Bond Survival of Adhesive Precoated Brackets using Self Etching Primers

การศึกษาเปรียบเทียบการอยู่รอดของการติดอยู่ของแบร็กเกตชนิดที่มีสารยึดติดอยู่บนฐานแบร็กเกต
แส Rarity โดยการใช้วิธีที่สามารถควบคู่หน่วยเรื่อยถูกสารยึดติดบนผิว

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ABSTRACT

The purpose of this clinical trial was to evaluate, over a 12-month period, the clinical bond failure of adhesive precoated brackets (APC) or conventional brackets using self-etching primers (SEP) or conventional bonding technique in a sample of North-Eastern Thai orthodontic patients. Sixty randomly selected patients who required full fixed appliances were recruited in a single center randomized clinical trial using a split mouth design was used. A total of 1,030 brackets were bonded. There were no significant difference in bond failure between both conventionally bonded brackets and APC brackets ($P=0.29$) and conventional bonding with SEP ($P=0.52$). Cox’s proportional hazard regression showed that SEP had 1.31 times more chance of bracket failure than conventional bonding and the APC brackets had 1.56 times to prevent bond failure than conventional brackets. No statistically significant differences were found for survival rate with respect to bracket system, bonding technique. Thus, APC and SEP appear to offer viable alternative for orthodontic bonding materials.

Key Words: Bond survival, Self etching primer, Adhesive precoated bracket

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บทคัดย่อ
การศึกษาทางคลินิกเพื่อเปรียบเทียบอัตราการอยู่รอดในช่วงเวลา 12 เดือนของแบร็กเกตแบบเดิมที่ทันตแพทย์เป็นผู้ทำสารยึดติดบนฐานแบร็กเกต และแบร็กเกตที่มีสารยึดติดอยู่บนฐานแบร็กเกตอยู่ก่อนแล้วจากบริษัทผู้ผลิต โดยการใช้วิธีการติดแบบเดิม หรือวิธีที่สารเตรียมผิวเคลือบฟันรวมอยู่กับสารยึดติดบนฟัน โดยสุ่มผู้ป่วยรายใหญ่แยกตะวันออกเฉียงเหนือที่จัดเป็นกลุ่มได้รับการรักษาทางทันตกรรมจัดฟันแบบติดแบร็กเกตเป็นจำนวน 60 คน ในกลุ่มของการศึกษาแบบแยกกลุ่มมีจำนวนเป็นจำนวน 1,030 เบร็กเกต ซึ่งผลการศึกษาพบว่าการสูญเสียของแบร็กเกตแบบเดิมที่ทันตแพทย์เป็นผู้ทำสารยึดติดบนฐานแบร็กเกต และแบร็กเกตที่มีสารยึดติดอยู่บนฐานแบร็กเกตอยู่ก่อนแล้วจากบริษัทผู้ผลิตไม่แตกต่างกันอย่างมีนัยสําคัญทางสถิติ (P=0.29) และพบว่าดั้งเดิมมีสารยึดติดอยู่บนฐานแบร็กเกตชิ้นใดชิ้นหนึ่งโดยการใช้วิธีที่สารเตรียมผิวเคลือบฟันรวมอยู่กับสารยึดติดบนฟันนั้นไม่แตกต่างกับการใช้วิธีที่สารเตรียมผิวเคลือบฟันนั้นเป็น 1.31 เท่า เทียบกับแบร็กเกตที่มีสารยึดติดอยู่บนฐานแบร็กเกตอยู่ก่อนแล้วจากบริษัทผู้ผลิต สามารถป้องกันการสูญเสียของแบร็กเกตได้ 1.56 เท่าเทียบกับแบร็กเกตแยกกลุ่มเดิมที่ทันตแพทย์เป็นผู้ทำสารยึดติดบนฐานแบร็กเกต นอกจากนี้ยังพบว่ามีการเปลี่ยนแปลงของอัตราการสูญเสียของแบร็กเกตไม่ปรากฏตามที่เคยคาดการณ์นั้น การใช้วิธีการติดแบบใด ดังนั้นจึงสรุปได้ว่าแบร็กเกตที่มีสารยึดติดอยู่บนฐานแบร็กเกตอยู่ก่อนแล้วจากบริษัทผู้ผลิต และวิธีที่สารเตรียมผิวเคลือบฟันรวมอยู่กับสารยึดติดบนฟันสามารถเป็นทางเลือกสำหรับสุดท้ายทางทันตกรรมจัดฟัน

Background and Significance

Efficient and economical orthodontic treatment depends upon maintaining the orthodontic appliances in place throughout treatment. According to Sunna and Rock, composite resins are the most popular adhesives for orthodontic brackets (Sonna and Rock, 1999). The bond strength of bracket/adhesive system influence to treatment progress. Previous study shows 0.5% to 16% of bonds fail (Zachrisson, 1977; Read and O'Brien, 1990; Millett and Gordon, 1994; Yap et al, 2004). The bond failure of brackets during treatment increases operator chairside time and lengthens treatment time. A prolong treatment is likely to increase the oral health risks of orthodontic treatment with fixed appliances one of which is irreversible enamel decalcification. It is useful for clinicians to know the best adhesive for fixed orthodontic brackets, to avoid failure during treatment. Typically, current etching techniques involve applying 37% phosphoric acid to dry tooth enamel for approximately 30 seconds (Gardner and Hobson, 2001) prior to thoroughly rinsing and drying the enamel surface. It is a technique sensitive procedure which, if performed incorrectly, can lead to an increase in bond failure, particularly on posterior teeth. The commonest reason for bond failure is moisture contamination (Wertz, 1980; Kinch et al, 1988; Wang and Lu, 1991). The effect of moisture contamination on bond strength of composite to enamel has been thoroughly investigated. Hormati et al, (1980) looked at the effect of contamination (Wertz, 1980; Kinch et al, 1988; Wang and Lu, 1991). The effect of moisture contamination on bond strength of composite to enamel has been thoroughly investigated. Hormati et al, (1980) looked at the effect of saliva contamination on the quality of acid-etched enamel
and its effect on shear bond strength. They showed shear bond strength reduced by 50 percent in the presence of moisture and that simply drying off the saliva was not sufficient. Scanning electron micrographs demonstrated an etched enamel pattern with porosities plugged by moisture, so the depths of the composite tags were not insufficient for retention. It would be helpful to incorporate a feature to overcome this problem. Recently, to overcome this problem, the manufacturers of a light-cured bonding system, Transbond™ (3M Unitek, Monravia, California, USA) have introduced a combined etch-primer system, Transbond-Plus™. This system by combination of etching and priming steps in the bonding process eliminates the need for rinsing and result in reducing the clinical time required for appliance placement. It comprises methacrylated phosphoric acid esters, which will both etch and prime the enamel surface prior to bonding. Obviously, from a clinical perspective this would be very advantageous since isolation should be less of a problem and enamel preparation would be less technique sensitive.

The manufacturers of this self etching primer (SEP) claim that it can be applied to a wet enamel surface and achieve adequate etching and priming in a 3-second period, reduction in bond failure and noticed fewer in the difficult, wet field areas (Miller, 3M Unitek Orthodontic Perspective). By contrast, Larmour et al., (2003) concluded that the SEP should achieve adequate bond strengths when applied to dry enamel surfaces. Bishara et al., (2001), and Bishara et al., (2002) found Transbond-Plus™ SEP has significant lower bond strength than the conventional system, although it could still be considered to be clinically acceptable. A recent survey showed that more than 20 per cent of U.S. orthodontists now use SEP routinely (Keim et al., 2002).

Modern orthodontic bonding adhesives in routine use are Bis-GMA based composite resin systems (Turner, 1996) with variable amounts of filler. Polymerization can be initiated chemically (chemically cured) or with a visible blue light source (light cured) or a combination (dual cured) depending on the system. Most systems require the application of a layer of unfilled resin or primer onto the etched enamel surface prior to bonding. The orthodontic brackets are available both as adhesive precoated (APC) brackets and non-precoated for direct bonding. APC use a more viscous modification of Transbond XT™ adhesive (Bishara et al., 1997). The APC version of Transbond XT™ has a greater amount of filler (80%) compared with Transbond XT™ adhesive (77%) that is used with the operator-coated brackets. The amount of Bis-GMA and Bis-EMA also differs between the two adhesives by only 2%. Both are dual cured. APC brackets are claimed to simplify chairside procedures and improve reliability of bonding. The manufacturer of APC has referred to clinical studies suggesting less than 1% bond failure rate on initial arch wire insertion (3M Unitek Corporation. Advertisement: Adhesive precoated brackets, 1993). Retrospective clinical study of APC over 6 months has demonstrated a failure rate of 3.28% on initial arch wire insertion (Oliver and Dama, 1997). Such a large difference in reported efficacy of the product is disturbing. Although there are a few clinical trials (Fricker, 1992; Miguel et al, 1995; Miller and
Mancl, 1996; Bishara et al, 1997; Oliver and Dama, 1997; Millett et al, 1998; Sunna and Rock, 1999) comparing the effectiveness of orthodontic adhesives, these trials typically compared a glass-ionomer adhesive with a composite resin adhesive (Fricker, 1992; Miguel et al, 1995; Miller and Mancl, 1996). Some studies are retrospective (Oliver and Dama, 1997; Millett et al, 1998). Only two clinical studies have compared prospectively the APC bracket system and Transbond XT™ (Sunna and Rock, 1998; Wong and Power, 2003). Thus, there is conflicting information comparing the efficacy of the APC bracket system and Transbond XT™. There is no study comparing bond failure of APC and Transbond XT™ using SEP and conventional etching system.

The purpose of this 365-day prospective clinical study was to compare the clinical bond failure of APC brackets (MBT prescription) and conventional brackets (MBT prescription) by using SEP (Transbond Plus™) and conventional bonding technique when randomly assigned in a split mouth design.

Protection of Human Subjects

According to ethical guidelines stated in the Helsinki’s Declaration, the study was granted approval by the Institutional Review Board (IRB) committee at Khon Kaen University in December 2006 and the patients or parents would give consent to the trial.

Methods

Single center randomized clinical trial study by using a split mouth technique was performed with sixty patients from the waiting list of the Orthodontics Department, Faculty of Dentistry, Khon Kaen University, Thailand between December 2006 and November 2007 were recruited for this study. Patients were eligible for inclusion in the study if they required two arch fixed appliance therapy, no history treatment by fixed orthodontic appliances, full eruption of permanent teeth, free of caries and fillings, no enamel hypoplasia and no occlusal interference which could affect bracket bond survival. All subjects will be treated by the same clinician.

Materials

1. 3M Unitek GEMINI metal adhesive precoated brackets MBT prescription (APC)
2. 3M Unitek GEMINI metal conventional brackets MBT prescription
3. 3M Transbond Plus self etching primer (SEP)
4. 3M TransbondXT primer and adhesive
5. 37% phosphoric acid etching gel

Treatment Groups

There are four types of brackets and bonding technique combinations.

Group A. Conventional brackets with conventional (conv.) bonding technique (37% phosphoric acid)
Group B. Conv. brackets with SEP.
Group C. APC with conv. bonding technique
Group D. APC with SEP.

A Demetron LC (Kerr) visible light curing unit was used for polymerization.
Bonding procedures

Split-mouth technique was employed by clockwise rotation of brackets and bonding technique combinations according to quadrant of the mouth that resulted in four series of bonding pattern as shown in Figure 1. There are fifteen copies for each series. Each copy sealed in white envelop placed in a box that was chosen by patients.

The operator followed the bonding pattern that the patient was picked, the teeth were cleaned with a rubber cup and water/pumice slurry, rinsed, and isolated using cheek retractors and a low volume suction evacuator. The appropriate etch and primer system for each quadrant was then applied, according to the manufacturers’ instructions. Bonding procedures were started with Transbond™ Plus SEP blisters were activated, the liquid rubbed onto the tooth surface for at least 3 seconds, followed by a gentle airburst directed away from the gingival margin using a 3-in-1 syringe, and it was ensured that the tooth surface retained a glossy appearance. APC brackets or conventionally bonded brackets were bonded using Transbond XT™ (3M Unitek) light cure adhesive on the base of the bracket, which were then placed on the labial or buccal surface of the tooth. Any excess composite was removed with a sharp dental probe prior to curing. The adhesive was cured using light polymerization for 20 seconds (10 seconds mesially and 10 seconds distally). For the two-step 37 per cent phosphoric acid, the etchant gel was applied for 30 seconds, the tooth surface was washed for 30 seconds and dried using a 3-in-1 syringe until the enamel was frosty white, and Transbond XT™ primer was applied via a microbrush. When all teeth were primed a gentle airburst to each tooth was directed away from the gingival margin using a 3-in-1 syringe, and it was ensured that the tooth surface retained a glossy appearance. APC brackets or conventionally bonded brackets were bonded in the same manner as in SEP group. The adhesive was cured using light polymerization for 20 seconds (10 seconds mesially and 10 seconds distally). The power output of the curing lights was checked on a weekly basis.

Depending on the severity of the crowding, initial aligning archwire either 0.014-inch NiTi or 0.014-inch premium plus Australian Wilcox wire were tied into the bracket slots with elastomeric modules after completion of bonding. Patients were advised to detect bond failure which is any bracket that is dislodged and becomes detached from the archwire at any time. Patients were reappointed at 4 weeks interval.

Figure 1 Clockwise rotation of brackets and bonding technique combinations
Data Collection

Each subject was monitored for 12 months. Date of bonding of the brackets, tooth number of bond failure, number of brackets failed and date of bond failure were recorded.

Blinding

The patients were not aware which protocol was used for bracket boning in which quadrant of the mouth. It was not possible to blind the operator at the first visit of bonding. If a bond failed, data collector who was the operator was not recognize which protocol was used and no information recorded about the protocol used in which quadrant in the patients charts. This information was retrieved after the end of the clinical trial.

Data Analysis

The data were tested with survival analysis by STATA 9 for comparing survival rate of each intervention to evaluate the factors that might cause bond failure in this study: Kaplan-Meier survival graph showed the relationship between bracket survival rate and the duration of treatment for the bonding materials; Log-rank test was used to evaluate the difference in overall survival probability in each group. Cox proportional hazard model for hazard ratio was used to evaluate the factors that might cause bond failure in this study.

Results

Profiles of randomized clinical trial

Sixty patients fulfilled the inclusion criteria and were entered into the trial. The brackets type/bonding technique combination were randomly allocated to all 60 patients, with total of 1,030 brackets. Number of bonded brackets according to Treatment Group are Group A 260 brackets, Group B 256 brackets, Group C 255 brackets and Group D 259 brackets.

Clinical bond failure rates

The total bracket failure was 23 brackets and the overall failure rate was 2.23 per cent. The bracket failure according to bonding system and bracket type were demonstrated in Table 1 and 2.

Table 1 Bracket numbers and failures according to bonding technique

<table>
<thead>
<tr>
<th>Bonding system</th>
<th>Total number (bracket)</th>
<th>Failure (bracket)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv bonding</td>
<td>515</td>
<td>10</td>
<td>0.52</td>
</tr>
<tr>
<td>SEP</td>
<td>515</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

During the 12-month observation period, the overall bracket failure rate for all brackets in the study was 2.23%. The failure rate was 2.52% for brackets bonded with SEP, and 1.94% for conv. bonding (Table 1), which are not significantly different (p = 0.52).

The bracket failure rate according to the type of bracket used was 1.75% for the APC, and 2.71% for conv. brackets (Table 2). The failure rate of APC was found to have lower failure rate than the conv. brackets, but they were not significantly different (p = 0.29).
Table 2  Bracket numbers and failures according to type of bracket

<table>
<thead>
<tr>
<th>Bracket</th>
<th>Total number (bracket)</th>
<th>Failure (bracket)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv. bracket</td>
<td>516</td>
<td>14</td>
<td>0.29</td>
</tr>
<tr>
<td>APC</td>
<td>514</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Bracket survival

Survival analysis was performed by STATA 9 to compare survival rate according to bonding technique (Table 3) and type of bracket (Table 4). Kaplan-Meier survival graph to show the relationship between bracket survival rate and the duration of treatment for each bonding technique (Fig. 2) and each type of bracket (Fig. 3).

Table 3 Bond survival according to bonding system

<table>
<thead>
<tr>
<th>Bonding system</th>
<th>% survival prob.</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv. bonding</td>
<td>97.95</td>
<td>96.20-98.89</td>
<td>0.52</td>
</tr>
<tr>
<td>SEP</td>
<td>97.36</td>
<td>95.49-98.46</td>
<td></td>
</tr>
</tbody>
</table>

The survival rate using SEP was lower than with conv. bonding (Table 3), but not significantly different (p = 0.52).

Figure 2  Bond survival according to bonding technique

The survival plot for each bonding technique showed slightly lower survival rate of SEP than conventional bonding.

Table 4 Bond survival according to bracket adhesive system

<table>
<thead>
<tr>
<th>Bracket</th>
<th>% survival prob.</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv. bracket</td>
<td>97.14</td>
<td>95.21-98.30</td>
<td>0.31</td>
</tr>
<tr>
<td>APC</td>
<td>98.17</td>
<td>96.50-99.04</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3  Bond survival according to bracket type

The survival plot for each type of bracket showed slightly higher survival rate of APC than conv. bonding.
By contrast, the APC were found to have higher survival rate than conventional brackets used with conventional adhesive. (Table 4), but not significantly different (p = 0.31).

Hazard ratio

Hazard ratio comparing between each bonding technique and each bracket type was evaluated by Cox proportional hazard model (Table 5).

### Table 5  Hazard ratio by Cox’s proportional hazard model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Adjust (Adjust)</th>
<th>95%CI</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conv. bracket</td>
<td>1</td>
<td>0.64</td>
<td>0.27-1.48</td>
</tr>
<tr>
<td>APC</td>
<td>0.64</td>
<td>0.27-1.48</td>
<td>0.30</td>
</tr>
<tr>
<td>Conv. bonding</td>
<td>1</td>
<td>1.31</td>
<td>0.57-2.98</td>
</tr>
<tr>
<td>SEP</td>
<td>1.31</td>
<td>0.57-2.98</td>
<td>0.52</td>
</tr>
</tbody>
</table>

* p value from partial likelihood ratio test

Cox’s proportional hazard regression (Table 5) showed that SEP had 1.31 times more chance of bracket failure than conventional bonding over the 12-month observation period (Hazard ratio 1.31 with 95% CI : 0.57-2.98) and the adhesive pre-coated brackets had 1.56 times to prevent bond failure than conventional brackets (Hazard ratio 0.64 with 95%CI : 0.27-1.48). This clinical study showed both APC and SEP were not have significant effect to bond failure.

**Discussion**

**Study design**

A clinical trial is a planned experiment on human beings and is designed to evaluate the effectiveness of one or more forms of treatment (Altman, 1991). It is vital, when planning the design of such a study, to ensure that the allocation of treatment regimes is independent of characteristics of the patients. The most acceptable method is random allocation. In this study, patients were successively allocated into various treatment groups (bracket/bonding combinations). This is sometimes referred to as “Pseudo-randomization” due to the openness of the allocation system. However, if conducted properly, successive allocation should introduce no bias in the study and for all practical purposes may be considered random (Altman, 1991).

In general, testing of bonding efficiency in orthodontics can be classified in two major categories: bond strength studies and clinical failure rate trials. Bond strength protocols provide strength values and allow for the study of fractured surfaces to investigate failure pattern. However, these studies, which are in vitro, have deficiencies attributed to confounding variables such as tooth morphology and structure, tooth selection and storage method, enamel surface preparation, amount of adhesive and force applied on the bracket, specimen mounting, and testing methods. These problems, coupled with the notable lack of a clinically derived minimum requirement for bond strength, make the clinical relevance of the method problematic. Also, masticatory forces and aging of adhesives cannot be assessed and, thus, no information on long-term
bond survival can be extrapolated from in vitro studies.

Clinical bond failure studies, on the other hand, have become popular recently because of their clinical relevance and because the examined variable is the actual survival of bonds. However, this method does not provide insight into the cause or pattern of failure. Moreover, this protocol is demanding from a setup perspective; it is laborious, requires extended monitoring, and is difficult to apply in an ordinary practice setup. Large clinical environments, such as those in educational institutions, have unfavorable features such as multiple operators, the socioeconomic and dental status of patients, and variations in malocclusion classification and resultant mechanotherapy, ie, use of interarch elastics, and space closure with chains, among others. Precautions must be taken to avoid cross-effects from various participant-related parameters such as habits, masticatory forces that vary with facial type, and diet. Also, several operator-induced parameters variables should be ruled out, including mechanics, handling of materials, and bonding procedures.

Differences in failure rate evidence from studies testing identical materials in different populations imply that culturally influenced dietary habits and sex differences can affect the failure rate of brackets in vivo. Thus, the variability observed among studies with regard to failure rates, jaw distribution, arch location, variations in malocclusion classification, habits could be assigned to be factors that influence bond failure.

In this study, all patients were bonded by one clinician to eliminate inter-operator variation. Only first time bond failures were recorded. This was to eliminate possible variation in bond strength introduced by re-bonding which may have skewed the results. Kinch et al, (1988) found a less favorable survival rate of second and third time bonds compared to first time failures. Therefore, this clinical study evaluating bond failure rated only first time failures in the patients who have no experience of orthodontic treatment.

**Evaluation of bond failure**

During the 12-month observation period, the overall clinical bracket failure rate for all brackets in the study was 2.23%. This is lower than the rates reported by O’Brien et al, (1989) who found clinical failure rates 4.7 per cent, Sonis and Snell, (1989) who found 4.5-7.7 per cent, Sunna and Rock, (1998) with 6.6 per cent, and Kula et al, (2002) with 7.5 per cent for various bracket/adhesive combinations. Oliver and Dama, (1997) found 9.59 per cent of brackets failure over six months observation. Wong and Power, (2003) found 7.37 per cent of clinical bracket failure within six months. For meaningful comparison of failure rates, it is important to note the observation period.

**Bracket failure and survival analysis of APC brackets versus conventional brackets (Transbond XT™) using 37% phosphoric acid etching technique**

The bracket failure rate according to the bracket used was 2.35% for the APC brackets and 1.54% for brackets with conventional adhesive applications, but without significant difference. This clinical study supports the findings of Sunna and Rock, (1998), Kula et al, (2002) and Wong and
Power, (2003) found higher failure of APC brackets, but with no significant difference. By contrast, Oliver and Dama, (1997) found APC brackets failed significantly more often than conventional operator-coating with a light-cured adhesive different from Transbond XT™.

This clinical results of this clinical study are also supported by in vitro study of Bearn et al, (1995), and Sunna and Rock, (1999) who found no significant difference in mean bond strength between APC brackets and conventional brackets. However, Bishara et al, (1997) found APC brackets had a significant lower shear bond strength than the uncoated brackets bonded with Transbond XT™.

Bracket failure and survival analysis of APC brackets versus conventional brackets (Transbond XT™) using SEP

The bracket failure rate using SEP with conventional brackets was 3.90%, and 1.16% for APC brackets, but without significant difference. Survival rate of APC brackets using SEP (98.76%) was higher than conventional brackets (95.95%), but the difference was not significant.

This study found only slightly inferior performance of SEP compared with conventional etching, 3.90% of bond failure in the group using SEP with conventional brackets and 1.54% of bond failure in the group using conventional etching technique with conventional brackets. This result was supported by some clinical studies carried out with a 12-month observation period that using Transbond XT™ (Fricker, 1994; Murfitt et al, 2006). Contrast with this study, the better performance were obtained with the SEP in accordance with other recent clinical evaluation (Aljubouri et al, 2004; Pandis and Eliades, 2005).

To date, little has been reported on the clinical efficacy of SEP for orthodontic bonding. There have been a number of in vitro studies of such primers and, when shear bond strength has been used as the measurement parameter, bond strengths have been found to be either comparable (Arnold et al, 2002) with or less than conventional acid-etching with 37% phosphoric acid (Bishara et al, 2002). This might perhaps explain why, in the present study, the bond failure rate after using the SEP was higher than that observed after conventional etching.

Conclusion

The result from this study demonstrated that Transbond Plus™ SEP and APC bracket can be effectively used as orthodontic bonding material because they have comparable bond survival and failure rate with conventional technique. The operator should weigh the advantage of time-saving versus the increasing cost for the different techniques. Further study should be considered because there is conflicting information comparing the efficacy of the APC bracket system and Transbond XT™ SEP.

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References


