicación desde el 2010 hasta marzo de 2021. Se tuvieron en cuenta aquellos artículos que comparaban la resistencia adhesiva en esmalte dental y/o nivel de fracaso utilizando estrategias adhesivas de grabado total vs autograbado, en la cementación de diferentes tipos de brackets. La búsqueda de artículos se realizó en diferentes bases de datos como: PubMed, Cochrane, LILACS, Google Scholar, Science Direct y EMBASE. Para la búsqueda se utilizaron términos MeSH (Medical Subjet Headings), palabras clave, operadores booleanos y literatura gris.

a. Selección de palabras claves por temática:

Tabla 1.- SELECCIÓN DE PALABRAS CLAVES POR TEMÁTICA DE REVISIÓN		
Temática	Resistencia adhesiva y nivel de fracaso entre grabado total y autograbado en la cementación de diferentes tipos de brackets	
Variable	**Palabras claves**	
FUERZA ADHESIVA	Palabra clave	Adhesive strength
	Términos [MeSH] Inglés	Dental Bonding
	Términos [Desc] Español/ inglés/ portugués	Fuerza adhesiva
	Sinónimos/ Términos relacionados	Bond strength
NIVEL DE FRACASO	Palabra clave	Bracket failure
	Términos [MeSH] Inglés	Bracket failure
	Términos [Desc] Español/ inglés/ portugués	Nivel de fracaso Falla de brackets

	Sinónimos/ Términos relacionados	Tasa de falla
GRABADO TOTAL	Palabra clave	Total etch
	Términos [MeSH] Inglés	Acid etching dental
	Términos [Desc] Español/ inglés/ portugués	Sin resultados
	Sinónimos/ Términos relacionados	Conventional etch
AUTOGRABADO	Palabra clave	Self etch
	Términos [MeSH] Inglés	Sin resultados
	Términos [Desc] Español/ inglés/ portugués	Sin resultados
ESMALTE	Palabra clave	Enamel
	Términos [MeSH] Inglés	Enamel, Dental Dental Enamels
	Términos [Desc] Español/ inglés/ portugués	Esmalte dentario
ORTODONCIA	Palabra clave	Orthodontics
	Términos [MeSH] Inglés	Sin resultados
	Términos [Desc] Español/ inglés/ portugués	Ortodoncia Correctiva Aparatos ortodónticos fijos
	Sinónimos/ Términos relacionados	Brackets

b. Estructuración de estrategia de búsqueda por temática

Tabla 2.-ESTRATEGIA DE BÚSQUEDA	
Temática	Resistencia adhesiva entre grabado total y autograbado
# 1	(adhesive strength) OR (dental bonding) OR (bond strength)
# 2	(bracket failure)
# 3	(total etch) OR (acid etching dental) OR (conventional etch)
# 4	(self-etch)
# 5	#1 AND #2 AND #3 AND #4 (((adhesive strength) OR (dental bonding) OR (bond strength)) AND ((total etch) OR (acid etching dental) OR (conventional etch) AND (self-etch) AND (bracket failure))

# 6	(enamel) OR (enamel dental) OR (dental enamels)
# 7	(orthodontics) OR (brackets)
# 8	#6 AND #7 (((enamel) OR (enamel dental) OR (dental enamels)) AND ((orthodontics) OR (brackets)))
# 9	#5 AND #8 (((adhesive strength) OR (dental bonding) OR (bond strength)) AND (bracket failurel) AND ((total etch) OR (acid etching dental) OR (conventional etch)) AND ((self-etch) AND (enamel) OR (enamel dental) OR (dental enamels)) AND ((orthodontics) OR (brackets)))

c. Resultados de aplicación de estrategia de búsqueda por temática en bases de datps (PubMed, Cochrane LILACS, Google Scholar, EMBASE, Science Direct)

Tabla 3.- Resultados de la aplicación de la estrategia de búsqueda por Temática PUBMED, Cochrane, LILACS, EMBASE, Google Scholar y Science Direct			
Temática	Resistencia adhesiva entre grabado total y autograbado		
Búsqueda	Algoritmos	Artículos encontrados	Artículos seleccionados
# 1	(adhesive strength) OR (dental bonding) OR (bond strength)	436.319	
# 2	(bracket failure)	130.006	
# 3	(total etch) OR (acid etching dental) OR (conventional etch)	110.711	
# 4	(self-etch)	41.912	
# 5	#1 AND #2 AND #3 (adhesive strength) OR (dental bonding) OR (bond strength) AND (total etch) OR (acid etching dental) OR (conventional etch) AND (self-etch)	18.209	
# 6	(enamel) OR (enamel dental) OR (dental enamels)	64.447	
# 7	(orthodontics) OR (brackets)	981.036	
# 8	#5 AND #6	8.986	

	(((enamel) OR (enamel dental) OR (dental enamels)) AND ((orthodontics) OR (brackets)))		
#9	#4 AND #7 ((adhesive strength) OR (dental bonding) OR (bond strength)) AND ((total etch) OR (acid etching dental) OR (conventional etch)) AND ((self-etch)) AND ((enamel) OR (enamel dental) OR (dental enamel)) AND ((orthodontics) OR (brackets))	1.826	8

d. Preselección de artículos por temática

Tabla 4.- PRESELECCIÓN DE ARTÍCULOS POR TEMÁTICA	
Temática	Resistencia adhesiva entre grabado total y autograbado
Base de datos	PubMed, Google Scholar, LILACS, Cochrane, EMBASE, Science Direct
Algoritmo final	((adhesive strength) OR (dental bonding) OR (bond strength)) AND ((total etch) OR (acid etching dental) OR (conventional etch)) AND ((self-etch)) AND ((enamel) OR (enamel dental) OR (dental enamel)) AND ((orthodontics) OR (brackets))
ARTÍCULOS PRESELECCIONADOS **Referencia y abstract**	
Farhadian N, Miresmaeili A, Zandi VS. Shear Bond Strength of Brackets Bonded with Self-Etching Primers Compared to Conventional Acid-Etch Technique: A Randomized Clinical Trial. Front Dent. 2019 Jul-Aug;16(4):248-255. doi: 10.18502/fid.v16i4.2083. Epub 2019 Aug 30. PMID: 32342053; PMCID: PMC7181350.	

Objectives: The purpose of this randomized clinical trial (RCT) was to compare the shear bond strength (SBS) of orthodontic brackets bonded to enamel with conventional acid-etch (AE) technique and self-etching primers (SEP). Materials and Methods: Twenty-two patients, requiring extraction of two bicuspids for orthodontic reasons, were recruited. In each individual, following blinding and allocation concealment, one intact premolar received conventional AE, whereas the contralateral premolar received SEP with a split-mouth design. Bonded brackets remained in the oral cavity for two months. Afterward, the teeth were extracted without debonding the brackets. SBS and adhesive remnant index (ARI) were measured using a Universal Instron machine and a stereomicroscope, respectively. Results: The mean SBS of the conventional AE and SEP groups was 9.53 and 9.20 MPa, respectively. Paired t-test showed no statistically significant difference between the two groups ($P=0.096$). Comparison of ARI between the two groups, using Wilcoxon test, indicated that significantly less adhesive remained on enamel with brackets bonded with SEP compared to brackets bonded with conventional AE ($P<0.001$) although the SBS was higher in the AE group. Conclusion: The present study indicated that although there is no significant difference in SBS between SEP and conventional AE for bonding orthodontic metal brackets, the amount of residual adhesive on the enamel surface is significantly less with SEP than with conventional AE.
Nogawa H, Koizumi H, Saiki O, Hiraba H, Nakamura M, Matsumura H. Effect of a self-etching primer and phosphoric acid etching on the bond strength of 4-META/MMA-TBB resin to human enamel. Dent Mater J. 2015;34(2):219-26. doi: 10.4012/dmj.2014-227. Epub 2015 Feb 24. PMID: 25740168. The purpose of this study was to evaluate the shear bond strength and durability of 4-META/MMA-TBB resin to human enamel. A self-etching primer that contained 4-META (Teeth Primer, TP) and 35–45% or 60–65% concentrations of phosphoric acid (K-Etchant Gel, KE, and Super Bond C&B Red Activator, RA) were used as the surface treatment agents. A methyl methacrylate (MMA)-based self-polymerizing resin (Super-Bond C&B) was used as a luting agent. The shear bond strength was determined both pre and post thermocycling. The results were statistically analyzed with a non-parametric procedure. The post-thermocycling shear bond strength of the TP group was significantly higher than that of other groups, and that of the KE group was significantly higher compared with the RA group. These results demonstrated that 4-META was effective. Furthermore, when the degree of tooth demineralization was compared, surface treatment with less demineralization using TP was the most effective treatment.
Sachdeva A, Raghav S, Goel M, Raghav N, Tiwari S. A comparison of the shear bond strength of conventional acid etching, self-etching primer, and single bottle self-adhesive - An *In vitro* study. Indian J Dent Sci 2017;9:170-5

Background: Bonding of brackets to enamel has been a critical issue in orthodontic research since the significance of achieving a stable bond between the tooth and its bracket was obvious from the onset. This study aimed to determine the shear bond strength (SBS) of self-adhesive system, to compare SBS of conventional etchant, self-etching prime and self-adhesive system under dry condition, and to estimate the chair-side time saved for the application of the bonding agents.
Mavreas D, Cuzin JF, Boonen G, Vande Vannet B. The effect of various adhesives, enamel etching, and base treatment on the failure frequency of customized lingual brackets: a randomized clinical trial. Eur J Orthod. 2018 May 25;40(3):249-253. doi: 10.1093/ejo/cjx055. PMID: 29016985. Summary Objectives: The aim of this paper was to compare failure differences in precious metal customized lingual brackets bonded with three adhesive systems. Also, differences in failure of non-precious metal brackets with and without a silicatized base layer bonded with the same adhesive, as well as the influence of enamel etching prior to using a self-etching dual cure resin were explored. Materials/methods: Five different groups were defined in a semi-randomized approach. Group 1 (IME): Maxcem Elite with 378 Incognito brackets and etched teeth, Group 2 (IMNE): Maxcem Elite with 193 Incognito brackets on non-etched teeth, Group 3 (INE): Nexus+Excite with 385 Incognito brackets, Group 4 (IRE): Relyx with 162 Incognito brackets, Group 5 (HRME) and Group 6 (HNRME): Maxcem Elite with 182 Harmony brackets with silicatized and non-slicatized bases respectively. Bracket failures were recorded over a 12-month period.Results: The number of failures during the observation period was small in the various adhesives types of groups, as well as in HRME and HNRME groups, and the comparisons among those groups were non-significant (*P* > 0.05). A statistically significant difference (*P* < 0.05) was found between the IME and IMNE groups. Conclusions: 1. During the first year of treatment customized lingual brackets failure frequencies (rates) are not different for the three adhesive materials tested. 2. Eliminating the etching stage when using self-etch/self-adhesive adhesives, may lead to a dramatic increase in the failure rates. 3. Silicoating of stainless steel customized lingual brackets does not seem to influence the failure of the bonds.
Turk T, Elekdag-Turk S, Isci D, Cakmak F, Ozkalayci N. Shear bond strength of a self-etching primer after 10,000 and 20,000 thermal cycles. J Adhes Dent. 2010 Apr;12(2):117-22. doi: 10.3290/j.jad.a17540. PMID: 20157670. Abstract: Purpose: To determine the effects of thermocycling on shear bond strengths (SBSs) of a self-etching primer (SEP) after 10,000 and 20,000 thermal cycles. The tested hypothesis was that 10,000 and 20,000 thermal cycles would affect the bond strength of metal brackets bonded to enamel with the self-etching primer. Materials and Methods: Brackets were bonded to bovine incisors with two etching protocols. In group CM (conventional method), teeth were etched with 37% phosphoric acid for 30 s. In group SEP, a self-etching primer (Transbond Plus, 3M Unitek) was applied. Brackets were bonded with light-curing adhesive (Transbond XT, 3M Unitek). The SBSs were determined after water storage at 37°C for 24 h, after 10,000 and 20,000 cycles of thermocycling.

Results: For both groups (CM and SEP), SBSs decreased with 10,000 and 20,000 thermal cycles. These decreased SBSs were significantly different from the values obtained with no thermocycling. Highest SBSs were observed with no thermocycling for groups CM and SEP (18.6 and 18.0 MPa, respectively). These values were not statistically different from each other. Lowest SBSs were obtained with 10,000 and 20,000 thermal cycles for group SEP (14.2 and 14.7 MPa, respectively). These values were significantly different from all other SBSs. Conclusion: This study indicates that the SEP (Transbond Plus) provides clinically acceptable bond strength values compared with the conventional method after 10,000 and 20,000 thermal cycles.
Sorake A, Rai R, Hegde G, Suneja R, Kumar N, Skaria J. Comparison of Shear Bond Strength of New Self-etching Primer with Conventional Self-etching Primers: An In-vitro Study. J Int Oral Health. 2015 Jul;7(7):17-21. PMID: 26229365; PMCID: PMC4513770. Background: In the past few years, there has been a major research drive to increase bond strength between dental materials and dental hard tissue and to reduce the associated demineralization around fixed orthodontic appliances. Thus, a recent approach is to incorporate an antibacterial agent into the primer to reduce the demineralization and enhance bond strength. The objective of this study was: (1) To evaluate the shear bond strength of orthodontic preadjusted edgewise appliance brackets bonded to extracted premolar teeth with antimicrobial self-etch primer (Reliance self-etching primer, Clearfil Protect Bond) and self-etching primer without antimicrobial agent (Clearfil SE bond). (2) To compare the mean shear bond strength values of the tested materials to conventional self-etching primer Transbond Plus. Materials and Methods: A total of 125 extracted human premolar teeth were randomly divided into five groups of 25 teeth each. Each sample was embedded in an acrylic block of polymethyl meth acrylate resin till coronal portion. Instron testing machine model LR LOYD 50 K was used for testing the shear bond strength of individual samples. Results: The results of the study showed that all five groups had adequate clinically acceptable bond strength. In intergroup comparison, there was statistically significant difference in bond strength of Reliance self-etching primer, Promt L pop, Clearfil Protect Bond, clearfil SE bond and Transbond Plus. Conclusion: Reliance self-etching primer showed highest bond strength, followed by Clearfil Protect Bond, clearfil SE bond, and Transbond Plus. Clearfil Protect Bond primer containing methacryloxy dodecyl pyridium bromide have been demonstrated to kill *Streptococcus mutans* within a short time of contact and also exhibits an inhibitory effect on the growth of bacteria on its surface. Conclusion: Reliance self-etching primer showed highest bond strength, followed by Clearfil Protect Bond, clearfil SE bond, and Transbond Plus. Clearfil Protect Bond primer containing methacryloxy dodecyl pyridium bromide have been demonstrated to kill *Streptococcus mutans* within a short time of contact and also exhibits an inhibitory effect on the growth of bacteria on its surface.
Cerone, M. *Enamel Bond Strength of Self-Etching Adhesives to Orthodontic Brackets: An In Vitro Study* (Doctoral dissertation).2017.

Abstract (summary): Background: Self-etch adhesives, which have combined the acidic monomer, primer and adhesive resin into one bottle, have been extensively tested on dentin and cut-enamel; however, very limited studies test their performances on uncut enamel. Objective: To assess their shear bond strength(SBS) on uncut enamel bonded to orthodontic brackets. Methods:160 premolars were divided into four groups: SU(Scotchbond™ Universal Adhesive), BU(All-Bond Universal), CU(Clearfil Universal Bond), the control total-etch adhesive, C(Adper™ Scotchbond™ Multi-Purpose Adhesive). Following storage in distilled water(24 h/6 months), they were tested for SBS, adhesive remnant index(ARI) and percentage of remaining resin(%RR). Data was analyzed by one-way ANOVA and Student-t test(α =0.05). Results: C group had the highest SBS, ARI and mean %RR. BU group had the lowest SBS. SBS and ARI decreased over time for SU and BU, but remained stable for CU and there was no difference in %RR. Conclusion: None of the self-etch adhesives achieved the recommended SBS for orthodontic treatment.
Shafiei F, Sardarian A, Fekrazad R, Farjood A. Comparison of shear bond strength of orthodontic brackets bonded with a universal adhesive using different etching methods. Dental Press J Orthod. 2019 Sep 5;24(4):33.e1-33.e8. doi: 10.1590/2177-6709.24.4.33.e1-8.onl. PMID: 31508704; PMCID: PMC6733226. Objective: The aim of this study was to compare the effects of three enamel etching modes - laser-etch, self-etch and acid-etch (5, 10 and 15 s) - on bracket bonding, using a universal adhesive. Methods: Eighty-four maxillary premolars were randomly divided into seven groups (n=12) based on the etching method and the adhesive used for bracket bonding. After water storage and thermocycling, shear bond strength was measured, and adhesive remnant index scores on debonded enamel were determined. Results: There were significant differences between the seven groups regarding bond strength values (p< 0.001). The highest values were observed in universal adhesive with laser etching group, while Transbond XT with acid or laser etching, and universal adhesive used in self-etch mode demonstrated the lowest bond strength. The universal adhesive with the three different etching times presented with statistically similar results, all showing an improvement in bond strength, compared with Scotchbond universal (SBU)/SE. Conclusions: The universal adhesive evaluated in the present study demonstrated statistically similar bond strengths to conventional orthodontic adhesive in self-etch mode. The bond strength can be improved by adding an initial acid etching or laser conditioning step, although enamel damage was observed in some cases.
Hellak A, Ebeling J, Schauseil M, Stein S, Roggendorf M, Korbmacher-Steiner H. Shear Bond Strength of Three Orthodontic Bonding Systems on Enamel and Restorative Materials. Biomed Res Int. 2016;2016:6307107. doi: 10.1155/2016/6307107. Epub 2016 Sep 21. PMID: 27738633; PMCID: PMC5050387.

Objective. The aim of this in vitro study was to determine the shear bond strength (SBS) and adhesive remnant index (ARI) score of two self-etching no-mix adhesives (iBond™ and Scotchbond™) on different prosthetic surfaces and enamel, in comparison with the commonly used total etch system Transbond XT™. Materials and Methods. A total of 270 surfaces (1 enamel and 8 restorative surfaces,) were randomly divided into three adhesive groups. In group 1 (control) brackets were bonded with Transbond XT primer. In the experimental groups iBond adhesive (group 2) and Scotchbond Universal adhesive (group 3) were used. The SBS was measured using a Zwicki 1120™ testing machine. The ARI and SBS were compared statistically using the Kruskal–Wallis test (). Results. Significant differences in SBS and ARI were found between the control group and experimental groups. Conclusions. Transbond XT showed the highest SBS on human enamel. Scotchbond Universal on average provides the best bonding on all other types of surface (metal, composite, and porcelain), with no need for additional primers. It might therefore be helpful for simplifying bonding in orthodontic procedures on restorative materials in patients. If metal brackets have to be bonded to a metal surface, the use of a dual-curing resin is recommended.
Alkis H, Turkkahraman H, Adanir N. Microleakage under orthodontic brackets bonded with different adhesive systems. Eur J Dent. 2015 Jan-Mar;9(1):117-121. doi: 10.4103/1305-7456.149656. PMID: 25713494; PMCID: PMC4319287. Objective: This in vitro study aimed to compare the microleakage of orthodontic brackets between enamel-adhesive and adhesive-bracket interfaces at the occlusal and gingival margins bonded with different adhesive systems. Materials and Methods: A total of 144 human maxillary premolar teeth extracted for orthodontic reasons was randomly divided into four groups. Each group was then further divided into three sub-groups. Three total-etching bonding systems (Transbond XT, Greengloo and Kurasper F), three one-step self-etching bonding systems (Transbond Plus SEP, Bond Force and Clearfil S3), three two-step self-etching bonding systems (Clearfil SE Bond, Clearfil Protectbond and Clearfil Liner Bond), and three self-adhesive resin cements (Maxcem Elite, Relyx U 100 and Clearfil SA Cement) were used to bond the brackets to the teeth. After bonding, all teeth were sealed with nail varnish and stained with 0.5% basic fuchsine for 24 h. All samples were sectioned and examined under a stereomicroscope to score for microleakage at the adhesive–enamel and adhesive–bracket interfaces from both occlusal and gingival margins. Statistical Analysis Used: Statistical analyses were performed with Kruskal–Wallis and Wilcoxon signed-rank tests. Results: The results indicate no statistically significant differences between the microleakage scores of the adhesives; microleakage was detected in all groups. Comparison of the average values of the microleakage scores in the enamel–adhesive and adhesive–bracket interfaces indicated statistically significant differences ($P < 0.05$). The amount of the microleakage was higher at the enamel–adhesive interface than at the bracket-adhesive interface.

Conclusions:

All of the brackets exhibited some amount of microleakage. This result means that microleakage does not depend on the type of adhesive used.

Fleming PS, Johal A, Pandis N. Self-etch primers and conventional acid-etch technique for orthodontic bonding: a systematic review and meta-analysis. Am J Orthod Dentofacial Orthop. 2012 Jul;142(1):83-94. doi: 10.1016/j.ajodo.2012.02.023. PMID: 22748994.

Introduction

The use of self-etch primers has increased steadily because of their time savings and greater simplicity; however, overall benefits and potential disadvantages and harms have not been assessed systematically. In this study, we reviewed randomized controlled trials to assess the risk of attachment failure, bonding time, and demineralization adjacent to attachments between 1-stage (self-etch) and 2-stage (acid etch) bonding in orthodontic patients over a minimum follow-up period of 12 months.

Methods

Data sources were electronic databases including MEDLINE, EMBASE, the Cochrane Oral Health Group's Trials Register, and CENTRAL, without language restrictions. Unpublished literature was searched on ClinicalTrials.gov, the National Research Register, and Pro-Quest Dissertation Abstracts and Thesis database. Authors were contacted when necessary, and reference lists of the included studies were screened. Search terms included randomized controlled trial, controlled clinical trial, random allocation, double-blind method, single-blind method, orthodontics, self-etch, SEP, primer, and bonding agent. Randomized clinical trials directly comparing self-etch and acid-etch primers with respect to the predefined outcomes and including patients with full-arch, fixed, and bonded orthodontic appliances (not banded) with follow-up periods of at least 12 months were included. Using predefined forms, 2 authors undertook independent data extraction with conflict resolution by the third author. Randomized clinical trial quality assessment based on the Cochrane Risk of Bias tool was also used.

Results

Eleven studies met the inclusion criteria; 6 were excluded because of a high risk of bias. In total, 1721 brackets bonded with acid-etch and 1723 with self-etch primer techniques were included in the quantitative synthesis. Relatively low statistical and clinical heterogeneity was observed among the 5 randomized clinical trials (n = 3444 brackets) comparing acid-etch with self-etch primers. A random effects meta-analysis demonstrated a tendency for a higher risk of failure (odds ratio, 1.35; 95% CI, 0.99-1.83; P = 0.06) with self-etch primers. A small but statistically significant time saving was also associated with the self-etch primer technique (weighted mean difference, 23.2 seconds per bracket; 95% CI, 20.7-25.8; P <0.001). There was insufficient evidence to assess the effect of bonding modality on demineralization rates.

Conclusions

There is weak evidence indicating higher odds of failure with self-etch primer than acid etch over 12 months in orthodontic patients, and there is strong evidence that a self-etch primer is likely to result in a modest time savings (8 minutes for full bonding) compared with acid etch
Torres, L. S., Alves, L. A. C., Fava, M., & Di Nicoló, R. Effects of thermomechanical and thermocycling on the shear bond strength of brackets to bovine enamel bonded with conventional and self-etching adhesive systems. Brazilian Dental Science. 2015. 18(3), 98-106. Abstract Several adhesive systems have been developed in the last decade. The aim of the current study was to evaluate the shear bond strength of orthodontic brackets bonded with conventional primers or self-etching primers, artificially aged by means of thermocycling and thermomechanical procedures.90 bovine incisors were used in the investigation. The roots were sectioned in the amelo-cementary junction. All samples were randomly divided in 2 groups (n= 45), according to the primer used for bracket bonding. XT Group–hydrophobic conventional primer (Transbond XT, 3M unitek, Monrovia, Calif); SEP Group –self-etching primer (Transbond Plus SEP, 3 M Unitek, Monrovia, Calif). All specimens were bonded with XT Transbond resin adhesive (3 M Unitek, Monrovia, Calif). A Universal Testing Machine EMIC DL2000 (EMIC Equip. Sist. Ensaio Ltda., São José dos Pinhais, PR, Brazil) was used for the collection of the values of SBS resistance. The results of the current study were: (Prompt L-Pop 1.72±0.13 MPa; Clearfil SE Bond 1.75±0.19 MPa; FL Bond 1.71±0.22 MPa; One-Up Bond 1.77±0.14 MPa; XT Control 10.5±0.86 MPa). In conclusion: the number of cycles in thermal and thermo mechanical cycling did not influence shear bond strength values for any of the primers tested;SEP Transbond Plus showed the greatest values for bond strength of orthodontic brackets.
Vinagre, Alexandra R., et al. Effect of time on shear bond strength of four orthodontic adhesive systems." Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial 55.3 . 2014. 142-151. Abstract Objectives To evaluate the shear bond strength (SBS) of orthodontic brackets bonded to enamel with four adhesive systems tested at three time periods. Methods A 180 cross sections of human premolars were randomly assigned into four groups according to the adhesive system used: Concise™ (G1), Transbond™ XT (G2), Transbond™ Plus Self-Etching Primer (TBS) (G3) and Heliosit®Orthodontic (G4). SBS was tested by producing bracket debonding after 15 min of bonding, after 24 h and after 24 h plus 500 cycles of thermocycling (TC). Bond failure was determined with the modified adhesive remnant index (ARI) and composite resin cements, conditioned enamel surfaces and adhesive interfaces were observed by scanning electron microscopy (SEM). Results

Two-way ANOVA determined no interaction between time or time and TC on the behavior of the adhesive systems (F = 0.372, p = 0.896). Post-bonding time induced a statistically significant increase in SBS (F = 37.447, p < 0.01), whereas thermocycling did not influence SBS (t = 0.608, p = 0.544). Adhesive systems **were** only different at 15 min (F = 4.75, p = 0.005). ARI scores revealed differences between groups when the test was performed after 24 h and after 24 h + TC. Groups 1, 3 and 4 showed differences along testing periods. SEM observations revealed that TBS produced a more irregular, shallow structure with less defined indentations of enamel prisms than phosphoric acid. Conclusions Regardless of the adhesive system, SBS were significantly higher at 24 h after bracket bonding procedure than after 15 min. The self-etching primer tested can successfully be used for bracket bonding. The thermocycling protocol did not affect shear bond strengths.
Suzuki T, Takamizawa T, Barkmeier WW, Tsujimoto A, Endo H, Erickson RL, Latta MA, Miyazaki M. Influence of Etching Mode on Enamel Bond Durability of Universal Adhesive Systems. Oper Dent. 2016 Sep-Oct;41(5):520-530. doi: 10.2341/15-347-L. Epub 2016 Jun 28. PMID: 27351078. Influence of Etching Mode on Enamel Bond Durability of Universal Adhesive Systems T Suzuki; T Takamizawa; WW Barkmeier; A Tsujimoto; H Endo; RL Erickson; MA Latta; M Miyazaki Oper Dent (2016) 41 (5): 520–530. SUMMARY The purpose of this study was to determine the enamel bond durability of three universal adhesives in different etching modes through fatigue testing. The three universal adhesives used were Scotchbond Universal, Prime&Bond Elect universal dental adhesive, and All-Bond Universal light-cured dental adhesive. A single-step self-etch adhesive, Clearfil S3 Bond Plus was used as a control. The shear bond strength (SBS) and shear fatigue strength (SFS) to human enamel were evaluated in total-etch mode and self-etch mode. A stainless steel metal ring with an internal diameter of 2.4 mm was used to bond the resin composite to the flat-ground (4000-grit) tooth surfaces for determination of both SBS and SFS. For each enamel surface treatment, 15 specimens were prepared for SBS and 30 specimens for SFS. The staircase method for fatigue testing was then used to determine the SFS of the resin composite bonded to the enamel using 10-Hz frequencies for 50,000 cycles or until failure occurred. Scanning electron microscopy was used to observe representative debonded specimen surfaces and the resin-enamel interfaces. A two-way analysis of variance and the Tukey post hoc test were used for analysis of the SBS data, whereas a modified t-test with Bonferroni correction was used for the SFS data. All adhesives in total-etch mode showed significantly higher SBS and SFS values than those in self-etch mode. Although All-Bond Universal in self-etch mode showed a significantly lower SBS value than the other adhesives, there was no significant difference in SFS values among the adhesives in this mode. All adhesives showed higher SFS:SBS ratios in total-etch mode than in self-etch mode. With regard to the adhesive systems used in this study, universal adhesives showed higher enamel bond strengths in total-etch mode. Although the influence of different etching modes on the enamel-

bonding performance of universal adhesives was found to be dependent on the adhesive material, total-etch mode effectively increased the enamel bond strength and durability, as measured by fatigue testing.
Sreedhara S, Savakkanavar MB, Rajesh RN, et al. Effect of Self-etch Primer-adhesive and Conventional Adhesive Systems on the Shear Bond Strength and Bond Failure of Orthodontic Brackets: A Comparative Study. The Journal of Contemporary Dental Practice. 2015 Feb;16(2):130-134. DOI: 10.5005/jp-journals-10024-1649.   BACKGROUND:Prompt-L-Pop is a sixth generation bonding system contains methacrylated phosphoric acid esters that combine an acidic component for etching the enamel and a primer, is an all-in-one adhesive. This study was undertaken to compare the bonding strength of brackets to enamel with traditional bonding technique and the new Prompt-L-Pop system using the same composite resin. MATERIALS AND METHODS:In this in vitro experimental study, 60 human premolar teeth extracted for orthodontic treatment were collected. The samples were randomly divided into three groups comprising of 20 teeth in each group. Shear bond strength and ARI scores for the specimens were measured. Comparison was done using one way ANOVA and Chi-square test. RESULTS:Fourth generation bonding adhesive system depicted similar bond strength to fifth generation bonding adhesive system. Both fourth and fifth generation exhibited higher shear bond strength as compared to sixth generation bonding adhesive system. CONCLUSION:Fourth and fifth generation exhibited higher shear bond strength as compared to sixth generation bonding adhesive system but the sixth generation has clinically acceptable shear bond strength. Also, it was found that sixth generation leaves less residual adhesive on the tooth after bracket removal.
Zope A, Zope-Khalekar Y, Chitko SS, Kerudi VV, Patil HA, Bonde PV, Jaltare P, Dolas SG. Comparison of Self-Etch Primers with Conventional Acid Etching System on Orthodontic Brackets. J Clin Diagn Res. 2016 Dec;10(12):ZC19-ZC22. doi: 10.7860/JCDR/2016/18842.9031. Epub 2016 Dec 1. PMID: 28208997; PMCID: PMC5296570.   **Introduction**   The self-etching primer system consists of etchant and primer dispersed in a single unit. The etching and priming are merged as a single step leading to fewer stages in bonding procedure and reduction in the number of steps that also reduces the chance of introduction of error, resulting in saving time for the clinician. It also results in smaller extent of enamel decalcification.   Aim   To compare the Shear Bond Strength (SBS) of orthodontic bracket bonded with Self-Etch Primers (SEP) and conventional acid etching system and to study the surface appearance of teeth after debonding; etching with conventional acid etch and self-etch priming, using stereomicroscope.   Materials and Methods   Five Groups (n=20) were created randomly from a total of 100 extracted premolars. In a control Group A, etching of enamel was done with 37% phosphoric acid and bonding of stainless steel brackets with Transbond XT (3M Unitek, Monrovia, California). Enamel conditioning in left over four Groups was done with self-etching primers and

adhesives as follows: Group B-Transbond Plus (3M Unitek), Group C Xeno V+ (Dentsply), Group D-G-Bond (GC), Group E-One-Coat (Coltene).

The Adhesive Remnant Index (ARI) score was also evaluated. Additionally, the surface roughness using profilometer were observed.

Results

Mean SBS of Group A was 18.26±7.5MPa, Group B was 10.93±4.02MPa, Group C was 6.88±2.91MPa while of Group D was 7.78±4.13MPa and Group E was 10.39±5.22MPa respectively. In conventional group ARI scores shows that over half of the adhesive was remaining on the surface of tooth (score 1 to 3). In self-etching primer groups ARI scores show that there was no or minor amount of adhesive remaining on the surface of tooth (score 4 and 5). SEP produces a lesser surface roughness on the enamel than conventional etching. However, statistical analysis shows significant correlation ($p<0.001$) of bond strength with surface roughness of enamel.

Conclusion

All groups might show clinically useful SBS values and Transbond XT can be successfully used for bracket bonding after enamel conditioning with any of the SEPs tested. The SEPs used in Groups C (Xeno V+) and D (G-Bond) have significantly lowered SBS. Although, the values might still be clinically acceptable.

Hellak A, Rusdea P, Schauseil M, Stein S, Korbmacher-Steiner HM. Enamel shear bond strength of two orthodontic self-etching bonding systems compared to Transbond™ XT. J Orofac Orthop. 2016 Nov;77(6):391-399. English. doi: 10.1007/s00056-016-0046-0. Epub 2016 Aug 31. PMID: 27582286.

Objective

The aim of this in vitro study was to compare the shear bond strength (SBS) and Adhesive Remnant Index (ARI) scores of two self-etching no-mix adhesives (Prompt L-Pop™ and Scotchbond™) for orthodontic appliances to the commonly used total etch system Transbond XT™ (in combination with phosphoric acid).

Materials and methods

In all, 60 human premolars were randomly divided into three groups of 20 specimens each. In group 1 (control), brackets were bonded with Transbond™ XT primer. Prompt L-Pop™ (group 2) and Scotchbond™ Universal (group 3) were used in the experimental groups. Lower premolar brackets were bonded by light curing the adhesive. After 24 h of storage, the shear bond strength (SBS) was measured using a Zwicki 1120 testing machine. The adhesive remnant index (ARI) was determined under 10× magnification. The Kruskal–Wallis test was used to statistically compare the SBS and the ARI scores.

Results

No significant differences in the SBS between any of the experimental groups were detected (group 1: 15.49 ± 3.28 MPa; group 2: 13.89 ± 4.95 MPa; group 3: 14.35 ± 3.56 MPa; $p = 0.489$), nor were there any significant differences in the ARI scores ($p = 0.368$).

Conclusions

Using the two self-etching no-mix adhesives (Prompt L-Pop™ and Scotchbond™) for orthodontic appliances does not affect either the SBS or ARI scores in comparison with the commonly used total-etch system Transbond™ XT. In addition, Scotchbond™ Universal supports bonding on all types of surfaces (enamel, metal, composite, and porcelain) with no need for additional primers. It might therefore be helpful for simplifying bonding in orthodontic procedures.
Lamper T, Ilie N, Huth KC, Rudzki I, Wichelhaus A, Paschos E. Self-etch adhesives for the bonding of orthodontic brackets: faster, stronger, safer? Clin Oral Investig. 2014 Jan;18(1):313-9. doi: 10.1007/s00784-013-0942-2. Epub 2013 Feb 14. PMID: 23408192. Objectives This study aimed to evaluate the performance of accelerating procedures for bonding of orthodontic brackets in vitro by comparing different adhesives (etch-and-rinse, self-etch) and polymerization procedures (curing devices, time). The performance was characterized by three parameters: (1) the bond strength achieved, (2) the incidence of enamel damage, and (3) the extent of residual composite on the tooth. Materials and methods Bracket bonding was performed on 500 extracted human teeth after application of either an etch-and-rinse adhesive or a one-step self-etch adhesive. Two different two-component self-etch adhesives (Clearfil SE and Transbond Plus) and two single-component self-etch adhesives (Ideal and iBond) were investigated after using different polymerization procedures (light-emitting diode for 10 or 20 s or plasma arc curing device for 3 or 6 s). The bond strength, incidence of enamel damage, and extent of residual composite on the tooth were measured. Results Single-component self-etch adhesives gave the lowest bond strengths. No significant difference in bond strength could be detected between the two-component self-etch adhesives and the etch-and-rinse method. There was a 70.3 % risk for enamel damage at bond strengths above 12 MPa, but only 5 % risk below 12 MPa and no risk below 8.2 MPa. The risk of enamel damage increased by an odds ratio increment of 1.3 for each additional MPa above 8.2 MPa. Conclusion Single-component self-etch adhesives showed the lowest bond strengths, caused limited enamel damage, and generally left less residual composite on the tooth. Clinical relevance The nature of the adhesive greatly influences the resultant bond strength, the risk of enamel damage, and the extent of residual composite on the teeth.
Grabouski, J. "Shear Bond Strength of Orthodontic Brackets with Varying Bonding Protocols." (2016). Objectives: To assess in vitro shear bond strength (SBS), modified adhesive remnant index (ARI), and treated enamel surface textures of various bracket bonding techniques. Methods: Extracted human premolars (n=97) were randomly assigned to six groups and bonded using assigned protocols. SBS was measured using a universal

testing machine. Modified ARI was measured via optical stereomicroscopy. Etched enamel surface textures were qualitatively described using scanning electron microscopy (SEM). Results: There was a statistically significant interaction between bonding technique and bracket placement. Various significant differences were found between groups. All groups exhibited clinically acceptable means SBS. ARI measurements differed between bonding techniques for both maxillary and mandibular brackets. Conclusions: All tested methods exhibited clinically acceptable shear bond strengths. Pre-etching prior to the application of SEP may enhance the strength of brackets compared to SEP alone. Pretreatment of normal enamel surfaces with NaOCl for 1 minute may affect the mode of failure.
İşman E, Karaarslan ES, Okşayan R, Tunçdemır AR, Üşümez S, Adanir N, Cebe MA. Inadequate shear bond strengths of self-etch, self-adhesive systems for secure orthodontic bonding. Dent Mater J. 2012;31(6):947-53. doi: 10.4012/dmj.2012-103. PMID: 23207199. This study evaluated the shear bond strength (SBS) of a traditional orthodontic bracket bonding agent (Transbond XT) against two self-etch, self-adhesive systems (Maxcem Elite and Vertise Flow). Sixty premolar teeth and sixty brackets were randomly and equally divided into five groups: Transbond XT (TXT) as the control, Maxcem Elite (ME) without etching, ME with etching (ME/ Etch), Vertise Flow (VF) without etching, and VF with etching (VF/Etch). Respective SBS results of the five groups were 9.86±3.20, 4.67±2.94, 7.82±2.56, 2.55±0.77, and 7.89±1.17 MPa. SBS values of the new self-etch adhesive systems were significantly lower than the traditional etch-and-rinse control (*p*<0.005). However, no significant differences were found between TXT and the self-adhesives applied with etching (*p*>0.005). After debonding, ARI scores “0" and “1" were predominant in non-etched ME and VF groups. It was concluded that new self-etch, self-adhesive bonding systems require additional phosphoric acid application to achieve comparable SBS values as the traditional orthodontic bonding agent.
Sharma S, Tandon P, Nagar A, Singh GP, Singh A, Chugh VK. A comparison of shear bond strength of orthodontic brackets bonded with four different orthodontic adhesives. J Orthod Sci. 2014 Apr;3(2):29-33. doi: 10.4103/2278-0203.132892. PMID: 24987660; PMCID: PMC4077105. Objectives: The objective of this study is to compare the shear bond strength (SBS) of stainless steel (SS) orthodontic brackets bonded with four different orthodontic adhesives.

Materials and Methods: Eighty newly extracted premolars were bonded to 0.022 SS brackets (Ormco, Scafati, Italy) and equally divided into four groups based on adhesive used: (1) Rely-a-Bond (self-cure adhesive, Reliance Orthodontic Product, Inc., Illinois, USA), (2) Transbond XT (light-cure adhesive, 3M Unitek, CA, USA), (3) Transbond Plus (sixth generation self-etch primer, 3M Unitek, CA, USA) with Transbond XT (4) Xeno V (seventh generation self-etch primer, Dentsply, Konstanz, Germany) with Xeno Ortho (light-cure adhesive, Dentsply, Konstanz, Germany) adhesive. Brackets were debonded with a universal testing machine (Model No. 3382 Instron Corp., Canton, Mass, USA). The adhesive remnant index (ARI) was recordedIn addition, the conditioned enamel surfaces were observed under a scanning electron microscope (SEM). Results: Transbond XT (15.49 MPa) attained the highest bond strength. Self-etching adhesives (Xeno V, 13.51 MPa; Transbond Plus, 11.57 MPa) showed clinically acceptable SBS values and almost clean enamel surface after debonding. The analysis of variance (F = 11.85, P < 0.0001) and Chi-square (χ^2 = 18.16, P < 0.05) tests revealed significant differences among groups. The ARI score of 3 (i.e., All adhesives left on the tooth) to be the most prevalent in Transbond XT (40%), followed by Rely-a-Bond (30%), Transbond Plus with Transbond XT (15%), and Xeno V with Xeno Ortho (10%). Under SEM, enamel surfaces after debonding of the brackets appeared porous when an acid-etching process was performed on the surfaces of Rely-a-Bond and Transbond XT, whereas with self-etching primers enamel presented smooth and almost clean surfaces (Transbond Plus and Xeno V group). Conclusion: All adhesives yielded SBS values higher than the recommended bond strength (5.9-7–8 MPa), Seventh generation self-etching primer Xeno V with Xeno Ortho showed clinically acceptable SBS and the least amount of residual adhesive left on the enamel surface after debonding.
Boruziniat A, Khazaei Y, Motaghi S, Moghaddas M. Evaluation of bond strength of orthodontic brackets without enamel etching. J Clin Exp Dent. 2015 Oct 1;7(4):e519-23. doi: 10.4317/jced.52253. PMID: 26535100; PMCID: PMC4628808.

Background: To compare the shear bond strength of brackets with and without enamel etching. Material and Methods: In this study, 60 sound premolars were randomly divided into four different groups: 1- TXE group: Enamel etching+Transbond XT adhesive+ Transbond XT composite. 2- TXS group: Transbond plus self-etch adhesive+ Transbond XT composite. 3- PQ1E group: Enamel etching+ PQ1 adhesive+ Transbond XT composite. 4- PQ1 group: PQ1 adhesive+ Transbond XT composite. The shear bond strengths of brackets were evaluated using universal testing machine at cross head speed of 0.5 mm/min. The Adhesive Remnant Index (ARI) was also measured. One-way ANOVA, Tukey's post hoc, Kruskal-wallis and Mann-Witney U test were used for data analysis. Results: There was a significant difference between etched and unetched groups respect to SBS and ARI ($p<0.05$), however; no significant difference was observed between unetched group and self-etch adhesive group ($p>> 0.05$). The shear bond strength of PQ1 group was the least but in acceptable range and its ARI was less than other groups. Conclusions: PQ1 adhesive can be used for bracket bonding without enamel etching with adequate bond strength and minimal ARI.
John, J., Kumar, J., Kumar, K., Solanki, V., & Puttaswamy, V. An evaluation and comparison of the shear bond strength of two newly formulated primer systems with a conventional primer system under different conditions: An in vitro study. *APOS Trends in Orthodontics. 2015. 5*(6), 267-274. Abstract: Aims and Objectives This study was carried to evaluate the shear bond strength of brackets bonded with self-etching primer and moisture insensitive primer (MIP) and compare it with the conventional adhesive system. Materials and Methods: A total of 90 extracted human premolar teeth were selected and divided into three groups of 30 teeth each with two sub groups (dry and wet), of 15 teeth each. Each group was bonded with three different types of bonding systems namely visible light cure Clearfil Liner Bond 2V, MIP and Transbond XT. These groups were named SD, MD and CD in dry conditions and SW, MW and CW in wet condition and each of these groups were color coded. The shear bond strength of the bonding system in each group was tested using Universal testing machine Instron (Instron model:4206, Instron Corporation, USA). Results: In dry condition all three groups showed good bond strength. Self-etch primer showed the average highest bond strength, followed by Transbond XT and then MIP. In wet condition MIP has highest bond strength, followed by self-etching primer and Transbond XT. Conclusion: Under dry conditions conventional primer is the material of choice. Under wet conditions, MIP showed the highest bond strength and hence can be considered to be a material of choice.
Mirzakouchaki B, Kimyai S, Hydari M, Shahrbaf S, Mirzakouchaki-Boroujeni P. Effect of self-etching primer/adhesive and conventional bonding on the shear bond strength in metallic and ceramic brackets. Med

Oral Patol Oral Cir Bucal. 2012 Jan 1;17(1):e164-70. doi: 10.4317/medoral.17024. PMID: 21743430; PMCID: PMC3448178.

Abstract

Introduction: Bracket debonding from the tooth surface is a common problem in fixed orthodontics. The aims of e present study were to assess the bond strength and failure sites in two ways of bonding technique, with metallic d ceramic brackets. Material and Methods: One hundred premolars were assigned to 4 groups of 25 each: Group metallic brackets/ conventional procedure; Group B, metallic brackets/Transbond XT; Group C, ceramic ackets/conventional procedure; and Group D, ceramic brackets/Transbond XT. Transbond XT composite paste was sed for bracket bonding and cured by conventional light-cure device. Specimens were subjected to thermocycling. ne week after bonding shearing force was applied to the bracket-tooth interface. Bonding failure site optically amined using a stereomicroscope under 10 × magnifications and scoring was done using the adhesive remnant dex (ARI). Data were subjected to analysis of One-way variance, Tukey post hoc, Chi-square and Spearman's tests. esults: Mean bond strength (in MPa) were: group A=9.2, group B=8.5, group C=6.2 and group D=5.7. Bond strength fferences between groups A and B, and between C and D were not significant, (p<0.0005). Insignificant difference und in ARI in all groups. Conclusion: The bond strengths of metallic brackets were significantly higher than ceramic nes and the selfetching primer produce fewer bonds than the conventional method (clinically acceptable). A positive rrelation found between changes in shearing bond strength and ARI.

Shaik JA, Reddy RK, Bhagyalakshmi K, Shah MJ, Madhavi O, Ramesh SV. In vitro Evaluation of Shear Bond Strength of Orthodontic Brackets Bonded with Different Adhesives. Contemp Clin Dent. 2018 Apr-Jun;9(2):289-292. doi: 10.4103/ccd.ccd_15_18. PMID: 29875575; PMCID: PMC5968697.

Background: There is necessary of dry operating field for bonding of orthodontic brackets. The presence of moisture can alter the bond strength. Hence, the aim of the present study was to evaluate the shear bond strength of orthodontic brackets with different adhesives. Materials and Methods:In this *in vitro* study, a total of 100 orthodontically extracted premolars with sound crown structure were divided into 4 equal groups of different primers. Bonding on the buccal surface of all teeth was done after acid etching with upper premolar brackets using different primers followed by light curing. Shear bond strength was evaluated with or without salivary contamination with both adhesives. A shear force for deboning the bracket was done with universal testing machine. The debonded specimens were examined at ×10 magnification to check site of bond failure and remaining adhesive on tooth using adhesive remnant index (ARI). The obtained data were statistically evaluated using SPSS 20 for Windows (SPSS Inc., Chicago, IL, USA) using ANOVA, Kolmogorov–Smirnov, and Levene's test at the statistical significance of $P < 0.05$. Results: Transbond Plus showed higher shear bond strength of 8.92 MPa under dry and 5.65 MPa with saliva contamination over Transbond XT of 7.24 MPa under dry and 2.43 MPa with saliva contamination, respectively. Higher ARI score was found without contamination in both adhesives. Conclusion: Transbond Plus hydrophilic resin had good shear bond strength under both dry and contamination condition compared to hydrophobic Transbond XT resin material.
Iglesias A, Flores T, Moyano J, Artés M, Gil FJ, Puigdollers A. In Vitro Study of Shear Bond Strength in Direct and Indirect Bonding with Three Types of Adhesive Systems. Materials (Basel). 2020 Jun 10;13(11):2644. doi: 10.3390/ma13112644. PMID: 32531966; PMCID: PMC7321563. **Abstract:** This study aimed to compare the shear bond strength (SBS) and adhesive remaining index (ARI) using one conventional and two novel adhesive systems with clinical step reduction and direct and indirect bonding. A sample of 72 human premolars were divided into six groups of 12 samples. The first three groups (G1, G2, G3) were bonded with a direct technique, while the remaining groups (G4, G5, G6) were bonded by the indirect technique. Groups G1 and G4 used conventional acid-etching primer composite (XT); groups G2 and G5 used self-etching bonding (BO), and groups G3 and G6 had an acid-etching treatment followed by a self-adhesive composite (OC). All groups were exposed to thermocycling. Shear bond strength was analyzed with a universal test machine, and the ARI was examined with 4× magnification. The results showed statistically significant differences between the three adhesive systems. The highest strength values were observed in the XT group G1 (13.54 ± 4 MPa), while the lowest were shown in the BO G2 samples (5.05 ± 2 MPa). There was no significant difference between the direct or indirect bonding techniques on the three compared groups. The type of primer and bonding material significantly influenced the SBS. Values with self-etching bonding were below the minimum recommended for clinical use (5.9–7.8 MPa). There was no difference between indirect and direct bonding techniques. The lowest

ARI scores (0–1) were observed in both self-etching and BO groups. Further clinical studies are needed to compare in vivo results.
Tuncer C, Ulusoy Ç. Tensile bond strength of lingual orthodontic brackets with adhesive systems. World J Orthod. 2010 Winter;11(4):393-7. PMID: 21491007. **Abstract** Aim: To study in vitro the bond strength of three adhesive systems on lingual brackets. Methods: Forty-five extracted human mandibular premolars were randomly divided into three groups of 15 specimens each. All brackets (Stealth lingual brackets) were bonded with Transbond XT Light Cure Adhesive. In group 1, the conventional primer was used; in group 2, Transbond Moisture Insensitive Primer was employed; and in group 3, an antimicrobial self-etching primer (Clearfil Protect Bond) was used. Results: The highest mean bond strength values were observed when Clearfil Protect Bond (13.54 ± 0.58 MPa) was used and the lowest after applying the conventional Transbond XT primer (6.41 ± 0.43 MPa). The mean bond strength in group 2 was 8.20 ± 0.50 MPa, which was significantly higher than that of group 1. Conclusion: Besides its antimicrobial effect, Clearfil Protect Bond results in high bond strength values. Therefore, this product might be preferable when bonding lingual brackets.
Ousehal L, El Aouame A, Rachdy Z, Benkiran G. Comparison of the efficacy of a conventional primer and a self-etching primer. Int Orthod. 2016 Jun;14(2):195-205. doi: 10.1016/j.ortho.2016.03.005. Epub 2016 Apr 11. PMID: 27080598. Abstract Introduction: In orthodontic practice, the bonding protocol makes use of a primer between the bracket and the enamel surface to create a reliable bond. In order to optimize the technique and reduce bonding time, a new group of primers has been introduced in orthodontics: the self-etching primers (SEP). The aim of this work was to compare their efficacy with that of a traditional primer. Materials and method: This study is a single-center, single-blind, clinical trial using the SEP system on teeth 14 and 25 and the Ortho-Solo(®) system (traditional hydrophilic primer) on teeth 24 and 15 in the same patient. The study population was composed of 100 patients treated in a private orthodontic office in Casablanca. Recruitment for this sample included all patients treated orthodontically without extractions, possessing teeth that were considered healthy, with no occlusal interferences; on the other hand, all patients with mental or physical disabilities, those aged under 14 and those with poor orodental hygiene were excluded from the study. The Kaplan-Meier test was used to compare results. Results: The bond failure rates for the two groups were 7.5% in the SEP group and 9% in the Ortho-Solo(®) group. The difference between these two adhesive systems was not statistically significant (P=0.34). Concerning the type

of bond failure, the comparison again shows no statistically significant difference (P=0.44). In both systems, cohesive failures concerned only 2% of all the brackets bonded. Discussion: The clinical trial was performed with a crossover design to avoid bias due to chewing patterns, a factor that is responsible for most of the failures noted in the study. The results of the studies by Miller and Buyukyilmaz, and some others, are in agreement with our results. However other in vivo and in vitro studies contradict our results, showing higher bond failure rates with the self-etching system. Conclusion: SEP is as effective as a traditional hydrophilic adhesive and, in addition, possesses advantages in terms of ergonomics and chair-time. The literature confirms the data of this clinical trial and recommends the use of SEP; the only remaining limitation is its high cost.
Yonekura Y, Iijima M, Muguruma T, Mizoguchi I. Effects of a torsion load on the shear bond strength with different bonding techniques. Eur J Orthod. 2012 Feb;34(1):67-71. doi: 10.1093/ejo/cjq168. Epub 2011 Jan 24. PMID: 21262935. The purpose of this study was to test the hypothesis that a torsional load applied after bracket bonding does not affect the shear bond strength (SBS) with different bonding techniques. Sixty human premolars were divided into two groups (experimental and control) to investigate the effects of a torsion load, and the two groups were further subdivided into three groups of 10 for the evaluation of different adhesive systems (one etch-and-rinse adhesive, Transbond XT; two self-etching primer adhesives, Transbond Plus and Beauty Ortho Bond). A torsion load (1.45 N/cm) was applied by beta-titanium wire at 15 minutes after bracket bonding in the experimental groups. All specimens were then thermocycled between 5 and 55°C for approximately 1 week (6000 cycles). The SBS for each sample was examined with a universal testing machine and the adhesive remnant index (ARI) score was calculated. Data were compared by two-way analysis of variance, Student's t-test, and a chi-square test. The SBS for Transbond XT after thermocycling with a torsion load was significantly lower than that without a torsion load. For Transbond Plus and Beauty Ortho Bond, there was no significant difference in the mean SBS between specimens thermocycled with and without a torsion load. No significant difference in the distribution of frequencies among the ARI categories was observed among the six groups, although the ARI scores for specimens with a torsion load tended to be higher than those without a torsion load. In conclusion, the SBS of the conventional etch-and-rinse adhesive system significantly decreased under a torsion load with thermocycling.
Türköz, Ç., Tuncer, B. B., Ulusoy, M. Ç., & Tuncer, C. Bond strength of different bonding systems to the lingual surface enamel of mandibular incisors. *Korean Journal of Orthodontics .2010. 40*(4), 260-266. Objective: The aim of this study was to determine whether different types of adhesive systems and enamel-protective agents will affect the tensile bond strength of lingual brackets. Methods: A total of 75 extracted mandibular incisors were randomly divided into 5 groups and lingual brackets were bonded. Group 1 specimens received Transbond XT (3M Unitek, Monrovia, CA, USA), Group 2 required the application of a fluoride-releasing

resin (Ortho-coat, Pulpdent, Watertown, MA, USA) with Transbond XT, Group 3 specimens received a chlorhexidine varnish (Cervitec Plus, Ivoclar Vivadent, Schaan, Lichtenstein) with Transbond XT. In Group 4, a light-cured orthodontic adhesive (Aegis Ortho, Bosworth, Skokie, USA) was applied and in Group 5, an antimicrobial self-etching primer (Clearfil Protect Bond, Kuraray, Osaka, Japan) was used. Results: There were no significant differences in bond strength whether fluoride-releasing resin or chlorhexidine varnish were used or not. Group 5 had significantly higher bond strength and adhesive remnant index (ARI) values than other groups ($p < 0.001$). The application of enamel-protective products did not have
an adverse affect on the bond strength of lingual brackets. Conclusions: These products might provide benefits both for the patient and the clinician, by supporting the oral hygiene during lingual orthodontic treatment. The higher ARI score may be beneficial for Clearfil Protect Bond but its excessive bond strength should be considered in clinical practice, especially where the enamel is thin.

Oz FD, Ergin E, Canatan S. Twenty-four-month clinical performance of different universal adhesives in etch-and-rinse, selective etching and self-etch application modes in NCCL - a randomized controlled clinical trial. J Appl Oral Sci. 2019;27:e20180358. doi: 10.1590/1678-7757-2018-0358. Epub 2019 Apr 11. PMID: 30994773; PMCID: PMC6459227.

Abstract

Objective

The aim of this randomized, controlled, prospective clinical trial was to evaluate the performances of two different universal adhesives and one etch-rinse adhesive for restoration of non-carious cervical lesions (NCCLs).

Material and Methods

Twenty patients with at least seven NCCLs were enrolled. Lesions were divided into seven groups according to adhesive systems and application modes: GSE: GLUMA Universal-self-etch, GSL: GLUMA Universal-selective etching, GER: GLUMA Universal-etch-and-rinse, ASE: All-Bond Universal-self-etch, ASL: All-Bond Universal-selective etching, AER: All-Bond Universal-etch-and-rinse, SBE (Control): Single Bond2-etch-and-rinse. A total of 155 NCCLs were restored with a nano hybrid composite (Tetric N-Ceram). Restorations were scored with regard to retention, marginal discoloration, marginal adaptation, recurrent caries and post-operative sensitivity using modified United States Public Health Service (USPHS) criteria after one week, 6, 12 and 24 months. Statistical evaluations were performed using Chi-square tests ($p=0.05$).

Results

The recall rate was 81.9% after the 24-month follow-up. The cumulative retention rates for self-etch groups (GSE: 72.2%, ASE:75%) were significantly lower than other experimental groups (GSL: 93.7%, GER: 100%, ASL: 94.1%, AER: 100%, SBE: 100%) at the 24-month follow-up ($p<0.05$). Regarding marginal adaptation and marginal discoloration, GSE and ASE groups demonstrated more bravo scores after 6 and 12-month observations but differences were not significant ($p>0.05$). Only one restoration from ASL group demonstrated post-operative

sensitivity at 6 and 12-month observations. No secondary caries was observed on the restorations at any recall. At the end of 24-month observations, no significant differences were detected among groups regarding any of the criteria assessed, except retention. Conclusion GLUMA Universal and All-Bond Universal showed better results in etch-and-rinse and selective etching mode compared to the self-etch mode regarding retention. Etch-and-rinse and selective etching application modes of the current universal adhesives tended to provide better clinical outcomes considering the criteria evaluated at the end of 24-month evaluation.
Pouyanfar H, Tabaii ES, Aghazadeh S, Nobari SPTN, Imani MM. Microtensile Bond Strength of Composite to Enamel Using Universal Adhesive with/without Acid Etching Compared To Etch and Rinse and Self-Etch Bonding Agents. Open Access Maced J Med Sci. 2018 Nov 22;6(11):2186-2192. doi: 10.3889/oamjms.2018.427. PMID: 30559887; PMCID: PMC6290427. Abstract AIM: Considering the recent introduction of universal adhesives and the controversy regarding the use/no use of etchant prior to their application, this study sought to assess the microtensile bond strength of composite to enamel using universal adhesive with/without acid etching compared to three-step etch and rinse, two-step etch and rinse and two-step self-etch bonding agents. METHODS: This in vitro, an experimental study was conducted on 80 extracted sound human molars in five groups (16 each): Scotchbond Universal adhesive (3M) with/without prior etching, Adper Scthe otchbond Multi-Purpose, Single Bond and Clearfil SE Bond. Etching was performed with 37% phosphoric acid for 20 seconds followed by rinsing and drying. The bonding agent was then applied and light-cured. The e-lite composite was bonded to surfaces and light-cured. The teeth were then mounted, sectioned and subjected to microtensile bond strength test in a universal testing machine. The mode of failure was, determined under a stereomicroscope. Data were analysed using one-way ANOVA followed by Tukey's test. RESULTS: Universal adhesive with prior etching yielded the highest bond strength ($P = 0.03$). Pairwise comparisons showed that the bond strength of this group was significantly higher than that of universal adhesive without prior etching ($P = 0.04$). No other significant differences were noted ($P > 0.05$). The modes of failure were significantly different among the groups ($P = 0.003$). CONCLUSION:

Enamel etching with phosphoric acid can significantly increase the bond strength to universal adhesive. Universal adhesive without prior etching provided the bond strength as high as that provided by etching and rinse and self-etch bonding agents.
33. Schauseil M, Blöcher S, Hellak A, Roggendorf MJ, Stein S, Korbmacher-Steiner H. Shear bond strength and debonding characteristics of a new premixed self-etching with a reference total-etch adhesive. Head Face Med. 2016 Apr 30;12(1):19. doi: 10.1186/s13005-016-0117-x. PMID: 27138595; PMCID: PMC4852429. Abstract Background To determine the shear bond strength and adhesive remnant index of a new premixed self-etching primer and adhesive (Tectosan, BonaDent, Germany) for orthodontic appliances in comparison to a reference total-etch system Transbond XT. Methods Bovine incisors were embedded in resin and randomly divided into two groups of 16 samples each. Brackets (Discovery, Dentaurum, Germany) were bonded in group 1 (total-etch-system, Transbond XT) and in group 2 (self-etch-system, Tectosan) with curing light for 40 s. Shear bonding strengths were measured after 24 h of storage in distilled water at 37 °C with a Zwicki 1120 testing machine (Zwick Roell, Germany). A force was applied on the bracket base at the wings in occluso-gingival direction. Then the adhesive remnant index (ARI) was determined. Results No statistical differences on SBS were found for both bonding agents ($p = 0.63$). ARI scores however differed statistically significantly ($p = 0.035$): in the total-etch group more adhesive remained on the teeth, whereas in the self-etch group more adhesive remained on the brackets. There were no visible enamel damages in both groups. Conclusions No differences in the shear bond strength were found between both bonding agents. In our study the self-etch-system shifted the adhesive remnant index from more adhesive on the teeth to more adhesive on the bracket - as other already published self-etch systems did - with the new benefit of not increased enamel damages. Tectosan might therefore be a promising alternative to adhesive systems.
34. Zhang L, Tang T, Zhang ZL, Liang B, Wang XM, Fu BP. Improvement of enamel bond strengths for conventional and resin-modified glass ionomers: acid-etching vs. conditioning. J Zhejiang Univ Sci B. 2013 Nov;14(11):1013-24. doi: 10.1631/jzus.B1300034. PMID: 24190447; PMCID: PMC3829650. ABSTRACT Objective: This study deals with the effect of phosphoric acid etching and conditioning on enamel micro-tensile bond strengths (μTBSs) of conventional and resin-modified glass ionomer cements (GICs/RMGICs). Methods: Forty-eight bovine incisors were prepared into rectangular blocks. Highly-polished labial enamel surfaces were either acid-etched, conditioned with liquids of cements, or not further treated (control). Subsequently, two

matching pre-treated enamel surfaces were cemented together with one of four cements [two GICs: Fuji I (GC), Ketac Cem Easymix (3M ESPE); two RMGICs: Fuji Plus (GC), RelyX Luting (3M ESPE)] in preparation for µTBS tests. Pre-treated enamel surfaces and cement-enamel interfaces were analyzed by scanning electron microscopy (SEM). Results: Phosphoric acid etching significantly increased the enamel µTBS of GICs/RMGICs. Conditioning with the liquids of the cements produced significantly weaker or equivalent enamel µTBS compared to the control. Regardless of etching, RMGICs yielded stronger enamel µTBS than GICs. A visible hybrid layer was found at certain enamel-cement interfaces of the etched enamels. Conclusions: Phosphoric acid etching significantly increased the enamel µTBSs of GICs/RMGICs. Phosphoric acid etching should be recommended to etch the enamel margins before the cementation of the prostheses such as inlays and onlays, using GICs/RMGICs to improve the bond strengths. RMGICs provided stronger enamel bond strength than GICs and conditioning did not increase enamel bond strength.

35. Prasad M, Mohamed S, Nayak K, Shetty SK, Talapaneni AK. Effect of moisture, saliva, and blood contamination on the shear bond strength of brackets bonded with a conventional bonding system and self-etched bonding system. J Nat Sci Biol Med. 2014 Jan;5(1):123-9. doi: 10.4103/0976-9668.127305. PMID: 24678210; PMCID: PMC3961916.

Abstract

Background:

The success of bonding brackets to enamel with resin bonding systems is negatively affected by contamination with oral fluids such as blood and saliva. The new self-etch primer systems combine conditioning and priming agents into a single application, making the procedure more cost effective.

Objective:

The purpose of the study was to investigate the effect of moisture, saliva and blood contamination on shear bond strength of orthodontic brackets bonded with conventional bonding system and self-etch bonding system.

Materials and Methods:

Each system was examined under four enamel surface conditions (dry, water, saliva, and blood), and 80 human teeth were divided into two groups with four subgroups each of 10 according to enamel surface condition. Group 1 used conventional bonding system and Group 2 used self-etched bonding system. Subgroups 1a and 2a under dry enamel surface conditions; Subgroups 1b and 2b under moist enamel surface condition; Subgroups 3a and 3b under saliva enamel surface condition and Subgroup 4a and 4b under blood enamel surface condition. Brackets were bonded, and all the samples were then submitted to a shear bond test with a universal testing machine with a cross head speed of 1mm/sec.

Results:

The results showed that the contamination reduced the shear bond strength of all groups. In self-etch bonding system water and saliva had significantly higher bond strength when compared to other groups.

Conclusion:

It was concluded that the blood contamination showed lowest bond strength from both bonding systems. Self-etch bonding system resulted in higher bond strength than conventional bonding system under all conditions except the dry enamel surface.

Keywords: Blood contamination, self-etching bonding system, shear bond strength

36**. Türköz C, Ulusoy C. Evaluation of different enamel conditioning techniques for orthodontic bonding. Korean J Orthod. 2012 Feb;42(1):32-8. doi: 10.4041/kjod.2012.42.1.32. Epub 2012 Feb 27. PMID: 23112929; PMCID: PMC3481965.**

Abstract

Objective

The aim of this study was to compare the effects of different enamel conditioning techniques for bracket bonding.

Methods

Ninety-one human premolars were randomly divided in six groups of 15 specimens each. The enamel surfaces of the teeth were etched with 35% orthophosphoric acid in Group 1, with a self-etching primer in Group 2, sandblasted in Group 3, sandblasted and etched with 35% orthophosphoric acid in Group 4, conditioned by Er:YAG laser in Group 5 and conditioned by Er:YAG laser and etched with 35% phosphoric acid gel respectively in Group 6. After enamel conditioning procedures, brackets were bonded and shear bonding test was performed. After debonding, adhesive remnant index scores were calculated for all groups. One tooth from each group were inspected by scanning electron microscope for evaluating the enamel surface characteristics.

Results

The laser and acid etched group showed the highest mean shear bond strength (SBS) value (13.61 ± 1.14 MPa) while sandblasted group yielded the lowest value (3.12 ± 0.61 MPa).

Conclusions

Although the SBS values were higher, the teeth in laser conditioned groups were highly damaged. Therefore, acid etching and self-etching techniques were found to be safer for orthodontic bracket bonding. Sandblasting method was found to generate inadequate bonding strength.

37. Hu H, Li C, Li F, Chen J, Sun J, Zou S, Sandham A, Xu Q, Riley P, Ye Q. Enamel etching for bonding fixed orthodontic braces. Cochrane Database Syst Rev. 2013 Nov 25;2013(11):CD005516. doi: 10.1002/14651858.CD005516.pub2. PMID: 24272130; PMCID: PMC6494434.

Abstract

Background

Acid etching of tooth surfaces to promote the bonding of orthodontic attachments to the enamel has been a routine procedure in orthodontic treatment since the 1960s. Various types of orthodontic etchants and etching techniques have been introduced in the past five decades. Although a large amount of information on this topic has been published, there is a significant lack of consensus regarding the clinical effects of different dental etchants and etching techniques.

Objectives

To compare the effects of different dental etchants and different etching techniques for the bonding of fixed orthodontic appliances.

38. Atash Biz Yeganeh L, Seyed Tabai E, Mohammadi Basir M. Bonding Durability of Four Adhesive Systems. J Dent (Tehran). 2015 Aug;12(8):563-70. PMID: 27123015; PMCID: PMC4847161.

Abstract

Objectives:

This study aimed to compare the durability of four adhesive systems by assessing their microtensile bond strength (MTBS) and microleakage during six months of water storage.

Materials and Methods:

A total of 128 human third molars were used. The adhesives tested were Scotch Bond Multipurpose (SBMP), Single Bond (SB), Clearfil-SE bond (CSEB), and All-Bond SE (ABSE). After sample preparation for MTBS testing, the microspecimens were subjected to microtensile tester after one day and six months of water storage. For microleakage evaluation, facial and lingual class V cavities were prepared and restored with composite. After thermocycling, microleakage was evaluated. Bond strength values were subjected to one-way ANOVA and Tamhane's test, and the microleakage data were analyzed by the Kruskal-Wallis, Dunn, Mann Whitney and Wilcoxon tests ($P<0.05$).

Results:

Single Bond yielded the highest and ABSE yielded the lowest bond strength at one day and six months. Short-term bond strength of SBMP and CSEB was similar. After six months, a significant decrease in bond strength was observed in ABSE and SBMP groups. At one day, ABSE showed the highest microleakage at the occlusal margin; however, at the gingival margin, there was no significant difference among groups. Long-term microleakage of all groups at the occlusal margins was similar, whilst gingival margins of SBMP and SB showed significantly higher microleakage.

Conclusion:

The highest MTBS and favorable sealability were obtained by Clearfil SE bond. Water storage had no effect on microleakage of self-etch adhesives at the gingival margin or MTBS of CSEB and SB.

Keywords: Dental Leakage, Adhesives, Tensile Strength

39. **Mirzakouchaki B, Shirazi S, Sharghi R, Shirazi S, Moghimi M, Shahrbaf S. Shear bond strength and debonding characteristics of metal and ceramic brackets bonded with conventional acid-etch and self-etch primer systems: An in-vivo study. J Clin Exp Dent. 2016 Feb 1;8(1):e38-43. doi: 10.4317/jced.52658. PMID: 26855704; PMCID: PMC4739366.**

Abstract

Background

Different in-vitro studies have reported various results regarding shear bond strength (SBS) of orthodontic brackets when SEP technique is compared to conventional system. This in-vivo study was designed to compare the effect of conventional acid-etching and self-etching primer adhesive (SEP) systems on SBS and debonding characteristics of metal and ceramic orthodontic brackets.

Material and Methods

120 intact first maxillary and mandibular premolars of 30 orthodontic patients were selected and bonded with metal and ceramic brackets using conventional acid-etch or self-etch primer system. The bonded brackets were incorporated into the wire during the study period to simulate the real orthodontic treatment condition. The teeth were extracted and debonded after 30 days. The SBS, debonding characteristics and adhesive remnant indices (ARI) were determined in all groups.

Results

The mean SBS of metal brackets was 10.63±1.42 MPa in conventional and 9.38±1.53 MPa in SEP system, (P=0.004). No statistically significant difference was noted between conventional and SEP systems in ceramic brackets. The frequency of 1, 2 and 3 ARI scores and debonding within the adhesive were the most common among all groups. No statistically significant difference was observed regarding ARI or failure mode of debonded specimens in different brackets or bonding systems.

Conclusions

The SBS of metal brackets bonded using conventional system was significantly higher than SEP system, although the SBS of SEP system was clinically acceptable. No significant difference was found between conventional and SEP systems used with ceramic brackets. Total SBS of metal brackets was significantly higher than ceramic brackets. Due to adequate SBS of SEP system in bonding the metal brackets, it can be used as an alternative for conventional system.

40. Franz A, Raabe M, Lilaj B, Dauti R, Moritz A, Müßig D, Cvikl B. Effect of two different primers on the shear bond strength of metallic brackets to zirconia ceramic. BMC Oral Health. 2019 Mar 28;19(1):51. doi: 10.1186/s12903-019-0740-6. PMID: 30922281; PMCID: PMC6437858.

Abstract

Background

In view of the increasing demand of adult orthodontics for esthetic purposes, adult treatment with brackets has become an important issue. One essential factor for the quality of such treatment is bracket bonding on ceramics. For testing the adhesive bond between the bracket and the ceramic surface it is important to consider the static or cyclic loading that goes along with it.

Methods

Metallic Brackets were adhesively fixed on zirconia ceramic blocks in a simulated leveling phase using two different primers (Monobond S and Monobond Etch & Prime). Half of the metallic brackets were activated using a 0.14-

nickel titanium wire, while the other half remained non-activated. Shear bond testing (SBT) was performed after thermocycling. Furthermore the Adhesive Remnant Index (ARI) was analyzed.

Results

SBT resulted in significantly higher shear bond values when Monobond Etch & Prime was used compared to the use of Monobond S. Activation of the brackets did not show different results in comparison to the non-activated brackets. The ARI did not indicate cement remnants on the ceramic surface, regardless of the primer and the activation status.

Conclusions

The use of Monobond Etch & Prime has great potential for the bonding of brackets on dental zirconia ceramics.

41. Ferreto-Gutiérrez, I., Cáceres-Zapata, H., & Chan-Blanco, J. R. Comparación de la fuerza de adhesión de brackets a esmalte dental con un sistema exclusivo para ortodoncia y un sistema restaurativo. *Revista Científica Odontológica. 2016. 12*(2).

Resumen

La adhesión a esmalte se ha estudiado exhaustivamente y ha demostrado tener una gran importancia en los tratamientos ortodónticos. Cada sistema adhesivo tiene características únicas que los hacen atractivos para el operador y juega un rol fundamental en la elección del mismo. ***Objetivo:*** *la investigación presente compara los sistemas adhesivos disponibles para aplicaciones ortodónticas y aquellos para aplicaciones restaurativas. Las pruebas se realizaron en esmalte.* ***Materiales y Métodos:*** *se usaron 10 premolares recién extraídos son caries, desinfectados y guardados en agua. El tercio apical de la raíz fue cortado en sentido transversal, colocándose el resto de la pieza en un disco acrílico. La zona del esmalte donde sería puesto el bracket se limpió con una mezcla de agua y piedra pómez por 10s, luego los brackets se colocaron según las indicaciones del especialista en el campo. Se colocó el sistema adhesivo 3M¨ª Unitek Transbond Plus (Monrovia, CA. Lot 388478B) en vestibular de la pieza y el sistema adhesivo 3M Adapter Single Bond 2 (St. Paul, MN. Lot N119660) se utilizó en la superficie lingual. Los brackets fueron probados con cizalla con una máquina de pruebas universales a una velocidad de 2mm/min. Los resultados fueron calculados en MPa y analizados con un test ANOVA de una vía calculados a 0.5 de significancia.* ***Resultados:*** *Adper Single Bond 2 mostró un nivel mayor de fuerza de adhesión que el Unitek Transbond. Los resultados mostraron que el Single Bond 2 tuvo una fuerza de adhesión a esmalte de 8.91 MPa, mientras que el Transbond Plus, obtuvo 10.7 MPa. No se encontró diferencia estadísticamente significativa entre los materiales estudiados.* ***Conclusiones:*** *los sistemas adhesivos para dentina pueden ser usados en tratamientos ortodónticos con la misma confianza con la que se usan los sistemas adhesivos exclusivos para estos tratamientos*

42. Charles Finny, M. *An in-vivo assessment of bracket failure and adhesive remnant index between two Different light cure adhesives with light Emitting diode: A Split Mouth study* (Doctoral dissertation, Ragas Dental College and Hospital, Chennai). 2018

Abstract AIM OF THE STUDY: To compare and evaluate clinical failure rates of metal brackets bonded with two different light cure composite resin materials activated using LED light cure unit. The two adhesives compared in this study are Transbond XT and Bracepaste. MATERIALS AND METHODS: All participants included in the study were informed in prior about the study and were eligible for undergoing fixed orthodontic treatment. • Using a rotary instrument with a rubber cup or bristle, the surfaces to be bonded were cleaned using slurry of pumice for 10 seconds, rinsed thoroughly with water for 20 seconds and air dried completely using an airway syringe. • The teeth were isolated using cheek retractors, tongue away and cotton rolls. • Bonding was done between second premolar to second premolar on both arches. The molars were banded with preformed bands. • The teeth to be bonded were acid etched using 37% phosphoric acid for 30 seconds. After thorough washing, the teeth were completely air dried. A frosty appearance of enamel is noticeably seen evenly on the tooth surface. • A bonding agent was applied using a micro brush and light cured using a 3M Elipar light cure unit for 20 seconds. • With a split mouth design being used, each of the participating patient's dentition is divided into four quadrants. The quadrants were switched opposite each other with different combinations in all patients to avoid any operator bias. The operator was not informed of the different composite used in the quadrants. • The brackets were bonded in appropriate positions and the excessive adhesive material were removed using a straight probe and the brackets were light cured using 3M ELIPAR light cure unit for 10 seconds in all directions mesial, distal, gingival, occlusal or incisal aspects of the bracket. After bonding of brackets, a minimum of 10 minutes is provided before placement of the initial arch wire. RESULTS: Transbond XT adhesive exhibited higher failures than Bracepaste adhesive material, however, the number of failures were statistically insignificant (p value > 0.05). The posterior region displayed statistically significant higher number of failures than anterior region. Similarly, males and NiTi wires displayed statistically significant higher failure of brackets (p value < 0.05) than their corresponding counterparts. In this study, the mandibular arch, patients above 18 years and the left quadrant, though displaying higher rate of failures than their counterparts did not show a statistical significance. Transbond XT displayed a statistically significant, higher number of failures in mandible while Bracepaste, though insignificant, displayed higher failure rates in maxilla. Transbond XT displayed higher failure rates in patients above 18 years and on the right quadrant, while Bracepaste displayed vice versa of the same. The ARI scores depicted a predominance of 5 according to Bishara and Truelove classification denoting higher failures at the enamel adhesive interface. CONCLUSION: It can be safely assumed in this study, that the efficiency of the two adhesive materials is optimal to be used in practice. Necessary care should be taken into consideration to follow ideal protocols in allied procedures andtechniques such as isolation, etching, curing etc.
43. Ciceri, A. L., Parada, J. J. M., Duarte, G. A., Salguero, A. L., & Barrero, J. R. R. Comparación de la fuerza adhesiva y el tipo de falla de dos sistemas adhesivos para ortodoncia. *Ustasalud. 2011. 10*(1), 29-35.

Resumen   Objetivo: Comparar la fuerza adhesiva y el tipo de falla de dos sistemas adhesivos para ortodoncia. Materiales y métodos: Veinte primeros premolares superiores fueron divididos aleatoriamente en dos grupos: 10 para el grupo de grabado total (Transbond™XT, 3M Unitek, St. Paul, Minnesota, USA) y 10 para el grupo autograbador (Transbond™ Plus Self Etching Primer + Transbond™ XT, 3M Unitek, St. Paul, Minnesota, USA). A estos dientes se les cementaron brackets estándar (Ortho Organizers, California, USA) y después de 24 horas fueron sometidos a 5000 ciclos térmicos. Posteriormente se aplicó una fuerza de corte (velocidad 1.5mm/min) en la interfase bracket-esmalte en una máquina universal de ensayos (Instron™). Finalmente, las superficies del esmalte y las bases de los brackets se observaron mediante un estéreo-microscopio (Stemi 2000C, Carl Zeiss, Göttingen, Germany). Resultados: En fuerza adhesiva se observó una diferencia estadísticamente significativa (P<0.05) entre los dos sistemas, presentó mayor promedio el adhesivo de grabado total (28,98MPa vs. 18,67MPa). El tipo de falla predominante fue en la interfase adhesivo-esmalte (80% y 70% respectivamente). Conclusión: La fuerza adhesiva y el tipo de falla están influenciados por el pre-tratamiento del esmalte y la composición química del adhesivo. La fuerza adhesiva obtenida al utilizar un sistema autograbador en ortodoncia produce suficiente retención micro-mecánica con menor riesgo de lesionar el tejido dental.
44. Ezgi, A. T. İ. K., & Ciğer, S. ORTODONTİK BONDİNG İŞLEMİNDE SELF-ETCH PRİMER VE KONVANSİYONEL ASİT-ETCH TEKNİKLERİNİN KARŞILAŞTIRILMASI. *Atatürk Üniversitesi Diş Hekimliği Fakültesi Dergisi.* 2015. *24*(3), 452-457. In recent years, new adhesive methods have been replaced with conventional bonding methods which are used for bonding orthodontic attachments, protecting teeth and saving time. Therefore; with the developing of the bonding procedures, new selfetching primers have been introduced. The advantages of the self-etching primers are; shorten application time due to not including acid-etching and washing processes, reducing salivary contamination because of easy application and fewer moisture sensibility. In the literature, conventional acid-etching and self-etching techniques are compared with regard to shear bond strength, adhesive remnant index scores, mean bonding time and survival period on teeth. Apart from these, studies about the effects of salivary contamination on the bond strength exist
45. Rodríguez Chávez, J. A., Barceló Santana, F. H., Yáñez, S. A. B., & Arenas Alatorre, J. Á. Comparison of the shear bond strength of brackets between two adhesive systems (SEP and MIP Transbond) at 60 minutes and 24 hours. *Revista Mexicana de Ortodoncia.* 2013. *1*(1), 38-44.   ABSTRACT

The purpose of this study was to compare the resistance when debonding the braces of the enamel after 60 minutes and 24 hours of its fixation with two different adhesive systems. 60 bicuspids where divided into 4 groups of 15 samples each one and were treated with self-etching adhesive SEP Transbond Plus 3M Unitek (group 3 and 4) and conventional adhesive Transbond MIP 3M Unitek (group 1 and 2). The samples were submitted to tangential forces with the universal machine Instron with speed load shedding 1.0 mm/min to obtain the resistance when debonding. After doing the statically analysis ANOVA showed that there are not significant statically difference at the debonding forces between Transbond MIP at 24 hours (mean = 6.8, SD = 2.9) and SEP Transbond at 24 hours (mean = 6.1, SD = 2.8) (t = 0.73 p = 0.46). There is no statistically significant difference between Transbond MIP at 60 minutes (mean = 6.01 SD = 5.2) and SEP Transbond Plus at 60 minutes (mean = 7.35, SD = 5.1) (t = -.71 p = 0.48). It was seen lees than the middle of the remnant adhesive in most of the sample.
Peneque, C. M. S. *Teste de microtração em esmalte de um sistema adesivo universal pela técnica etch-and-rinse e etch-and-dry* (Doctoral dissertation). TESTE DE MICROTRAÇÃOEM ESMALTE DE UM SISTEMA ADESIVO UNIVERSAL PELA TÉCNICA ETCH-AND-RINSEE ETCH-AND-DRYCarolina PenequeiiiRESUMO. 2014 Objetivo:Recorrendo ao teste de microtração, avaliar e comparar as forças adesivas em esmalte cortado de um sistema adesivo universal (Scotchbond Universal Adhesive, 3M ESPE, St. Paul, MN, USA) usadosegundo as instruções do fabricante, nosmodosetch-and-rinsee etch-and-dry. A hipótese nula testada é a de que não existem diferenças estatisticamente significativas nas forças de adesão ao esmalte cortado entre as duas estratégias de adesão propostas pelo fabricante para o mesmo adesivo universal.Materiais e Métodos:Foi usadauma amostra de oito terceiros molares humanos. Cortaram-se as superfícies coronárias no sentido mesio-distal, de forma a obter dois segmentos de coroa por dente. Os dentes foramaleatoriamente distribuídospor um dos grupos de teste, de acordo com a estratégia de adesão: SBU aplicado como self-etchde um passo (SBU SE); SBU aplicado como etch-and-rinsede dois passos (SBU TE). Nos segmentos de coroa do grupo SBU TE foi realizado condicionamento com ácido ortofosfórico a 32% (Scotchbond Universal Etchant, 3M ESPE, St Paul, MN), durante 15 segundos. Foram aplicados incrementos de compósito sobre as superfícies dentárias preparadas, até perfazer uma altura de aproximadamente 6 mm. Após 24h numa estufa de incubação a 37º, os dentes foram seccionados de forma a obter palitos com uma área de aproximadamente 1 mm2. Os palitos foram submetidos a uma força de tração, a uma velocidade de 1 mm/minuto. A análise estatística foi realizada com o teste t para amostras independentes. Resultados:As forças médias de resistência àmicrotração (em MPa) e desvios padrão em cada grupo foram: SBU TE = 22,8 (12,3); SBU SE = 14,3 (6,7). Verificaram-se diferenças estatisticamente significativas entre os grupos(p=0,000).Conclusões:A hipótese nula foi rejeitada. O condicionamento ácido da superfície do esmalte cortado aumentou significativamente as forças de adesão produzidas pelo sistema adesivo Scotchbond Universal Adhesive.
47. GIJON, F. L. Resistencia a la tracción de brackets metálicos bondeados con sistema adhesivo de restauración vs sistema adhesivo de ortodoncia. Estudio in vitro.2019

El objetivo del presente estudio fue comparar la resistencia a la tracción de brackets metálicos Edgewise Borgatta Specialties divididos en dos grupos al ser sometidos a fuerza de tracción por medio de la maquina universal de pruebas. Se recolectaron un total de 30 premolares extraídos por indicación ortodóncica en la Clínica Odontológica Benjamín Moreno Pérez, perteneciente a la Universidad Autónoma de Querétaro los cuales una vez hecha la limpieza y desinfección se procedió a guardar en un recipiente con solución salina para evitar la deshidratación. Se dividieron de manera aleatoria en dos grupos de 15 especímenes a los cuales se procedió al bondeo de brackets de base de 12mm2 (Edgewise Borgatta Specialites) conforme el eje longitudinal de diente a una altura de 4.0 mm medida con el posicionador de brackets articulado marca Morelli en los cuales el Grupo I se cementaron con Sistema Adhesivo de Restauración Z350 Flow de 3M Filtek y el Grupo II se cementaron con Sistema Adhesivo de Ortodoncia Transbond XT de 3M Unitek. Se procedió a la colocación de ligadura metálica 0.010´´ marca Massel contorneando las aletas del bracket y se procedió a la colocación de espécimen en la máquina universal de pruebas y se aplicó fuerza de tracción en dirección vertical y paralela al eje longitudinal del diente. Los resultados obtenidos para la prueba de tracción en MPa se analizaron presentando diferencias estadísticamente significativas con un valor de $p<0.0001$ usando el software estadístico GraphPath concluyendo de esta manera que el sistema adhesivo de Ortodoncia Transbond XT de 3M Unitek tiene mejor adhesión que el sistema adhesivo de restauración Filtek Z350 flow de 3M ESPE.

48. Sains Malaysiana Effectiveness of Self-Etching Primer Versus Conventional Etch and Bond Technique in Fixed Orthodontic Treatment (Keberkesanan Teknik Primer Pengasidan Sendiri Berbanding Teknik Pengasidan serta Pengikatan Konvensional pada Rawatan Ortodontik Tetap) .2011. 41(8),1051–1056

Abstract A good adhesive is an important factor to consider in orthodontic bonding. Frequent bracket failure prolongs treatment duration and causes inconvenience to patient and operator. This study aimed to compare the effectiveness of two bonding agents, i.e. the self etching primer (SEP) and the conventional etch and bond (CEB) by monitoring the incidence, time and sites of bracket failure. Eighty orthodontic patients were recruited after informed consent were obtained. A randomized split mouth technique was used where one side was bonded with CEB agent, while the other side was bonded using SEP agent. All bonded brackets were examined every 4 weeks for 20 months. Incidence of bracket failure was noted and comparison between the two groups was done using paired t-test. Time and frequent site of failure were also assessed. Out of 1314 brackets, only 33 brackets were debonded with 16 from SEP group and 17 from CEB group which statistically insignificant ($p>0.05$). Almost 55% of bracket failure occurred during the first 3 months after bonding for both adhesives with lower premolars was most the frequent site to fail in both adhesives (39.4%). Bracket bonded on the left side failed significantly compared to the right side. In conclusion, both self-etching primer and conventional acid-etch bonding agents are equally effective in retaining brackets clinically. Bracket failure mostly occurres during the first 3 months after bonding. The premolar brackets and the left side are mostly debonded when compared to other sites.

49. Ousehal L, El Aouame A, Rachdy Z, Benkiran G. Comparison of the efficacy of a conventional primer and a self-etching primer. Int Orthod. 2016 Jun;14(2):195-205. doi: 10.1016/j.ortho.2016.03.005. Epub 2016 Apr 11. PMID: 27080598.

Summary

Introduction

In orthodontic practice, the bonding protocol makes use of a primer between the bracket and the enamel surface to create a reliable bond. In order to optimize the technique and reduce bonding time, a new group of primers has been introduced in orthodontics: the self-etching primers (SEP). The aim of this work was to compare their efficacy with that of a traditional primer. Materials and method This study is a single-center, single-blind, clinical trial using the SEP system on teeth 14 and 25 and the Ortho-Solo® system (traditional hydrophilic primer) on teeth 24 and 15 in the same patient. The study population was composed of 100 patients treated in a private orthodontic office in Casablanca. Recruitment for this sample included all patients treated orthodontically without extractions, possessing teeth that were considered healthy, with no occlusal interferences; on the other hand, all patients with mental or physical disabilities, those aged under 14 and those with poor orodental hygiene were excluded from the study. The Kaplan–Meier test was used to compare results. Results The bond failure rates for the two groups were 7.5% in the SEP group and 9% in the Ortho-Solo® group. The difference between these two adhesive systems was not statistically significant (P = 0.34). Concerning the type of bond failure, the comparison again shows no statistically significant difference (P = 0.44). In both systems, cohesive failures concerned only 2% of all the brackets bonded. Discussion The clinical trial was performed with a crossover design to avoid bias due to chewing patterns, a factor that is responsible for most of the failures noted in the study. The results of the studies by Miller and Buyukyilmaz, and some others, are in agreement with our results. However other in vivo and in vitro studies contradict our results, showing higher bond failure rates with the self-etching system. Conclusion SEP is as effective as a traditional hydrophilic adhesive and, in addition, possesses advantages in terms of ergonomics and chair-time. The literature confirms the data of this clinical trial and recommends the use of SEP; the only remaining limitation is its high cost.

50. Mihaela Păstrav, A. Chisnoiu, . Comparative in vitro study of the different orthodontic brackets using two etching techniques Published Materials Science Direct bonding of the bracket to the enamel is the elective procedure for the orthodontic treatment. .2014 62 (4. 201-209

Among various factors influencing the adhesive force at the enamel level, the etching technique seems to be the most important one. The present study aims at evaluating the influence of the storage media and the etching technique used, on the bond strength between different bracket types and dental structures. The results of this study showed that, regardless of the brackets and the immesion solution used, by working with the classic etch and rinse technique the adhesion force is higher than by using a self etching adhesive

51. . Basaran,T. Özer &O. Hamamci . Biotechnology & Biotechnological Equipment, An 8 Month Clinical Trial of Bond Failues with Four Different Types of Orthodontic Adhesives G 20:1, 163-168, DOI: 10.1080/13102818.2006.10817324

ABSTRACT

In this study the bonding survival of total etching and self etching composite resins (Rely-a-Bond, Kurasper F, Ideal 1, Prompt L pomp with Transbond XT) for orthodontic purposes were compared. A sample of 20 patients were treated with fixed appliances. The treatment group consisted of 10 girls and 10 boys who were 16–19 years old. A split mouth technique was used. The patients were followed for a period of 8 months. Bond failures were recorded in each patient's special record, with the time of bond failure identified as the date when bond failure was noticed. Bond failure rates and the corresponding bracket survival curves were plotted using the Kaplan-Meier product limit estimate. Bracket survival distributions were then compared with a student t test. The type of the bonding agent did not influence the bracket survival rate significantly (p >.05). In conclusion, Self etching primers could be used as an alternative to conventional etching adhesive systems.

52. Stefański a,*, A. Kloc-Ptaszna b, L. Postek-Stefańska . Archives of Materials Science and Engineering. Bond strength of orthodontic adhesives to dry and saliva-moistened enamel – a comparative in vitro study T.. 2019. 96(2) 79-84

ABSTRACT

Purpose: To compare the bond strengths of six different dental adhesives to dry and salivamoistened enamel**.** **Design/methodology/approach**: One hundred twenty stainless steel brackets were bonded to human mandibular third molars with six materials: Enlight LC® (Ormco Corp), Grengloo® (Ormco Corp), Light Bond® (Reliance Orthodontic Products), Charisma® (Heraeus Kulzer), SmartBond® (Gestenco), and Transbond XT® with MIP® primer (3M Unitek). One half of the specimens in each group (n=10) was bonded to dry enamel, while the other half to saliva-moistened enamel. Bond strength testing was performed with a wire loop loading technique after 30-min incubation in artificial saliva. Failure mode was evaluated using adhesive remaining index (ARI). **Findings:** No significant differences in bond strength to dry enamel were noted for all composite materials ($p>0.05$). SmartBond exhibited significantly greater bond strength to moistened enamel (7.10 ± 1.47 MPa) and comparable with other composite materials to dry enamel. Composite materials demonstrated significantly reduced bond strength to saliva-moistened enamel ($p <0.001$) except for Transbond MIP, whose bond strength was not significantly decreased by saliva contamination ($p=0.089$). There was not statistically significant difference between bond strength of SmartBond and Transbond to saliva contaminated enamel. A higher incidence of cohesive failures was noted for all materials. **Research limitations/implications:** Composite light-cured materials provide adequatebond strength to dry enamel. Cyanoacrylate adhesive provides sufficient bond strength only under moist conditions. Transbond XT+MIP has sufficient bond strength to either dry or saliva-moistened enamel. **Practical implications:** The study evaluated the bonding strength of orthodontic brackets, which is a critical parameter in orthodontics, especially in situations that do not allow for proper isolation from saliva, such as bonding to impacted teeth following surgical exposure. **Originality/value**: Bond strengths evaluated with loop loading technique in different study environments would help the orthodontist to choose the most effective adhesive for the specific clinical situation.

53. Ozoe-Ishida R, Endo T, Shimooka S. Comparing bond strengths of brackets on primary teeth with 3 different primers. Pediatr Dent. 2010 Mar-Apr;32(2):118-22. PMID: 20483014.

Purpose: The purposes of this study were to: (1) examine the shear bond strengths (SBSs) of orthodontic brackets bonded to primary teeth with conventional, self-etching, and moisture-insensitive primers; and (2) evaluate the mode of bracket failure. Methods: Seventy-eight human primary teeth were divided equally into 6 groups: (1) the enamel surface was etched, and a conventional primer was applied under dry conditions; (2) the enamel surface was dried, and a self-etching primer was applied; (3) the enamel surface was etched, and a moisture-insensitive primer was applied under dry conditions; (4-6) the same adhesives were used as those in groups 1 to 3, but before priming, each tooth was moistened. Metal brackets were bonded with adhesive. SBSs were measured using a universal testing machine, and the bracket/adhesive failure modes were evaluated with the adhesive remnant index. Results: A notable drop in bond strength and a high incidence of bond failure at the enamel-adhesive interface were found in group 4. There was no significant difference in mean SBSs among the other groups. Conclusion: These adhesive systems under specific conditions enable us to use a primary tooth in the sectional bracket appliance as the anchor tooth, thus helping improve the outcome of early treatment for malocclusion.

54. B Khosravani fard, A Fetrati, E Asadi. Comparison between self-etching and conventional primers in repeated bracket bonding. J Res Dentomaxillofac Sci. 2017, 2(4): 20-32

Abstract: Background and Aim: This study aimed to evaluate the effect of repeated bonding by self-etching primers (SEPs) and a conventional phosphoric acid-etchant on shear bond strength (SBS), adhesive remnant index (ARI), and enamel morphology at different debonding time points. Materials and Methods: In this experimental study, 120 premolars were randomly divided into six groups of 20. In the first three groups, the brackets were bonded by Transbond XT, Transbond Plus, and Beauty Ortho Bond, and were debonded after 30 minutes. Adhesive remnants were removed from the enamel surface by a tungsten carbide bur. Rebonding was done with new brackets as described. The remaining three groups were debonded after aging. The SBS, ARI, and enamel surface morphology were evaluated. The SBS data were analyzed by two-way analysis of variance (ANOVA). The ARI scores were compared by using Mann-U-Whitney and Kruskal-Wallis tests. Results: The SBS of Transbond XT in the first debonding was significantly higher than that of Transbond Plus. Transbond Plus showed a higher SBS than Beauty Ortho Bond. In the second debonding, the SBS values of Transbond XT and Transbond Plus were not significantly different, but their SBS values were significantly higher than that of Beauty Ortho Bond. SEPs showed a higher bond strength in the second bonding compared to the first bonding. Scanning electron microscopy (SEM) showed more porosity in the enamel surface before the second bonding compared to the first bonding. The SBS of Beauty Ortho Bond significantly decreased after aging, and SEM images showed

a gap at the resin-enamel interface. Conclusion: SEPs are recommended for secondary bonding in the clinical setting due to a decreased chair time, less damage to enamel, and an adequate bond strength.
55. Ana Paula DeCastro. Orthodontic Bracket Bond Strength Using Self-Etching Primer With or Without Pumice or Acid Etch Pretreatment, Virginia Commonwealth University **Abstract** The purpose of this study was to compare the shear bond strength of orthodontic brackets to enamel in four bonding protocols: SEP without prior pumicing (None), Pre-etch and SEP without prior pumicing (Pre-etch), control: SEP with prior pumicing (Pumice), and Pre-etch and SEP with prior pumicing (Both). 80 extracted bovine incisors were randomly divided into 4 groups of 20, and brackets were bonded under the different experimental conditions. Debonding force was measured with an Instron universal testing machine. A two-way ANOVA comparing the four groups indicated that there was a significant difference in debonding force (P = 0.001). The SEP without prior pumicing group (17.69 ± 7.18 MPa) was statistically different from the SEP group with prior pumicing (25.82 ± 6.84 MPa). There was no statistical difference found among the other groups. Differences in the Adhesive Remnant Index (ARI) were analyzed by chi-square. ARI scores differed significantly (P =0.0048).
56 Thiago. F, Rejane .P, Ariana .A , Geisy. M. Comparative Analysis of Shear Bond Strength of Steel and Ceramic Orthodontic Brackets Bonded with Six Different Orthodontic Adhesives. Int. J. Odontostomat. 2020. 14(4)
57. Fonseca-Silva Thiago, Otoni Rejane Pereira, Magalhães Ariana Alves Moraes, Ramos Geisy Michelle, Gomes Taís Rodrigues, Rego Thiago Motta et al . Comparative Analysis of Shear Bond Strength of Steel and Ceramic Orthodontic Brackets Bonded with Six Different Orthodontic Adhesives. Int. J. Odontostomat. [Internet]. 2020 Dic [citado 2021 Abr 22] ; 14(4): 658-663. Disponible en: https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0718-381X2020000400658&lng=es. http://dx.doi.org/10.4067/S0718-381X2020000400658. **ABSTRACT:** Orthodontic accessories bonding in tooth enamel has been a critical step since the introduction of direct bonding techniques due to the importance of bracket stability. The aim of this study was to evaluate adhesion strength of different adhesive systems used for bracket bonding on dental surface. The present in vitro study was made from the analysis of shear strength of steel and ceramic brackets bonding with six different types of orthodontic adhesives. The brackets were bonded to 120 human extracted first premolar teeth with Orthocem®, Orthocem® + Ambar Universal® primer, Orthobond Plus®, Biofix®, Transbond XT®, Ortholink VLC®. Shear strength tests were performed on a universal testing machine EZ-Test-Shimadzu® and the data were analyzed using ANOVA test with Post-Hoc Bonferroni and 95 % statistical significance (p <0.05). Transbond XT® and Ortholink VLC® resin values showed greater shear resistance for steel brackets bonding and Transbond XT® and Orthobond Plus® adhesives showed better adhesion results for ceramic brackets bonding.

58. Yasser .L, Essam. A, Ahmad. M, Influence Of Prolonged Continuous Orthodontic Force On The Shear Bond Strength Of Metallic Brackets Bonded With Various Adhesive Sistems Egyptian Dental Journal. 2017. 63, 2931:2938 **ABSTRACT** Purpose: To estimate the effect of prolonged continuous force on the shear bond strength (SBS) of orthodontic brackets bonded with different adhesive systems. Materials and Methods: Eighty premolars were randomly divided into four groups (I, II, III and IV) according to the bonding adhesive used. Orthodontic metal brackets were bonded with one of the succeeding adhesives; Rely-a-bond, Transbond XT primer and adhesive, Transbond Plus self-etch primer (SEP) and Transbond XT adhesive and Smart Bond. Half of the brackets were subjected to 150 g of force for 12 months. All the specimens were thermocycled 1000 times between 5° C and 55° C. A Universal Testing Machine was used to measure SBS. Results: Transbond XT primer and adhesive exhibited the highest significant SBS value (12.8Mpa). Smart bond showed the lowest value (7.7Mpa). Rely-a-bond and Transbond Plus SEP adhesive systems had middle values (8.8 and 7.8Mpa). There was a significant decrease in the SBS of all studied adhesives(p-0,05) accompanied force application (P-0,05) Smart Bond showed the higher reduction in SBS while Transbond XT primer + Transbond XT adhesive revealed the lesser reduction. Conclusion: Application of 150 gram of force for 12 months produced a pronounced negative effect on SBS especially with either SEP or Smart Bond.
59 Yoonjeon .O, Sohee O.. Effects of Saliva Contamination on Shear Bond Strength with Conventional, Moisture Insensitive, and Self-Etching Primers J Korean Acad Pediatr Dent 2019; 46(1): 21-28 **Abstract** The aim of this study was to compare the shear bond strengths of orthodontic bracket with Conventional primer (CP), Moisture insensitive primer (MIP), and Self-etching primer (SEP). In addition, the effect and the timing of saliva contamination on shear bond strength was evaluated.
60. Dr. Suhad M., M.MUSTANSIRIA DENTAL JOURNAL Storage effect on the bond strength of orthodontic metal brackets bonded by three types of adhesive 2008, 5(1), 53-61 **Abstract** The effect of food simulants on the bond strength of orthodontic metal brackets bonded to enamel with light cured composite was studied. One hundred twenty extracted human premolars were selected and randomly divided into three equal groups each with 40 teeth, representing the adhesive bonding generation (5th, 6th and 7th). Each group was subdivided in to two subgroups which represented the storage media, which are distilled water (DW) and 75% aqueous ethanol (Food simulating solution-FSS). Then the storage media group was subdivided into two subgroups with 10 teeth each, representing two storage periods (1 day and 30 days).At the end of the storage period in the immersion media the brackets were debonded by an Instron universal testing machine to measure the shear bond strength.It was found immersion in the food simulants for 30 days significantly reduces the bond strength of light cured composite brackets.

61. **A Mishra, A Mishra. International. Assessment of Metallic and Ceramic Brackets Bond Strength with New Adhesive Systems. Journal of preventive and clinical dental research. 2018; 5(2):70-72** Introduction: Metallic brackets are the most commonly used brackets during fixed orthodontic treatment, but the metallic appearance is not acceptable for many patients. In recent years, orthodontic patients have become more aware of the importance of esthetic appearance. The purpose of this in vitro study was to assess the shear bond strength (SBS) of different metallic and ceramic brackets by two different adhesive systems. Materials and Methods: A total of 68 caries-free human maxillary premolars were randomly assigned to four groups of 14 each.
62. Jim Griffin, Mark Ruddy, Dimitris Mavreas, Susan Nace, Bart Vande Vannet, Kenneth T. Stanton. Comparison of shear bond strength and ARI of four different adhesive systems used to bond molar tubes: An in vitro study, International Orthodontics, 2020 Summary Objective The purpose of this *in vitro* study was to determine and compare the shear bond strength and ARI score of one traditional etch-and-rinse adhesive system serving as control, with those of two other all-in-one adhesives but with enamel acid etching preceding their application, and of one new 8th generation all-in-one bonding agent combined with a traditional adhesive used to bond stainless steel buccal tubes to molar teeth. Material and methods Four groups of teeth were formulated according to the adhesive system used to bond the tubes on the molars. Shear bond strength was measured using a universal testing machine (Hounsfield, UK). After debonding, each enamel surface was imaged using Inspex HD l080p Vesa camera (Ash Technologies Ltd., Ireland) to determine the ARI score. Results The mean SBSs in MPa for the four groups were respectively: A: 9.640 (±3.69), B: 10.261 (±3.03), C: 9.689 (±2.48), D: 8.412 (±3.02). No statistically significant differences were neither found through one-way ANOVA to exist between the group means (*P*: 0.715), nor for the ARI score frequence through Chi^2 (*P*: 0.534). Maxcem Elite showed four and G-Premio Bond zero instances of enamel fracture. Conclusions 1. SBSs of all adhesives and ARI score distributions did not present any significant differences when used to bond stainless steel molar tubes. 2. All adhesives presented with acceptable shear bond strengths for clinical use. 3. Maxcem Elite under the tested conditions presented the greatest and G-Premio the least number of enamel fractures.
63. Dubernard C, Raynal P, Tramini P. Comparative study of enamel adhesion between RelyX™ Unicem® (3M), a self-adhesive bonding agent, and the combination of MIP® (3M), a hydrophilic adhesive, and Transbond Supreme Low Viscosity® (3M), a traditional hydrophobic adhesive. Int Orthod. 2013 Sep;11(3):247-61. doi: 10.1016/j.ortho.2013.06.009. Epub 2013 Aug 1. PMID: 23916465. Summary Although the bond strength of self-adhesive bonding agents is inferior to that of other families of adhesives, it is still adequate for orthodontic purposes provided prior enamel etching is performed. Aim To determine the efficacy of RelyX™ Unicem® (3M) self-adhesive cement both *in vitro* and in *vivo* and to compare it with the combination of MIP® (3M), a moisture-insensitive primer, with a traditional hydrophobic adhesive, Transbond Supreme Low Viscosity® (3M).

In vitro

Comparison of bonding results on 23 trial dentures using RelyX™ Unicem® (3M) with bonding results on 29 trial dentures using a combination of MIP® and Transbond Supreme Low Viscosity® (3M), by means of a multipurpose Instron® 4444 testing machine. Results: the breaking force of MIP®/Transbond Supreme Low Viscosity® (3M) (mean: 144 ± 37.5 Newtons) was significantly higher than that of RelyX™ Unicem® (3M) (mean = 110 ± 26 Newtons) (*P* = 0.001).

In vivo

A 12-month prospective, randomized, monocentric, single-blind clinical study in order to investigate the failure rate of orthodontic attachments according to the type of adhesive used, and the precise site of the debonding. Bracket bonding was performed on 16 patients with randomized allocation of the two adhesives to each of the semi-arches. Results: The failure rates were: 15.3% for the MIP®/Transbond Supreme Low Viscosity® (3M) combination and 8.2% for the RelyX™ Unicem® (3M), with a significant difference (*P* = 0.039). The more posterior the bonded teeth, the greater the superiority of RelyX™ Unicem® (3M). The *in vivo* results did not concord with those obtained *in vitro*. RelyX™ Unicem® (3M) exhibited lower adhesion values *in vitro* and yet it presented a debonding rate almost half that of the MIP®/Transbond Supreme Low Viscosity® (3M). The viscosity of RelyX™ Unicem® (3M) and its moisture tolerance would appear to account for these results.

Conclusion

With prior etching, RelyX™ Unicem® (3M), a self-adhesive, self-etching bonding agent is compatible with use in the orthodontic indirect bonding technique. The MIP®/Transbond Supreme Low Viscosity® (3M) combination, though very effective, still remains sensitive and requires special care during usage.

64. Magna F, Pedro D, José F, Karina K, José B, Effects of application mode of self-etching primer on shear bond strength of orthodontic brackets, Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial, 2016 57 (1), 9-13

Abstract

Objectives

To compare the effects of application mode of one self-etching adhesive on the shear bond strength of metallic orthodontic brackets.

Methods

Seventy-five healthy bovine incisors were divided into 5 groups (*n* = 15). The self-etching primer (Transbond Plus, 3M Unitek) was applied on the enamel actively and passive for 0 (control), 5 and 10 s, followed by air jet application and light cured for 10 s (600 mW/cm^2). The metal brackets were bonded with adhesive (Transbond XT) and light cured for 20 s each proximal surface (mesial and distal). The shear bond strength was determined after water storage at 37 °C for 24 h. The specimens were tested using a universal testing machine (Instron 3342). Once debonded, each specimen was examined to identify the failure mode. The bond strength data were subjected to One-way Anova and Tukey tests (α = 0.05) and failure mode data were analyzed by Kruskal–Wallis test (α = 0.05).

Results

No significant difference in bond strength was found between 5 groups. Increasing the application time and applying agitation of self-etching primers did not affect the shear bond strength (*p* = 0.487). There were no differences between failure mode values in all tested groups (*p* = 0.88) and score 1 was predominant.

Conclusions

The shear bond strength of the self-etching adhesive is not influenced by the application mode.

65. Thorsten G, Brent E. Larson. Repeated bracket bonding: Conventional or self-etching primer, Journal of the World Federation of Orthodontists. 2014 , 3(3), 102-105

Abstract

Background

The aim of this study was to evaluate the effects of repeated bonding using a conventional primer (CP) or a self-etching primer (SEP) on the in vitro shear bond strength (SBS) and adhesive remnant index (ARI) of orthodontic brackets.

Methods

A total of 144 human premolars were divided into two equal-sized groups and bonded with metal brackets using a CP in one group and an SEP in the other group. The SBS and ARI were determined after bracket debonding using a universal testing machine. Each group of premolars was then further divided into two equal-sized subgroups, which were bonded with new brackets using a CP in one subgroup and an SEP in the other subgroup. Again, the SBS and ARI were determined. Differences in SBS and ARI between the groups and among the subgroups were tested for statistical significance.

Results

During the first debonding sequence, the mean SBS values were 10.60 and 10.13 MPa in the CP and SEP groups, respectively. During the second debonding sequence, the mean SBS values ranged from 10.37 to 11.39 MPa. Most or all adhesive remained on the tooth after bracket debonding. There were no statistically significant differences in SBS or ARI between the first and second debonding sequences, between the groups, or among the subgroups.

Conclusion

With regard to SBS and ARI, SEPs perform as well as CPs for repeated bracket bonding.

66. Alavi S, Ehteshami A. Comparison of shear bond strength and enamel surface changing between the two-step etching and primer and self-etch primer methods in rebonding of orthodontic brackets: An in vitro study. Dent Res J (Isfahan). 2019 Jul-Aug;16(4):239-244. PMID: 31303878; PMCID: PMC6596179.

Abstract

Background:

The aim of this study was to compare shear bond strength (SBS) and enamel surface changing of two methods of bonding in rebonding of orthodontic brackets.

Materials and Methods:

In this *in vitro* study, 30 human premolars were randomly classified into three equal groups. Two bonding systems were applied. At first bonding, Group 1 and 2 were bonded by conventional etching and primer technique (CEP) and Group 3 by self-etching primer (SEP). Thermocycling for 5000 cycles was done. Then, 30 brackets were debonded and SBS and Adhesive remnant index (ARI) were evaluated. One sample was selected from each group, for SEM, 30 new brackets were used for rebonding. Group 1 was bonded by CEP method and Group 2 and 3 were bonded by SEP method. Thermocycling, SBS, ARI, and scanning electron microscope (SEM)

were done in the same protocol of the first bonding. One-way ANOVA, two-sample *t*-test, and Mann–Whitney U-test were used for statistical analysis. $P < 0.05$ was considered statistically significant.

Results:

The mean SBS values were not significantly different between the three groups in the first bonding and rebonding stages ($P = 0.22$ and 0.24). Further, there was no significant difference between the first bonding and rebonding in SBS values of Groups 1, 2 and 3 ($P = 0.44$, $P = 0.60$, and $P = 0.56$). SEM examination showed obvious differences in the enamel surface between CEP and SEP samples in both first bonding and rebonding.

Conclusion:

With regard to the advantages of SEP methods, it seems this method can be properly used for rebonding of orthodontic brackets.

67. Mansour AY, Drummond JL, Evans CA, Bakhsh Z. In vitro evaluation of self-etch bonding in orthodontics using cyclic fatigue. Angle Orthod. 2011 Sep;81(5):783-7. doi: 10.2319/012811-59.1. Epub 2011 May 5. PMID: 21545301.

Abstract
Objective:

To evaluate the bond strength of a self-etch bonding system using static loading and cyclic fatigue with shear testing. This is a two-part evaluation; the first part will evaluate shear testing, the second part tensile testing.

Materials and Methods:

Bovine teeth (n = 82) were randomly distributed to either a self-etch (Transbond Plus) or total-etch (37% phosphoric-acid + Transbond XT) group. The static shear (SSBS) and cyclic shear (CSBS) bond strengths were measured 24 hours after the bonding of mesh-based brackets. The adhesive remnant index (ARI) and failure sites were evaluated.

Results:

The mean SSBS was 34.25 ± 9.21 and 24.64 ± 9.42 MPa for the total- and self-etch groups, respectively. CSBS was 24.07 ± 0.65 MPa and 18.92 ± 1.08 MPa for the total- and self-etch groups, respectively. Cyclic loading produced lower bond strengths compared to static testing for both adhesives; the difference was only statistically significant for the total-etch system. Comparison of the two materials showed a statistically significant difference between the two techniques. The total-etch had higher bond strengths than the self-etch bonding system. The samples showed a predominance of ARI scored of 2 and 1, and their bonding failure sites were cohesive within the composite.

Conclusion:

Cyclic loading, simulating occlusal forces, reduces the bond strength of both bonding systems. Even though the self-etch bonding system had lower shear bond strength than the total-etch system, both were still clinically acceptable

68. Mansour AY, Bamashmous M. Survival analysis of an orthodontic bracket bond subjected to cyclic tensile and shear forces. J Orthod Sci. 2018 Feb 15;7:1. doi: 10.4103/jos.JOS_51_17. PMID: 29765913; PMCID: PMC5952239.

Journal of Orthodontic Science

Abstract
OBJECTIVES:

The objective of this study was to evaluate the use of survival analysis in cyclic fatigue testing in orthodontic bracket bonding.

MATERIALS AND METHODS:

We used 100 extracted bovine lower incisors (50 orthodontic brackets and 50 eyelet brackets). Each set of brackets was further divided by etching technique (25 total-etch and 25 self-etch). Cyclic fatigue testing was performed at a crosshead speed of 2 mm/min using an up-and-down method. Kaplan–Meier survival data analyses and Cox regression analyses were performed.

RESULTS:

Survival analysis proved to be a simple methodology and revealed that the etching technique was not a statistically significant predictor for survival of orthodontic bracket bonding with either tensile or shear cyclic forces at $P > 0.05$. In tensile cyclic loading, high mechanical loading after controlling for the etching technique is a statistically significant predictor for lower survival of the orthodontic bracket bond at $P < 0.001$.

CONCLUSIONS:

Both etching techniques (total-etch and self-etch) are equally efficient in bonding orthodontic brackets. High mechanical loading is an important predictor of bond failure when applying tensile cyclic forces. Finally, survival analysis is a simpler alternative method to analyze orthodontic bracket bonding subjected to cyclic tensile and shear forces and gives similar results to other complicated methods

69. **Imani MM, Aghajani F, Momeni N, Akhoundi MSA. Effect of Cyclic Loading on Shear Bond Strength of Orthodontic Brackets: An In Vitro Study. J Dent (Tehran). 2018 Nov;15(6):351-357. PMID: 30842795; PMCID: PMC6399460.**

Abstract
Objectives:

In clinical conditions, orthodontic brackets are exposed to periodic stresses mainly induced by mastication and intraoral forces. The objective of the present study was to evaluate the effects of cyclic loading to simulate masticatory forces on shear bond strength (SBS) of metal brackets bonded to teeth using self-etch and total-etch bonding systems.

Materials and Methods:

Eighty-four caries- and crack-free bovine mandibular incisors were selected and randomly assigned to two groups based on the type of bonding system. After bonding, all samples were thermocycled (500 cycles) followed by cyclic loading of the half of the specimens in each group by applying 40 N load with 2 Hz frequency for 10,000 cycles. The SBS was measured using a universal testing machine. The adhesive remnant index (ARI) score was calculated subsequently. Data were analyzed using Kolmogorov-Smirnov test, two-way ANOVA and Mann-Whitney test.

Results:

The SBS was 10.09±3.78 MPa and 14.44±6.06 MPa for self-etch and total-etch bonding systems in cyclic loading group, respectively. The SBS was 9.43±5.3 MPa and 11.31±5.42 MPa in self-etch and total-etch groups without cyclic loading, respectively. Cyclic loading did not cause any significant difference in SBS (P>0.05). The ARI scores of the groups were significantly different (P<0.05).

Conclusions:

The present results demonstrated that low masticatory forces at 10,000 cycles did not have a significant impact on bracket-adhesive SBS; however, they significantly changed the ARI score. Even though the total-etch bonding system yielded higher SBS than the self-etch system, the performance of both was clinically acceptable.

70. **Fernandes HO, Santos LB, Firoozmand LM. Shear bond strength of an orthodontic self-etching adhesive after intracoronary bleaching. Orthod Craniofac Res. 2015 May;18(2):117-24. doi: 10.1111/ocr.12067. Epub 2015 Jan 20. PMID: 25600658.**

Objectives

To evaluate the effects of intracoronary bleaching on the bond strength of orthodontic brackets using self-etching and total-etch adhesive systems.

Material and Methods

In 60 bovine incisors, a coronal lingual access was made to clean the pulp chamber and standardise the thickness of the dentine. The sample was randomly divided into four groups (each *n* = 15): (CT), control group, without bleaching and bonded with the total-etch system (Transbond™ XT-3M); (CTSE), without bleaching treatment and bonded with the self-etching system (Transbond™ Plus Self-Etching Primer-3M); (BT), treated with 35% hydrogen peroxide for internal bleaching and bonded with the total-etch adhesive system; and (BTSE), treated with 35% hydrogen peroxide and bonded with the self-etching adhesive system. Shear bond strength was measured using a universal testing machine (EMIC). The adhesive remnant index (ARI) score was verified. The data were analysed using a two-way anova and Tukey test ($p < 0.05$).

Results

Significant differences were found, and the self-etching adhesive groups presented the highest bond strength values (CTSE=11.55 ± 2.85 MPa; BTSE=14.14 ± 2.23 MPa). The ARI scores revealed significant differences among the groups; the greater amount of remaining adhesive was observed in the CTSE group, and the lowest scores were observed in the BT group.

Conclusions

The use of the self-etching adhesive system, even after intracoronal bleaching, presented satisfactory adhesive strength for the bonding of brackets.

71. **Bayar Bilen H, Çokakoğlu S. Effects of one-step orthodontic adhesive on microleakage and bracket bond strength: An in vitro comparative study. Int Orthod. 2020 Jun;18(2):366-373. doi: 10.1016/j.ortho.2020.01.010. Epub 2020 Feb 25. PMID: 32111576.**

Objective

To evaluate the effects of one-step orthodontic composite combined with primer on microleakage and shear bond strength (SBS) of metal and ceramic brackets.

Materials and methods

This in vitro study included 144 extracted premolar teeth. Teeth were divided into two main groups according to the bracket type (metal and ceramic). In each group, brackets were bonded with three different bonding systems: two-step total-etch (37% phosphoric acid + Transbond XT primer + Transbond XT light cure adhesive), one-step self-etch (Transbond Plus self-etch primer + Transbond XT light cure adhesive), and one-step orthodontic adhesive (37% phosphoric acid + GC Ortho Connect light cure adhesive). A total of 6 groups (n = 12) were performed for each evaluation. All samples were subjected to thermal cycling. After dye penetration, sections were prepared and assessed under stereomicroscope. After SBS test, adhesive remnant index (ARI) scores were determined. Data were analyzed statistically.

Results

There were no significant differences between total-etch and one-step orthodontic adhesive for microleakage. Self-etch adhesive showed more microleakage at occlusal interfaces ($P < 0.05$). The highest and lowest mean SBS values were found in ceramic brackets bonded with total- and self-etch adhesives, respectively. No significant differences were found among the SBS values of the groups. However, the differences between ARI scores were found statistically significant ($P < 0.05$).

Conclusions

Orthodontic composite integrated with primer can be used safely instead of two-step total-etch adhesives during the bonding of metal and ceramic brackets due to less microleakage and adequate SBS values.

72. Nanjannawar LG, Nanjannawar GS. Effects of a self-etching primer and 37% phosphoric acid etching on enamel: a scanning electron microscopic study. J Contemp Dent Pract. 2012 May 1;13(3):280-4. doi: 10.5005/jp-journals-10024-1137. PMID: 22917996.

ABSTRACT

Objective: The purpose of this study was to compare the etching effects of a self-etching primer with 37% phosphoric acid on enamel by using a scanning electron microscope. Bond strengthand the site of bond failure were also determined for bracketsbonded using SEP and 37% phosphoric acid.Materials and methods: A total of 60 maxillary premolar teethwere used for this study and they were divided into four groups.First two groups were used for studying the different types ofetch patterns obtained and the next two groups were used to testthe bond strength with the help of Universal testing machine.After debonding, the amount of residual adhesive was assessedaccording to adhesive remnant index using a stereomicroscope.Results: The majority of etch patterns obtained in the 37%phosphoric acid group were type II, whereas in the SEP group,type IV pattern was more common. There was no statisticallysignificant difference between mean bond strengths obtained withthe SEP group and the phosphoric acid group. Use of SEP resultsin less amount of residual adhesive on tooth surface afterdebonding.Conclusion: SEP produces more conservative etch patterncompared to 37% phosphoric acid. Use of SEP for bondingprovides similar and clinically acceptable bond strength comparedto use of 37% phosphoric acid etching technique and requiresless clean-up procedures hence, reduces enamel loss

73. **Ozer M, Bayram M, Dincyurek C, Tokalak F. Clinical bond failure rates of adhesive precoated self-ligating brackets using a self-etching primer. Angle Orthod. 2014 Jan;84(1):155-60. doi: 10.2319/022013-149.1. Epub 2013 Jul 2. PMID: 23819593**.

ABSTRACT

Objective:

To comparatively assess the failure rate of adhesive precoated (APC) self-ligating metal brackets bonded with two different enamel surface preparation techniques: self-etching primer (SEP) and conventional two-step etch and primer method (CM).

Materials and Methods:

Fifty-seven patients with complete permanent dentition were included in this study. A total of 1140 APC self-ligating brackets (3M Unitek, Monrovia, Calif) were bonded using a split-mouth design. For each patient, SEP (Transbond Plus SEP, 3M Unitek) and CM (37% phosphoric acid) were used in alternate quadrants. All brackets were bonded by the same investigator after pumicing and rinsing of all of the teeth. The number, site, and date of first-time bracket failures were monitored throughout orthodontic treatment (mean, 22 months). The survival rates of the brackets were estimated by Kaplan-Meier and log-rank tests ($P < .05$). The adhesive remnant index was used to determine the bond failure interface.

Results:

The bond failure rates were 2.97% and 2.18% for the CM and SEP, respectively. No statistically significant difference in failure rates was found between the groups. The bond failure sites were predominantly at the enamel-adhesive interface in both groups.

Conclusion:

This long-term in vivo study showed that the combined use of SEP and the APC bracket system can be used effectively for bonding brackets after pumicing the enamel surfaces in clinical orthodontics

74. **Sorake A, Jayakrishnan U, Suneja R, Sam S, Abraham T, Jayaraj A, Govind SL. Lingual Bracket Systems with Self Etching Primers- An In Vitro Study to Evaluate Shear Bond Strength. J Contemp Dent Pract. 2019 Feb 1;20(2):166-172. PMID: 31058630.**

Aim

To evaluate the shear bond strength of orthodontic lingual bracket systems bonded to extracted premolar teeth (Reliance self-etching primer, Clearfil Protect Bond) and self-etching primer (Clearfil SE Bond) Materials and methods: A total of 160 extracted human first premolars were selected and divided into four groups of 10 for each bracket system to be used with four different primers. Each sample was then embedded in an acrylic block, till the coronal portion. Instron testing machine model LR LOYD 50 K was used for testing the shear bond strength.

Results

The results obtained, suggested that all the primers had clinically acceptable shear bond strength with all the bracket system considered in the study. However, there were statistically significant differences in the shear bond strength in intergroup comparisons.

Conclusion

The Reliance Self-Etching primer showed the highest bond strength with Alias lingual bracket system by Ormco, followed by clearfil protect bond, clearfil SE bond, and transbond, with the Alias lingual bracket system in the same order.

75. Pakshir H, Ajami S. Effect of Enamel Preparation and Light Curing Methods on Microleakage under Orthodontic Brackets. J Dent (Tehran). 2015 Jun;12(6):436-46. PMID: 26884778; PMCID: PMC4754570.

Abstract

Objectives:

This study aimed to compare the microleakage beneath metallic brackets following two different methods of enamel preparation and light curing.

Materials and Methods:

A total of 120 bovine deciduous lower incisors were randomly divided into four groups of 30 teeth. The preparations were as follows: Group I: Acid etching + Transbond XT primer + direct illumination, group II: acid etching + Transbond XT primer + transillumination, group III: Transbond XT self-etching primer + direct illumination and Group IV: Transbond XT self-etching primer + transillumination. Dye penetration was used as the method of microleakage evaluation. Sections made at the enamel-adhesive and adhesive-bracket interfaces were evaluated under a stereomicroscope. The Kruskal-Wallis and Mann-Whitney U tests were used for statistical analysis. The level of significance was set at $P<0.05$.

Results:

All groups showed greater microleakage at the gingival in comparison to the incisal margin and the differences were significant among groups with transillumination ($P<0.001$). No significant differences were observed in the microleakage scores at the gingival and incisal margins in any of the interfaces ($P>0.05$). Mesiodistal margins of the self-etching group with direct illumination showed significantly lower scores in comparison with acid etched group ($P<0.05$).

Conclusion:

Use of self-etching primers for bonding of orthodontic brackets yields acceptable results if all bracket margins are cured directly.

76. Goto S, Hasegawa Y, Miyagawa Y, Endo T. Effects of contact compressive force on bracket bond strength and adhesive thickness : Study using orthodontic resins with different viscosities. J Orofac Orthop. 2020 Mar;81(2):79-88. English. doi: 10.1007/s00056-019-00202-9. Epub 2019 Dec 18. PMID: 31853585.

Purpose

To assess the effect of the contact compressive force to seat orthodontic brackets on shear bond strength (SBS) and adhesive thickness using adhesive resins with different viscosities.

Methods

A total of 184 premolars were divided equally into eight groups of 23. Transbond XT and Beauty Ortho Bond paste viscous self-etching adhesive systems were used with contact compressive forces of 0.5, 1, 2, and 3 N (groups 1–4 and groups 5–8, respectively) via a push–pull tension gauge. SBS and adhesive thickness were measured in each adhesive system for each contact compressive force.

Results

Significant differences existed in the SBSs between the adhesive systems for each contact compressive force and the SBSs were significantly higher in groups 1 (17 MPa) and 2 (16 MPa) than in groups 3 (14 MPa) and 4 (13 MPa). Significant differences existed for the adhesive thickness between the adhesive systems for the three contact compressive forces less than 3 N. The adhesive in group 1 (0.184 mm) was significantly thicker than that in groups 2–4 (from 0.098 to 0.129 mm). In groups 2 (0.129 mm) and 3 (0.121 mm) it was thicker than in group 4 (0.098 mm), and in group 5 (0.119 mm) it was thicker than in groups 6–8 (from 0.087 to 0.088 mm).

Conclusions

The high-viscosity adhesive Transbond XT exhibited higher SBSs than the low-viscosity Beauty Ortho Bond paste. For the adhesive Transbond XT, lower contact compressive forces produced greater adhesive thicknesses and higher SBSs. For the Beauty Ortho Bond paste, no significant changes in the adhesive thickness or SBS values were observed for contact compressive forces greater than 0.5 N

Baka ZM, Akin M, Ileri Z, Basciftci FA. Effects of remineralization procedures on shear bond strengths of brackets bonded to demineralized enamel surfaces with self-etch systems. Angle Orthod. 2016 Jul;86(4):661-7. doi: 10.2319/041515-247.1. Epub 2015 Nov 2. PMID: 26524389.

Objective:

To compare the effects of different remineralization procedures on the surface roughness of teeth, shear bond strengths (SBSs), and Adhesive Remnant Index scores of self-etching primer (SEP) used to bond orthodontic brackets to previously treated demineralized enamel surfaces.

Materials and Methods:

A total of 140 extracted human premolar teeth were randomly divided into seven equal groups. Group I was the control group. A demineralization procedure was performed in the other six groups. A remineralization procedure was performed before bonding by using casein phosphopeptide-amorphous calcium phosphate, fluoride, a microabrasion mixture (18% hydrochloric acid-fine pumice), a microabrasion agent, and resin infiltration in groups III to VII. Brackets were bonded using a self-etching primer/adhesive system. The specimens were tested for SBS. The roughness and morphology of the enamel surfaces were analyzed using profilometer and scanning electron microscopy. Data were analyzed with analysis of variance, Tukey, and G-tests at the α = .05 level.

Results:

Significant differences were found in the SBS values among the seven groups (F = 32.69, P = .003). The lowest SBS value was found in group II (2.62 ± 1.46 MPa). No significant differences were found between groups I, III, and VII, between groups III and IV, or between groups V and VI. The differences in the roughness values were statistically significant among the groups (P = .002).

Conclusions:

Remineralization procedures restore the decreased SBS of orthodontic brackets and decrease surface roughness caused by enamel demineralization. SEPs provide clinically acceptable SBS values for bonding orthodontic brackets to previously treated demineralized enamel surfaces.

78. Sameer A. , Laxmikanth SM. Comparative Evaluation of the Shear Bond Strength and De-bonding Properties of Self-Etch Adhesive Composite Cement (Maxcem Elite Chroma) vs. Self-Etching Primer Composite System (Transbond Plus Sep, 3M Unitek, Monrovia, Calif) used for Orthodontic Bracket Bonding. The Dentist 1

Background: Over the last 50 years the bonding of various adhesives to enamel and dentin has developed a niche in nearly all areas of dentistry, including orthodontics. Combining conditioning and priming into a single step improves bonding time and cost-effectiveness to the clinician and Orthodontists use the acid-etch bonding technique to attach brackets to the enamel surface. Maintaining a sound, unblemished enamel surface after de-bonding the brackets is a primary concern to the clinician. Self-adhesive cements were introduced in 2002 as a new subgroup of resin cements. Self-adhesive cements do not require any pre treatment of the tooth surface. Once the cement is mixed, its application is a single clinical step. Sufficient research is not available with regard to whether self etching adhesives can be satisfactorily used in the field of orthodontics to bond the brackets. Maxcem Elite Chroma (Kerr Dental) is a self-etch/self-adhesive resin cement with a Colour Cleanup Indicator. The use of Maxcem Elite Chroma in the field of orthodontics is rather unexplored. Its basic properties such as SBS, the de-bonding properties and its effect on enamel demineralization need to be evaluated to commend its use for bonding in orthodontics.Aims and objective: Comparative evaluation of the shear bond strength and de-bonding properties of self etch adhesive composite cement (Maxcem Elite Chroma) versus self etching primer composite system (Transbond Plus SEP, 3M Unitek, Monrovia, Calif) used for orthodontic bracket bonding.Materials and methods: This was an in vitro study, conducted in controlled laboratory settings. Forty extracted human premolars extracted for purpose of orthodontic treatment. 20 premolars bonded with orthodontic brackets using the self-etch primer Transbond Plus (3M Unitek) containing both the acid and the primer by following manufacturer’s recommendation and 20 premolars bonded with orthodontic brackets using the self-etching composite adhesive (Maxcem Elite™ Chroma Self-etch/Self-adhesive Resin Cement) cement by following manufacturer's recommendation. Results of continuous measurements were presented as mean ± SD. Significance was assessed at 5% level of significance at 95% confident interval. Mann Whitney U test was used to compare the shear bond strength of self-etching composite adhesive to self etch primer. Chi square test was used to evaluate the differences in ARI scores among both the groups. Chi square test showed that there were statistically significant differences among the groups ($p<0.001$).Results: Maxcem elite chroma exhibited the highest mean shear bond strength of 25.7 MPa and Transbond Plus (3M Unitek, Monrovia, CA, USA) exhibited the mean shear bond strength of 18.7 MPA. Maxcem elite chroma exhibited the highest ARI index thereby demonstrating its better de-bonding properties.Conclusion: Within the limitations of the current study we concluded that: 1. New self-etch, self-adhesive bonding system surprisingly showed high SBS as compared to self etch primer, 2. It also demonstrated a high ARI scores on the bracket surface which signifies that the de-bonding takes place mostly at tooth resin interface thereby reduces the chances of deleterious effects like crazing of enamel surface from de-bonding forces.

79. M. J. Ravindranath. Comparison of Morphological Variation and Shear Bond Strength Between Conventional Acid Etchant at Different Etch Times and Self Etching Primer-An in Vitro Study. international Journal of Pharma Medicine and Biological Sciences. 2015. Vol. 4, No. 1,

Abstract—The bonding of orthodontic attachments to acid-etched enamel is an accepted clinical procedure. Phosphoric acid is the commonly used acid for etching before bonding. This in vitro study compared the enamel etch patterns achieved on the orthodontic bonding area of extracted premolars treated with 37% wt/wt phosphoric acid applied for 15, 30seconds and self etching primer. The etch patterns were viewed with a scanning electron microscope and assessed. The statistical analysis indicates that the self etching primer and 37% phosphoric acid at 15 & 30 seconds etched tooth produced variable etching pattern. Application of 37% phosphoric acid was more effective at producing a good etch pattern at 30 seconds than 15 seconds. Shear bond strength study shows that the30 seconds etched tooth surface with 37% wt/wt phosphoric acid shows relatively higher bond strength when compared with 15 seconds etched tooth. While comparing with the 30 seconds of 37% wt/wt phosphoric acid and self etching primer group comparison shows there was no significant difference in bond strength, and comparison of 15 seconds of etching with phosphoric acid and self etching shows that self etching primer etching was effective than the 15 seconds etching with phosphoric acid.

80. Arash V, Naghipour F, Ravadgar M, Karkhah A, Barati MS. Shear bond strength of ceramic and metallic orthodontic brackets bonded with self-etching primer and conventional bonding adhesives. Electron Physician. 2017 Jan 25;9(1):3584-3591. doi: 10.19082/3584. PMID: 28243410; PMCID: PMC5308498.

Abstract

Introduction

Adult patients typically require high-quality orthodontic treatment for ceramic brackets, but some clinicians remain concerned about the bond strength of these brackets. Therefore, the aim of this study was to determine the shear bond strength and de-bonding characteristics of metallic and ceramic brackets bonded with two types of bonding agents.

Methods

In an experimental study done in 2013 in Babol, Iran, 120 extracted human maxillary premolar teeth were randomly divided into four groups as follows: HM group: metallic bracket/conventional bonding agent; SM group: metallic bracket/Transbond self-etching primer; HC group: ceramic bracket/conventional bonding agent; SC group: ceramic bracket/Transbond self-etching primer. Twenty-four hours after thermocycling (1000 cycle, 5 °C–55 °C), the shear bond strength values were measured. The amount of resin remaining on the tooth surface (adhesive remnant index: ARI) was determined under a stereomicroscope. Enamel detachment index was evaluated under a scanning electron microscope. To perform statistical analysis, ANOVA, Kruskal–Wallis, and Tukey post-hoc tests were applied. The level of significance was set at $p<0.05$.

Results

The mean shear bond strength values (MPa ± SD) were group HM=12.59, group SM=11.15, group HC=7.7, and group SC=7.41. Bond strength differences between groups HM and SM ($p=0.063$) and between HC and SC ($p=0.091$) were not statistically significant. There were significant differences between HM and HC and between SM and SC groups ($p < 0.05$). Insignificant differences were found in ARI among all groups.

Conclusion

Our findings indicated that the metallic brackets had higher bond strengths in comparison with ceramic brackets. In addition, self-etching primer was able to produce fewer bonds compared with the conventional technique. Many samples showed the bracket-adhesive interface failure or failure inside the adhesive.

81. Dominguez GC, Tortamano A, Lopes LV, Catharino PC, Morea C. A comparative clinical study of the failure rate of orthodontic brackets bonded with two adhesive systems: conventional and self-etching primer (SEP). Dental Press J Orthod. 2013 Mar-Apr;18(2):55-60. doi: 10.1590/s2176-94512013000200014. PMID: 23916432.

ABSTRACT

OBJECTIVE: This study compared the clinical performance of orthodontic brackets bonded with Transbond adhesive paste after two priming systems: a two-stage conventional system (acid etching + Transbond XT adhesive primer) and a singlestage self-etching primer (SEP) (Transbond Plus).
METHODS: The sample comprised 480 metal brackets bonded to the teeth of 24 consecutive patients treated for 36 to 48 months. A split-mouth design was used for bonding, and both systems were used in each patient. Bracket failure rates for each system were analyzed; and failure causes as reported by the patients and the quadrant of teeth for which brackets failed were recorded.
RESULTS: The conventional system group had a failure rate of 5.41%, whereas the rate for SEP was 4.58%. In this group, there were 5 failures (38.4%) in the right maxillary quadrant, 2 (15.4%) in the left maxillary quadrant, 4 (30.8%) in the right mandibular quadrant, and 2 (15.4%) in the left mandibular quadrant. In the SEP group, there were 4 (36.4%) failures in the right maxillary quadrant, 1 (9%) in the left maxillary quadrant, 3 (27.3%) in the right mandibular quadrant, and 3 (27.3%) in the left mandibular quadrant. Results of descriptive statistical analysis and odds ratio did not show any significant differences between rates ($p = 0.67$).
CONCLUSION: The clinical efficiency of SEP was similar to that of the conventional system.

Keywords: Orthodontic brackets. Bonding. Dental adhesive.

82. Hassan, A. H. (2010). Shear bond strength of precoated orthodontic brackets: an in vivo study. Clinical, cosmetic and investigational dentistry, 2, 41.

Objective: To evaluate the shear bond strength of precoated orthodontic brackets bonded with self-etching primer relative to that of noncoated conventionally-bonded brackets at two different time intervals.Methods: Twenty-one subjects were selected for randomized split-mouth bonding of two types of brackets to the maxillary arch. Half of the teeth had precoated brackets bonded using self-etching adhesive, and the other half had regular brackets bonded using Transbond XT adhesive. Nitinol wires were tied to the upper arch and were left until the time of debonding. The patients were randomly divided into two groups: one debonded after one hour and the other debonded two weeks after the initial wire placement. The shear bond strength was directly recorded from the patients' mouths using an in vivo debonding device.Results: There were no significant differences in shear bond strength between the precoated and conventional groups or within each group at different time intervals. There were significant dif-ferences between anterior and posterior teeth in both the precoated and conventional groups.Conclusion: Pre-coated brackets bonded with self-etching adhesive have the same bonding strength as the conventionally bonded brackets.Keywords: shear bond, bonding, orthodontics, precoated, brackets, self-etching adhesive

4. **Selección final de artículos por temática (criterios de selección e inclusión de artículos)**

Todos los artículos preseleccionados se leyeron a texto completo y se aplicaron los siguientes criterios de selección.

Criterios de inclusión:

- Estudios clínicos que evalúen la resistencia adhesiva y/o el nivel de fracaso de diferentes tipos de brackets cementados con sistemas de autograbado o grabado total.
- Ensayos clínicos que comparen autograbado y grabado total
- Estudios en humanos que hayan tenido por lo menos la fase inicial in vivo
- Estudios realizados en pacientes con dentición permanente

Criterios de exclusión:

- Estudios en pacientes con defectos congénitos del esmalte, caries, restauraciones, anomalías craneofaciales y enfermedades sistémicas.

5. **Proceso de extracción de información de artículos por temática:**

Los artículos fueron seleccionados por dos revisores (P.C.A.V y A.B.G.A); inicialmente por título y resumen; cuando este era insuficiente para tomar una decisión, se leyó en texto completo. En los casos donde no se pudo llegar a un acuerdo, se consultó con un tercer revisor (S.P.C.D). Los artículos duplicados en las bases de datos fueron incluidos una sola vez. Se realizó una tabla de extracción de datos que incluyó información importante sobre cada artículo como: autor, fecha de publicación, tema del estudio, características de los participantes, tipo de estudio, intervenciones, forma de medición, resultados, criterios de selección, objetivo y conclusiones de cada estudio.

Evaluación de la calidad metodológica de los estudios

La calidad metodológica de los estudios fue evaluada, utilizando la herramienta de control de riesgo de sesgos para ensayos clínicos (Revised Cochrane risk-of-bias tool for randomized trials RoB 2) versión del 22 de agosto del 2019 (Sterne, J. A., 2019), (Anexo 2) el cual, comprende cinco dominios:

I. Riesgo de sesgo derivado del proceso de aleatorización

II. Riesgo de sesgo debido a desviaciones de las intervenciones previstas (efecto de la asignación a la intervención)
III. Riesgo de sesgo debido a la falta de datos de resultado
IV. Riesgo de sesgo en la medición del resultado
V. Riesgo de sesgo en la selección del resultado reportado

Después de haber evaluado los cinco dominios, el riesgo de sesgo fue clasificado de acuerdo a las siguientes características:

- Bajo riesgo de sesgo: Se considera que el estudio tiene bajo riesgo de sesgo cuando todos los dominios tienen este resultado.
- Algunos problemas: Al menos uno de los dominios obtuvo este resultado.
- Alto riesgo de sesgo: Al menos uno de los dominios obtuvo este resultado. O, cuando el estudio obtuvo "algunos problemas" en varios dominios.

Cada estudio fue calificado siguiendo las recomendaciones planteadas por el manual expuesto anteriormente. Cuando dos investigadores estaban de acuerdo con la calificación del estudio, y uno en desacuerdo, se evaluó el subdominio y se llegó a un consenso, hasta que los tres investigadores quedaron satisfechos con la calificación final de cada dominio y final del estudio.

5. Consideraciones en propiedad intelectual:

a. Sustento legal

Este proyecto tiene en cuenta las normas científicas, técnicas y administrativas para la investigación en salud según la resolución 008430 capítulo I artículo 11, expedida por el ministerio de salud en 1993, el cual regula los aspectos éticos de la investigación. Según este, el estudio se considera sin riesgo porque no hay intervención en humanos ni animales.

6. Resultados

1. Resumen de proceso de búsqueda de información

a. Medición de resultados

Esta revisión evaluó las siguientes variables de los resultados:

1) Fuerza adhesiva producida en la adhesión de diferentes brackets con autograbado y grabado total, medida en MPa
2) Falla del bracket medida por medio de una encuesta al paciente para saber fecha, sitio y causa de la descementación del bracket.

b. Estrategia de búsqueda

Una estrategia de búsqueda detallada fue realizada en diferentes bases de datos: PubMed, Cochrane, LILACS, Google Scholar, Science Direct y EMBASE. Los artículos fueron buscados sin restricción de lenguaje, pero, se aplicaron filtros de fecha de publicación desde el 2010 hasta marzo del 2021. Se utilizaron términos MeSH (Medical Subjet Headings), palabras clave, operadores booleanos (OR, AND) y literatura gris. El algoritmo de búsqueda utilizado fue el siguiente:

#1 adhesive strength OR dental bonding OR bond strength

#2 bracket failure

#3 total etch OR acid etching dental OR conventional etch

#4 self-etch

#5 #1 AND #2 AND #3 AND #4

6 enamel OR enamel dental OR dental enamels

#7 orthodontics OR brackets

#8 #5 AND #6

#9 #5 AND #8

2. Resultados de proceso de extracción de información

Selección de estudios y Extracción de datos

Dos revisoras (P.C.A.V y A.B.G.A) evaluaron los títulos, resúmenes y textos completos de los artículos; el desacuerdo entre los revisores se resolvió mediante discusión. Cuando no se pudo llegar a un acuerdo, se consultó a un tercer revisor (S.P.C.D). La información de los artículos se extrajo y registró teniendo en cuenta los siguientes datos: Autor, año de publicación, título, muestra, tamaño de muestra, diseño de estudio, criterios de selección, asignación, objetivo, materiales y métodos, resultados y conclusiones.

Síntesis de datos

Los datos se agruparon en tablas de extracción de información y se creó un resumen, para determinar la cantidad de datos y estudiar las variaciones en términos de características y resultados al analizar la resistencia adhesiva y el nivel de fracaso en diferentes tipos de brackets, al utilizar las estrategias adhesivas de autograbado y grabado total (Tabla 1).

Resultados de la búsqueda:

La estrategia de búsqueda arrojó 1.826 artículos potencialmente elegibles en las bases de datos (PubMed, Google Scholar, Cochrane, LILACS, EMBASE y Science Direct) y 4 artículos con búsqueda en literatura gris, de los cuales 20 artículos estaban duplicados y fueron excluidos. Luego, se excluyeron 1.469 artículos según su título. Se revisó el resumen de 341 artículos, excluyendo 259. Finalmente 82 artículos fueron leídos a texto completo, de los cuales fueron excluidos 74. Como resultado se incluyeron 8 artículos que cumplieron con todos los criterios de inclusión propuestos para ser parte de la revisión sistemática. (Figura 1)

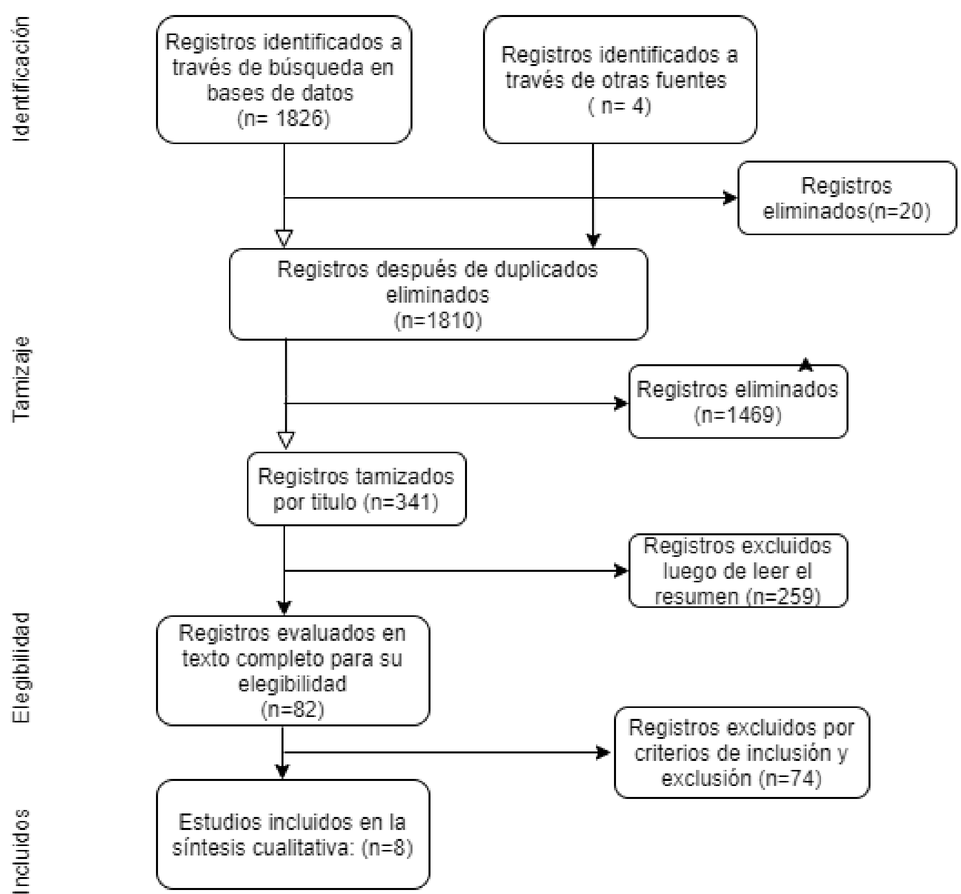

Figura 1. Flujograma de selección de los estudios de la revisión sistemática.

TABLA DE EXTRACCIÓN DE DATOS

ESTUDIO	PARTICIPANTES		TIPO DE ESTUDIO	EVALUACIÓN ESTRATEGIAS ADHESIVAS		INTERVENCIONES	MEDICIÓN
	TAMAÑO DE MUESTRA	EDAD Y GÉNERO		AUTOGRABADO	GRABADO TOTAL		
Farhadian et al 2019							
Shear bond strength of brackets bonded with self-etching primers compared to conventional acid-etch technique: A randomized clinical trial	22 pacientes	Edad: Menores de 30 años Género: No información	Ensayo clínico aleatorizado	22 brackets Roth slot 0.018 (Dentaurum, Ispringen, Germany), Transbond Plus SEP (3M Unitek, Monrovia, CA, USA)	22 brackets Roth slot 0.018 (Dentaurum, Ispringen, Germany)Transbond XT resin (3M Unitek, Monrovia, CA, USA)	44 brackets Roth slot 0.018 (Dentaurum, Ispringen, Germany)	Fuerza de unión en (Mpa) y estereomicroscopia para evaluar el índice de remanente adhesivo (ARI) puntuado por Artun y Bergland.
Mirzakouchaki et al 2016							
Shear bond strength and debonding characteristics of metal and ceramic brackets bonded with conventional acid-etch and self-etch primer systems: An in-vivo study	28 pacientes	Edad: 18-29 años Género: 15 mujeres - 13 hombres	Ensayo clínico aleatorizado	1- 30 dientes con brackets de Metal adheridos con sistema de grabado convencional.(3M Unitek, Monrovia USA) 2-30 dientes con brackets ceramicos adheridos con sistema de grabado convencional. (3M Unitek, Monrovia USA)	1- 30 dientes con brackets de Metal adheridos con sistema de autograbado.(3M Unitek, Monrovia USA) 2-30 dientes con brackets ceramicos adheridos con sistema de autograbado. (3M Unitek, Monrovia USA)	112 brackets metálicos y cerámicos (3M Unitek, Monrovia, USA)	Fuerza de unión medida en Mpa, esteriomicroscopio con 40x de aumento para determinar características de desprendimiento y la cantidad de ARI, el cual incluye 5 puntuaciones
Ousehal et al 2016							
Comparison of the efficacy of a conventional primer and a self-etching primer	100 pacientes	Edad: mayores de 14 años Género: 80 mujeres - 20 hombres	Ensayo clínico aleatorizado	conventional hydrophilic primer (Ortho-Solo)	self-etching primer (3 M Unitek, Monrovia, California, USA)	49 brackets (25 con autograbado y 24 con grabado total)	Se pidió a los pacientes notificar inmediatamente cualquier falla de unión. En caso de falla se tomó en cuenta: sitio de falla, número de brackets descementados, fecha de falla, causa, y tipo de falla (adhesiva o cohesiva).
Sam et al 2012							
Effectiveness of Self-Etching Primer Versus Conventional Etch and Bond Technique in Fixed Orthodontic Treatment	80 pacientes	Edad: 13 - 33 años Género: 33 hombres - 47 mujeres	Ensayo clínico aleatorizado	n=657 Brackets de arco recto slot 0.56 mm × 0.71 mm (prescripción MBT, Mini Master, American Orthodontics),sistema adhesivo convencial (Transbond XT, 3M Unitek, Monrovia, CA, USA)	n=657 Brackets de arco recto slot 0.56 mm × 0.71 mm (prescripción MBT, Mini Master, American Orthodontics), sistema de autograbado (G-Bond, GC Corporation, Tokyo, Japan)	1314 brackets prescripción MBT Mini Master (657 grabado convencional y 657 autograbado)	Evaluación de la falla de unión: Cada sujeto fue monitoreado cada 4 semanas. Se registraron los siguientes datos: diente en el que se produjo la falla, momento de la descementación.

Ozer et al 2014							
Clinical bond failure rates of adhesive precoated self-ligating brackets using a self-etching primer	57 pacientes	Edad: promedio 16 años Género: 39 mujeres - 18 hombres	Ensayo clínico aleatorizado	505 Brackets de autoligado Smart-clip (3M Unitek)Transbond XT Primer; 3M Unitek	505 Brackets de autoligado Smart-clip (3M Unitek)Transbond Plus SEP, 3M Unitek	1010 Brackets de autoligado Smart-clip (3M Unitek)	Las fallas de unión de los brackets fueron registradas una sola vez. Se determinaron las tasas de falla de la unión para todos los períodos de tratamiento para cada procedimiento de unión. Se utilizó el índice de remanente adhesivo (ARI) para determinar la interfaz de falla de la unión.
Dominguez et al 2013							
A comparative clinical study of the failure rate of orthodontic brackets bonded with two adhesive systems: Conventional and Self-Etching Primer (SEP)	24 pacientes	Ni Ni	Ensayo clínico aleatorizado	240 brackets MBT con sistema autograbador Transbond Plus (3MTransbond XT adhesive primer)Transbond XT resin.	240 brackets MBT (victory) sistema autograbador Transbond Plus (3M Unitek, Monrovia, CA) Transbond XT resin.	480 Brackets metálicos MBT (Victory)	Se controlaron las fallas de los brackets y se registraron sus causas y el diente correspondiente durante todos los tratamientos, que variaron de 36 a 48 meses
Mohamad 2015							
Bond Failure Rate of MBT Brackets Bonded with either Self-Etching Primer or Resin Modified Glass Ionomer vs Conventional Method – an in Vivo Study	46 pacientes	33 Mujeres 13 hombres	Ensayo clínico aleatorizado	230 brackets Gemini MBT t (3M Unitek) con sistema autograbador Transbond Plus (3MTransbond XT adhesive primer)Transbond XT resin.	230 brackets Gemini MBT t (3M Unitek) sistema grabado convencional Transbond XT resin.	920 Brackets metálicos Gemini MBT (3M Unitek)	Las fallas de unión de los brackets fueron registradas una sola vez en un seguimiento a 12 meses. Se utilizó el índice de remanente adhesivo (ARI) para determinar la interfaz de falla de la unión.
Romano et al 2012							
Clinical evaluation of the failure rates of metallic brackets	20 pacientes	13 mujeres 7 hombres	Ensayo clínico aleatorizado	100 brackets con sistema autograbador Transbond Plus (3MTransbond XT adhesive primer)Transbond XT resin.	100 brackets con sistema aconvencional (3MTransbond XT adhesive primer)Transbond XT resin.	400 brackets edgewise (Morelli, Sorocaba, SP, Brazil	Se controlaron las fallas de los brackets y el diente correspondiente durante 6 meses.

CRITERIOS DE SELECCIÓN	ASIGNACIÓN	OBJETIVO	MATERIALES Y MÉTODOS	RESULTADOS	CONCLUSIONES
Farhadian et al 2019					
Pacientes que requieran extracciones de 2º premolares, sin tratamiento de ortodoncia previo, con esmalte intacto. Se excluyeron sujetos con anomalías craneofaciales, hipoplasias, desmineralizaciones.	Secencia aleatoria generada por tablas numericas aleatorizadas, los cuadrantes derecho e izquierdo se asignaron aleatoreamente al grupo control o al grupo intervencion, con la asignacion y la evaluacion de la intervencion cegadas.	Comparar la fuerza de unión de brackets adheridos con grabado convencional y autograbado en situaciones clínicas. La hipótesis nula refiere que no hay diferencias significativas entre los 2 grupos. El objetivo secundario fue comparar el índice de remanente adhesivo (ARI) entre los dos grupos después de la descementación de los brackets.	Ensayo clinico a boca dividida, la primera parte in vivo con los brackets cementados a premolares que seran extraidos, ligados a arcos de niti o acero durante dos meses y posteriormente se realizan las exodoncias, segunda parte in vitro, se realiza conlos dientesmontados en un modelo acrilico sometido a descementacion en maquina Instron para medir resistencia adhesiva e indice ARI.	El promedio de resistencia de fuerza adhesiva para grabado total y autograbador fue de 9,53 y 9,20 Mpa respectivamente, con un valor p de 0,096, sin diferencia estadisticamente significativa, y para el indice ARI el promedio fue de 3,50 y 11,38 para grabado total y autograbador respectivamente, con una diferencia estadisticamente significativa del adhesivo remanente en el esmalte despues de la adhesion para el grupo de grabado total. Se usó test de wilcoxon para determiniar la diferencia estadistica en los valores del indice ARI	Los hallazgos del presente estudio indicaron que no existe una diferencia significativa en la fuerza adhesiva entre el autograbado y el grabado convencional para la unión de brackets metálicos de ortodoncia. Además, la cantidad de adhesivo residual en la superficie del esmalte es significativamente menor con autograbador en comparación con el grabado convencional. No se observó fractura de esmalte en ninguno de los grupos.
Mirzakouchaki et al 2016					
Esmalte intacto, sin defectos estructurales mostrados con transiluminación; sin previos tratamientos con agentes químicos. Se excluyeron dientes con diferencias de tamaño y forma, casos donde se descementaban brackets después de las exodoncias, o cuando existía contacto oclusal con el bracket.	Los sujetos fueron asignados aleatoreamente y posterior a esto los cuatro premolares fueron asignados aleatoreamente a uno delos cuatro grupos de estudio.	Simular condiciones de tratamiento reales. Los objetivos fueron: 1. Comparar la fuerza de unión de brackets cerámicos t metálicos adheridos con sistemas de autograbado y grabado convencional. 2. Determinar características de descementación y falla en la adhesión de los brackets adhericos con ambos sistemas.	Ensayo clinico con una primera parte in vivo con los brackets cementados a primeros premolares superiores que seran extraidos, ligados a arcos de niti o acero durante 30 dias y posteriormente se realizan las exodoncias, segunda parte in vitro, se realiza con los dientes montados en un modelo acrilico sometido a descementacion en maquina de pruebas para medir resistencia adhesiva e indice ARI.	El tipo de bracket y el sistema adehsivo tiene un efecto significativo en la resistencia adehsiva (P=0.0001 and P=0.005 respectivamente). Se encontraron diferencias estadisticamente significativas entre el sistema convencional y autograbado cuando se usaron brackets metalicos (P=0.004). No se encontraron diferencias estadisticamente significativas entre los dos sistemas al usar brackets ceramicos. (P>0.05), no hubo diferencias estadisticametne significativas en cuanto al indice ARI ni para falla adhesiva. Se usó	El presente estudio in vivo mostró que el uso del autograbado para la unión de brackets de ortodoncia metálicos puede considerarse como una alternativa al grabado ácido convencional. Sin embargo, la fuerza de unión de los brackets cerámicos adheridos con sistemas convencionales y autograbadores fue más bajo que el rango aceptable.
Ousehal et al 2016					
Ortodoncia correctiva en maxilar superior e inferior sin extracciones; libres de caries, restauraciones, hipoplasias; libres de interferencias oclusales, consentimiento informado para participar en el ensayo	En cada paciente se usaron los dos sistemas de adhesion, en el cuadrante superior derecho los brackets fueron adheridos al primer premolar (14) con autograbado y al segubdo premolar (15) con adhesivo convencional (Ortho-Solo), con una disposicion contraria en el cuadrante contralateral (Autograbado en el 25 y Ortho-Solo en el 24).	Comparar en un periodo de 6 semanas el rendimiento clínico de un sistema autograbador con el convencional, mediante el cálculo de la tasa de supervivencia de los bracketsde ortodoncia. El objetivo secundario fue estudiar los factores que contrubuyen al la falla de uniñon de los brackets.	Ensayo clinico con cegamiento a los participantes, de asignacion cruzada, completamente in vivo, se evalua el tiempo, tipo y causa de la falla adhesiva en tres tiempos con un seguimieto durante 6 meses.	No se encontraron diferencias estadsiticamente significativas para los tres aspectos evaluados. Se uso un test de Kaplan Meier con un valor P < 0.05.	Los adhesivos autograbantes son tan efectivos como los sistemas de convencionales. Debido a las ventajas ergonómicas y al ahorro de tiempo en silla que proporciona el sistema de autograbado, recomendamos su uso. Varios estudios en la literatura confirman estos resultados y también recomiendan el uso de autograbadores; su inconveniente es el costo superior al de los sistemas convencionales, y el uso de una unidad separada para cada paciente.
Sam et al 2012					
Pacientes que requieran tratamiento de ortodoncia, sin ortodoncia previa, sin interferencias oclusales, extracciones simétricas, buena higiene oral. Se excluyeron dientes con alteraciones en el esmalte, hiperplasias gingivales, dientes donde se retrasó ña colocación de brackets, anomalías dentofaciales, dientes que requieran exposición quirúrgica	Loa pacientes fueron asignados aleatoreamente por hemi arcada derecha o izquierda al grupo grabado convencional o autograbado.	Comparar la efectividad de dos tipos de adhesivos, el sistema autograbador y el grabado convencional, mediante el monitoreo de la tasa de falla del bracket, el intervalo de tiempo de falla del bracket y el sitio de falla del bracket.	Ensayo clinico a boca dividida, completamente in vivo que evalua el porcentaje, tiempo y lugara de la falla.	No se encontraron diferencias estadisticamente significativas en la cantidad de falla en los dos grupos, se observo que las fallas adehsivas se presentan principalmente en los 3 primeros meses y el sitio que mas fallas adhesivas presenta es en el lado izquierdo en la zonade premolares inferiores.	El resultado mostró que solo el 2,51% de los brackets se desprendieron de este estudio con 16 brackets del grupo de imprimación autograbante y 17 del grupo de grabado convencional. Ambos adhesivos son igualmente efectivos para cementar brackets. La falla del brackets ocurre con mayor frecuencia durante los primeros 3 meses de tratamiento. El premolar inferior es el sitio más común de falla del bracket, mientras que el incisivo superior tiene el menor fallo del bracket.

Ozer et al 2014					
Pacientes que requieran aparatología fija, candidatos a extracciones y no extracciones, extracciones simétricas, sin defectos de esmalte, hipoplasias o restauraciones sobre las superficies de los dientes que puedan afectar la adhesión del bracket.	NI	Evaluar el rendimiento clínico de los brackets de autoligado unidos con autograbado y grabado convencional durante todo el periodo de tratamiento. La hipótesis nula asume que no hay diferencias en las tasas de falla.	Ensayo clinico a boca dividida, qie evalua la tasa de supervivencia, falla adhesiva e indice ARI de autoligado de brackets cementados con sistemas adhesivos convencional o de autograbado con un seguimiento promedio de 22 meses.	No se encontraron diferencias estadisticamente significativas en cuanto a supervivencia de los brackets, falla adhesiva e indice ARI. Las diferencias fueron evaluadas con el test de kaplan Meier para supervivencia y test de chi cuadrado para falla adhesiva e indice ARI.	No hubo diferencias entre las tasas de fracaso de la unión clínica de los brackets metálicos de autoligado unidos con autograbado y grabado convencional. Este estudio in vivo a largo plazo demostró que el uso combinado del sistema autograbador y el sistema de brackets con recubrimiento de adhesivo previo se puede utilizar de forma eficaz para unir brackets después de usar piedra pómez en las superficies del esmalte en ortodoncia clínica
Dominguez et al 2013					
Pacientes sin ortodoncia previa, extracciones de los 4 primeros premolares	No hay informacion de la aleatorizacion de los sujetos pero si de los cuadrantes asignados a cada grupo, donde se asigno un sistema de grabado al cuadrante superior derecho e inferior izqueirdo y el sistema de grabado opuesto a sus contralaterales cuadrantes.	Evaluar las tasas de falla de los brackets en individuos que se sometieron a un tratamiento de ortodoncia completo durante 36 a 48 meses utilizando el sistema convencional con grabado ácido (ácido fosfórico al 37%) junto con el adhesivo Transbond XT (3M Unitek, Monrovia, CA) y el Transbond Plus SEP (3M Unitek, Monrovia, CA).	Ensayo clinico a boda dividida que evalua falla, tiempo y causa en un periodo de 36 a 48 meses.	No se encontraron diferencias estadsiticamente significativas respecto a la falla con los dos sistemas, se encontro que la mayoria de las fallas se presenta durante los 6 primeros meses del tratamietno y se da principalmente en los premolares.	La eficacia del sistema de uniónautograbador fue similar al del sistema convencional, y su uso en ortodoncia parece ser confiable.
Mohamad 2015					
Pacientes sin ortodoncia previa, clase I sin extracciones, sin presencia de restauraciones ni defectos del esmalte.	No hay informacion de la aleatorizacion de los sujetos, se realizó un diseño a boca dividida y por cada paciente los cuadrantes asignados a cada adhesivo fueron alternados consecutivamente para estar distribuidos equitativamente. alternativamente	Evaluar la tasa de falla de brackets de acero inoxidable MBT adheridos con autograbador, ionomero de vidrio modificado con resina en comparacion con metodo de grabado convencinal.	Ensayo clinico a boda dividida que evalua falla de los brackets en un periodo de 12 meses.	No se encontraron diferencias estadsiticamente significativas respecto a la falla con los dos sistemas en conjunto con resina, se encontraron diferencias significativas cuando se usa autograbado con ionomero modificado con resina y la falla se presenta con mayor frecuencia en los premolares.	La eficacia del sistema de uniónautograbador fue similar al del sistema convencional, y su uso en ortodoncia parece ser confiable en conjunto con resina ocnvencional, no se recomienda eluso de autograbador con ionomero modificado con resina.
Romano et al 2012					
Pacientes sin ortodoncia previa, que no necesiten tratamiento quirúrgico, sin necesidad de exdoncias, sin restauraciones, defectos de esmalte o ausencias dentales	No hay informacion de la aleatorizacion de los sujetos pero si de los cuadrantes asignados a cada grupo, donde se asigno un sistema de grabado a cada cuadrante y est patron se repitio cada 5 pacientes.	Evañuacion clinica de la tasa de falla de brackets adherido con Orthodontic Concise, Transbond XT (convencional), Transbond XT sin primer y Transbond XT+TAutograbador. El numero de fallas fue comparado tambien por arcos, regiones, superficies y cuadrantes.	Ensayo clinico a boda dividida que evalua falla y lugar de esta en 6 meses.	No se encontraron diferencias estadsiticamente significativas respecto a la falla con los sistemas de grabado total y autograbado, no hay diferenias estadisticamente significativas en el arco, lado o superficie de la falla pero si en la region, siendo en la posterior más frecuente las fallas de descementado.	La eficacia del sistema de unión autograbador fue similar al del sistema convencional, y su uso en ortodoncia parece ser confiable.

Tabla 1. Tabla de extracción de datos

Estudios incluidos:

En total, se incluyeron ocho artículos en esta revisión sistemática, los cuales fueron realizados en Irán (Farhadian, N., 2019)(Mirzakouchaki, B., 2016), Marruecos (Ousehal, L., 2016), Malasia (Sam, N., 2012), Turquía (Ozer, M., 2014), Brasil (Dominguez, G., 2013) (Romano, F., 2012) y Siria (Mohamad, G., 2015). Los artículos fueron publicados entre el 2012 y el 2019; los ocho artículos seleccionados fueron ensayos clínicos aleatorizados (Farhadian, N., 2019, Mirzakouchaki, B., 2016, Ousehal, L., 2016, Sam, N., 2012, Ozer, M., 2014, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015). Dos estudios evaluaron la resistencia adhesiva de brackets adheridos con grabado total y autograbado (Farhadian, N., 2019, Mirzakouchaki, B., 2016), siete estudios evaluaron nivel de fracaso de los brackets (Mirzakouchaki, B., 2016, Ousehal, L., 2016, Sam, N., 2012, Ozer, M., 2014, Dominguez, G., 2013, Mohamad, G., 2015, Romano, F., 2012). Tres estudios evaluaron el índice de remanente adhesivo después de la descementación de brackets (Farhadian, N., 2019, Mirzakouchaki, B., 2016, Ozer, M., 2014).

Dos artículos fueron realizados en dos fases , la primera fase con un modelo experimental in -vivo comprendido por pacientes con requerimientos de ortodoncia, y la segunda con análisis in-vitro con resultados procedentes de la primera fase luego de realizar exodoncias de premoalres indicadas para dichos pacientes(Farhadian, N., 2019, Mirzakouchaki, B., 2016) y los seis restantes fueron estudios in vivo (Ousehal, L., 2016, Sam, N., 2012, Ozer, M., 2014, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015) con un seguimiento en el tiempo variable de 6 semanas hasta 48 meses.

La mayoría de los artículos realizaron las pruebas en Brackets metálicos convencionales (Farhadian, N., 2019, 2016, Ousehal, L., 2016, Sam, N., 2012, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015), uno utilizo Brackets metálicos de autoligado (Ozer, M., 2014) y uno evaluo diferencias entre Brackets cerámicos y Brackets metálico en cuanto a grabado total y autograbado. (Mirzakouchaki, B., 2016)

Calidad metodológica de los estudios:

De los 8 estudios incluidos, uno mostró bajo riesgo de sesgo (Farhadian, N., 2019), seis mostraron riesgo moderado (Mirzakouchaki, B., 2016; Sam, N., 2012; Ozer, M., 2014; Dominguez, G., 2013, Mohamad, G., 2015, Romano, F., 2012) y solo uno evidenció alto riesgo de sesgo (Ousehal, L., 2016). El riesgo de sesgo se evaluó usando la herramienta RoB 2, El 87.5% de los artículos analizados presentaron alto o moderado riesgo, presentó esta calificación debido a la falta de información respecto a los datos perdidos o excluidos y su efecto de sesgo en el resultado. (Figura 2).

La evaluación con la herramienta RoB2 fue realizada por los evaluadores de forma independiente y ante una falta de consenso un tercer evaluador intervino para lograr el consenso en la evaluación y puntaje obtenido por cada articulo. (Tabla 2)

Resistencia adhesiva: Grabado vs autograbado:

La resistencia adhesiva es evaluada como la cantidad de MegaPascales requeridos por la maquina universal de pruebas para lograr la fractura entre las superficies de esmalte y bracket correspondiente. Dos de los ocho artículos, evaluaron la resistencia adhesiva. Dos de los ocho artículos, evaluaron la resistencia adhesiva. (Farhadian, N., 2019) encontró un promedio de resistencia adhesiva para GT y AG de 9.53 y 9.20 Mpa respectivamente. Y un Valor p= 0.096, mostrando que no existen diferencias estadísticamente significativas entre ambos sistemas.

Nivel de fracaso de brackets:

Para el nivel de fracaso, se tiene en cuenta la descementación de los Brackets durante un periodo de tiempo determinado de seguimiento, y es reportado por los pacientes mediante una encuesta al momento de referir la descementación. En este aspect la frecuencia mas alta de falla adhesiva se reportó en la region adhesive y la menor en la interfase esmalte-adhesivo, sin embargo, no se encontraron diferencias significativas entre los grupos estudiados. ($P>0.05$) al no existir diferencias estadísticamente significativas en los dos sistemas, se sugiere una eficacia similar entre ellos (Farhadian, N., 2019, Mirzakouchaki, B., 2016, Ousehal, L., 2016, Sam, N., 2012, Ozer, M., 2014, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015). A pesar de no encontrar diferencias estadísticamente significativas (Ousehal, L., 2016) recomienda usar autograbado ya que presenta ciertas ventajas ergonómicas y ahorro de tiempo en silla; sin embargo, también refiere que su inconveniente principal sería el costo de este frente a un sistema de grabado total.

Estrategias adhesivas en diferentes tipos de brackets:

De los ocho artículos, siete usaron brackets metálicos convencionales (Farhadian, N., 2019, Ousehal, L., 2016, Sam, N., 2012, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015), un artículo utilizó brackets de autoligado (Ozer, M., 2014), mientras que otro, (Mirzakouchaki, B., 2016) comparó brackets convencionales con brackets cerámicos, este último encontró diferencias estadísticamente significativas entre el grupo de grabato total y autograbado, cuando se usan brackets metalicos ($P=0.004$), con un promedio paqra grabado total de 10.63±1.42 MPa vs. 9.38±1.53 MPa en dientes con autograbado. No se encontraron diferencias en el uso de los dos sistemas al usar Brackets cerámicos ($P>0.05$). (Mirzakouchaki, B., 2016) Mientras que, los demás artículos no encontraron diferencias estadísticamente significativas al usar los dos sistemas (Farhadian, N., 2019, Ousehal, L., 2016, Sam, N., 2012, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015).

Índice de remanente adhesivo (ARI):

Dos artículos (Farhadian, N., 2019, Mirzakouchaki, B., 2016) evaluaron el índice de remanente adhesivo. Farhadian encontró diferencias estadísticamente significativas en el ARI, se observa que la cantidad de adhesivo residual en la superficie del esmalte es significativamente menor con autograbador en comparación con el grabado convencional, ($P<0.001$), con puntajes de 3 para grabado total y 1 para autograbado.

(Farhadian, N., 2019). Mientras que, (Mirzakouchaki, B., 2016) encontró puntajes de 1 el mayor y 5 el menor en frecuencia en brackets metálicos (37.5% y 1.8%). En brackets ceramincos ,no encontró diferencias estadísticamente significativas en el ARI al comparar los dos sistemas adhesivos en diferentes tipos de brackets.

	D1. Risk of bias arising from de randomization process	D2. Risk of bias due to deviations from the intended intervention (effect assignment to intervention)	D3. Risk of bias due to missing outcome data	D4. Risk of bias in measurement of the outcome	D5. Risk of bias in selection of the reported result	OVERALL RISK OF BIAS
Farhadian et al 2019	+	+	+	+	+	+
Mirzakouchaki et al 2016	?	?	+	?	+	?
Ousehal et al 2106	?	?	-	+	+	-
Mohammad 2015	+	?	+	+	?	?
Ozer et al 2014	?	?	+	+	+	?
Dominguez 2013	?	?	+	+	?	?
Sam et al 2012	+	?	+	+	+	?
Romano 2012	+	?	+	+	+	?

Figura 2. Resumen del riesgo de sesgo de los estudios incluidos en la síntesis con la herramienta "Revised Cochrane risk-of-bias tool for randomized trials (RoB 2)"

ARTICULO	1.1 Was the allocation sequence random?	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	2.1. Were participants aware of their assigned intervention during the trial?	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the trial context?	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?
Farhadian et al 2019	Y: Aleatoria con tab	Y: Usan sobres opacos	N	N: No se les dijo	Y: operador no cegado	PN: consistentes con el protocolo	NA	
Mirzakouchaki et al 2016	PY: No dice que tip	NI: No dice si cegaron a los partic	N	NI	NI	PN:	NA	
Ousehal et al 2016	N: Predecible porqu	Y: Pacientes no son advertidos de	NI: No dice cuantos niños y ni	N: No se les dijo	NI	PN	NA	
Sam et al 2012	N: Predecible porqu	NI: No dice si cegaron a los partic	N	NI	Y: operador no cegado	PN	NA	
Ozer et al 2014	N: Predecible porqu	NI	N	NI	Y: operador no cegado	PN	NA	
Dominguez et al 2013	N: Predecible porqu	NI	N	NI	NI	NI	NA	
Mohamad 2015	PY	PY	N	N	NI	PN	NA	NA
Romano 2012	PY	PY	N	NI	PY	PN	NA	NA

2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	3.1 wer data for this outcome availablefor all, or nearly all, participants randomized?	3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depend on its true value?	4.1 Was the method of measuring the outcome inappropiate?	4.2 Could measurement or ascertainment of the outcome have differed betwen intervention groups?	4.3 If N/PN to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study participants?
NA	Y: T-test bien utilizado	NA	Y: No hay datos perdidos	NA	NA	NA	N	N: los midieron todos igual	N: outcome assessors fueron c
NA	Y:	NA	Y: No hay datos perdidos	NA	NA	NA	N: método de medid	N	NI
NA	Y: Evaluaron el tiempo qu	NA	Y:	NA	NA	NA	N	N	NI
NA	Y	NA	Y	NA	NA	NA	N	N	NI
NA	Y	NA	Y: se reportan los datos pe	NA	NA	NA	N	N	NI
NA	Y	NA	Y	NA	NA	NA	N	N	NI
NI	PN	NI	PN	PN	NA	N	PN	NI	PN
NI	NI	NI	PN	PN	NA	PN	PN	PY	PN

4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knoledge or intervention received?	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knoledge of intervention received?	5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?	5.2 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible outcome measurementss (eg scales, definitions, time points) within the outcome domain?	5.3 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible analyses of the data?	OVERALL RISK OF BIAS JUDGEMENT
NA	NA	Y	N: se midio todo	N	BAJO RIESGO
PN	NA	Y	N:	N	SOME CONCERNS
PN	NA	Y	N	N	SOME CONCERNS
PN	NA	Y	N	N	SOME CONCERNS
PN	NA	Y	N	N	SOME CONCERNS
PN	NA	Y	N	N	SOME CONCERNS
NA	Y	PN	PN	N	SOME CONCERNS
NA	Y	PN	PN	N	SOME CONCERNS

Tabla 2. Evaluación de riesgo de sesgo Paola Carolina Arcos Viscarra

ARTICULO	1.1 Was the allocation sequence random?	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	2.1. Were participants aware of their assigned intervention during the trial?	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the trial context?	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?
Farhadian et al 2019	y	Y	N	N	Y	PN	NA
Mirzakouchaki et al 2016	PY	NI	N (SC)	N	NI	PN	NA
Ousehal et al 2016	N	Y	NI(SC)	N	NI	PN	NA
Sam et al 2012	Y	NI	N(SC)	NI	Y	PN	NA
Ozer et al 2014	N	NI	NI(SC)	NI	Y	PN	NA
Dominguez et al 2013	Y	NI	N(SC)	NI	NI	NI	NA
Mohamad 2015	PY	PY	N (bajo riesgo)	N	NI	PN	NA
Romano 2012	PY	PY	N (bajo riesgo)	NI	PY	PN	NA

2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	3.1 were data for this outcome availablefor all, or nearly all, participants randomized?	3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depend on its true value?	4.1 Was the method of measuring the outcome inappropiate?
NA	Y	NA (bajo riesgo)	Y	NA	NA	NA (bajo riesgo)	N
NA	Y	NA (bajo riesgo)	Y	NA	NA	NA (bajo riesgo)	N
NA	Y	NA (bajo riesgo)	NI	N	NI	NI (Alto riesgo)	N
NA	Y	NA (bajo riesgo)	Y	NA	NA	NA(bajo riesgo)	N
NA	Y	NA (bajo riesgo)	Y	NA	NA	NA(bajo riesgo)	N
NA	Y	NA (SC)	Y	NA	NA	NA(bajo riesgo)	N
NA	NI	PN (some concerns-moderado)	NI	PN	PN	NA (bajo riesgo)	N
NA	NI	NI (some concerns- moderado)	NI	PN	PN	NA (bajo riesgo)	PN

4.2 Could measurement or ascertainment of the outcome have differed betwen intervention groups?	4.3 If N/PN to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study participants?	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knoledge or intervention received?	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knoledge of intervention received?	5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?	5.2 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible outcome measurementss (eg scales, definitions, time points) within the outcome domain?	5.3 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible analyses of the data?	OVERALL RISK OF BIAS JUDGEMENT
N	N	NA	NA (bajo riesgo)	Y	N	N (bajo riesgo)	LOW RISK
N	NI	PN	NA (bajo riesgo)	Y	N	N (bajo riesgo)	SOME CONCERNS
N	NI	PN	NA (bajo riesgo)	Y	N	N (bajo riesgo)	HIGH RISK
N	NI	PN	NA (bajo riesgo)	Y	N	NA(bajo riesgo)	SOME CONCERNS
N	NI	PN	NA(bajo riesgo)	Y	N	NA(bajo riesgo)	SOME CONCERNS
N	NI	PN	NA(bajo riesgo)	Y	N	NA(bajo riesgo)	SOME CONCERNS
PN	NI	PN	NA (bajo riesgo)	Y	PN	PN (bajo riesgo)	MODERADO
PN	PY	PN	NA (bajo riesgo)	Y	PN	PN (bajo riesgo)	MODERADO

Tabla 3. Evaluación de riesgo de sesgo Ángela Brigitte García Álvarez

ARTICULO	1.1 Was the allocation sequence random?	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	2.1. Were participants aware of their assigned intervention during the trial?	2.2. Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the trial context?	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?	2.6 Was an appropriate analysis used to estimate the effect of assignment to
Farhadian et al 2019	Y	Y	N (bajo riesgo)	PN	Y	N	NA	NA	PY
Mirzakouchaki et al 2016	PY	NI	PN (Some concerns -moderado)	NI	PY	PN	NA	NA	NI
Ousehal et al 2016	PY	NI	N (Some concerns -moderado)	N	PY	N	NA	NA	PN
Sam et al 2012	PY	PY	PN (bajo riesgo)	NI	NI	PN	NA	NA	NI
Ozer et al 2014	PN	PN	PN (alto riesgo)	N	NI	PN	NA	NA	NI
Dominguez et al 2013	Y	NI	PN (Some concerns -moderado)	NI	NI	PN	NA	NA	NI
Mohamad 2015	PY	PY	N (bajo riesgo)	N	NI	PN	NA	NA	NI
Romano 2012	PY	PY	N (bajo riesgo)	NI	PY	PN	NA	NA	NI

2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	3.1 wer data for this outcome availablefor all, or nearly all, participants randomized?	3.2 If N/PN/NI to 3.1: Is there evidence that the result was not biased by missing outcome data?	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depend on its	4.1 Was the method of measuring the outcome inappropiate?	4.2 Could measurement or ascertainment of the outcome have differed betwen intervention groups?	4.3 If N/PN to 4.1 and 4.2: Were outcome assessors aware of the intervention received by study	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knoledge or intervention received?
NA (bajo riesgo)	Y	NA	NA	NA (bajo riesgo)	N	N	Y	PN
NI (some concerns - moderado)- bajo riesg	Y	NA	NA	NA (bajo riesgo)	N	N	NI	NI
PN (some concerns - moderado)	PN	PN	NI	PY (Alto riesgo)	PN	N	PY	PN
PN (some concerns - moderado)	Y	Y	NA	NA (bajo riesgo)	PN	N	NI	PN
PN (some concerns - moderado)	PY	PY	PN	NA (bajo riesgo)	PN	N	NI	PN
PN (some concerns - moderado)	PY	NA	NA	NA (bajo riesgo)	PN	PN	NI	PN
PN (some concerns-moderado)	NI	PN	PN	NA (bajo riesgo)	N	PN	NI	PN
NI (some concerns- moderado)	NI	PN	PN	NA (bajo riesgo)	PN	PN	PY	PN

4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knoledge of intervention received?	5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for	5.2 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible outcome measurementss (eg scales, definitions, time points) within the outcome domain?	5.3 Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple elegible analyses of the data?	OVERALL RISK OF BIAS JUDGEMENT
NA (bajo riesgo)	Y	N	PN (bajo riesgo)	BAJO
PN (Some concerns- moderado)	PY	PN	PN (bajo riesgo)	MODERADO
NA (bajo riesgo)	PY	PN	PN (bajo riesgo)	ALTO
NA (bajo riesgo)	PY	PN	PN (bajo riesgo)	MODERADO
NA (bajo riesgo)	Y	PN	PN (bajo riesgo)	ALTO
NA (bajo riesgo)	PN	PN	PN (Some concerns - Moderado))	MODERADO
NA (bajo riesgo)	Y	PN	PN (bajo riesgo)	MODERADO
NA (bajo riesgo)	Y	PN	PN (bajo riesgo)	MODERADO

Tabla 4. Evaluación de riesgo de sesgo Sandra Patricia Castaño Duque

7. Discusión

Resumen de los resultados principales

Esta revisión sistemática, a diferencia de otras existentes en ortodoncia, se enfocó en incluir artículos actuales con buen nivel de evidencia, incluyendo únicamente ensayos clínicos aleatorizados. Lo que permite resultados mucho más actualizados y confiables, cercanos a la realidad clínica, para responder la interrogante principal, sobre qué sistema adhesivo se debería utilizar para obtener la mejor adhesión de diferentes tipos de brackets durante el tratamiento ortodóntico.

De los dos artículos que analizaron resitencia adehsiva, uno de ellos encontró un promedio de resistencia adhesiva para GT y AG de 9.53 y 9.20 Mpa respectivamente, es decir no encontraron diferecnias estadísticamente significativas. Para el nivel de fracaso, los 8 artículos incluidos no muestraron diferencias estadísticamente significativas en los dos sistemas, lo cual sugiere eficacia similar entre ambos sistemas (AG y GT).

Para aquellos que utilizaron diferentes tipos de brackets, Mirzakouchaki, usó brackets metálicos convencionales y brackets cerámicos, encontró diferencias estadísticamente significativas entre GT y AG al usar brackets metálicos con una $p=0.004$ y no encontró diferencias estadísticamente significativas al usar brackets cerámicos con $p> 0.05$.

Calidad de la evidencia y limitaciones

Una de las limitaciones encontradas en esta revisión sistemática fue que los artículos fueron muy heterogéneos en su diseño, razón por la cual, no fue posible realizar un análisis estadístico de síntesis; y además, la cantidad de estudios encontrados que cumpliera con todos los criterios de inclusión fue muy reducida. En cuanto al sesgo, en la mayoría de los artículos incluidos, se presenta una característica inherente al diseño del estudio en odontología, en donde es imposible cegar al operador.

Acuerdos y desacuerdos con otros estudios o revisiones

Al comparar grabado total y autograbado en esta revisión sistemática, se observa que no existen diferencias estadísticamente significativas en la resistencia adhesiva (Farhadian, N., 2019), ni en el nivel de fracaso de los brackets adheridos con estos dos sistemas (Farhadian, N., 2019, Mirzakouchaki, B., 2016, Ousehal, L., 2016, Sam, N., 2012, Ozer, M., 2014, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015). Otros autores, encontraron que los adhesivos de cuarta y quinta generación exhibieron mayor fuerza de unión en comparación con el sistema de unión de sexta generación, pero también, afirman que el sistema de sexta generación tiene una fuerza de unión clínicamente aceptable (Sanjay, N., et al, 2015). Otro estudio, concuerda que clínicamente el autograbador y el grabado convencional son igualmente efectivos en la adhesión de brackets (Sam., et al, 2012)

Sin embargo, es común encontrar en la literatura que el sistema autograbador puede presentar ciertas ventajas que han permitido mejorar los procedimientos clínicos, tanto en la evolución de los componentes y su funcionamiento, como en la disminución del tiempo operatorio de aplicación de cada uno de ellos. Pero, sus ventajas se pueden ver contrastadas con su baja efectividad en cuanto a resistencia de unión y su permeabilidad, la cual, favorece la presencia de nanofiltración, alterando los resultados de adhesión ideales (Aguilar, A., et al, 2015). Por otro lado, otro artículo menciona que los monómeros ácidos en los adhesivos de autograbado son menos potentes en términos de eficacia de grabado en comparación con los convencionales, lo que posiblemente provoque un patrón de grabado irregular y una menor penetración de resina aplicada sobre el diente (Körner, P., et al, 2019).

Por lo mencionado, es normal preguntarse qué hace que el autograbador y el grabado total sean igualmente efectivos en la adhesión de brackets. La respuesta puede radicar en que los niveles de adhesión que se necesita en procesos de rehabilitación oral, sean mucho mayores que los necesitados en ortodoncia. Donde, únicamente se requiere que el adhesivo sea lo suficientemente fuerte para mantener los brackets unidos a los dientes pero no tan fuerte como para que la superficie del diente se dañe cuando se retira el bracket, es decir, en ortodoncia se necesita un sistema adhesivo funcional pero reversible ya que los brackets en algún momento deben ser retirados o reubicados (Mandall, N. A., et al., 2016)

En general esta revisión sistemática no encontró diferencias estadísticamente significativas en el nivel de fracaso de brackets cementados con grabado total y autograbado. Al no encontrarlas, (Ousehal, L., 2016), recomienda usar autograbador, ya que, presenta ciertas ventajas en cuanto a simplicidad, confort para el paciente y ahorro de tiempo en silla. Lo cual, concuerda con lo sugerido en una revisión sistemática publicada anteriormente, quienes mencionan que utilizar la técnica de un solo paso puede resultar en un modesto ahorro de tiempo en comparación con la técnica de dos pasos (Fleming PS., et al, 2012). Igualmente, Basaran, T., et al, 2006, concluye en su artículo que los autograbadores poder ser usados como alternativa a los sistemas de grabado convencional.

Siete de los artículos incluidos en esta revisión, usaron brackets metálicos convencionales, los cuales, fueron cementados con autograbado y grabado total sin encontrar diferencias estadísticamente significativas (Farhadian, N., 2019, Ousehal, L., 2016, Sam, N., 2012, Dominguez, G., 2013, Romano, F., 2012, Mohamad, G., 2015). Mientras que, Mirzakouchaki, B., 2016, usó brackets cerámicos y tampoco encontró diferencias estadísticamente entre los dos sistemas diferentes. Otros estudios, encontraron que los brackets metálicos tienen mayor resistencia adhesiva en comparación con los brackets cerámicos (Arash, V., et al, 2017).

Por otro lado, se ha encontrado que el tipo de falla que predomina es en la interface adhesivo-esmalte (Ciceri, A., et al, 2011); por lo que, se recomienda realizar estudios que comparen las interfaces adhesivo esmalte; y adhesivo – bracket para tener resultados mucho más certeros.

8. Conclusiones

En la cementación de brackets el uso de sistemas de autograbado tienen la misma eficacia que el de grabado total, teniendo en cuenta que la resistencia adhesiva que se necesita en el esmalte puede ser suficiente para mantener los brackets como aditamentos de cementación temporal.

El sistema de autograbado podría generar menor daño en el esmalte durante la descementación, debido a que el adhesivo remanente fue menor en esta superficie.

Basado en las limitaciones y la calidad metodológica de los estudios, se recomienda tomar con cautela los resultados presentados.

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