Original Article

Long-term Clinical Failure Rate of Molar Tubes Bonded with a Self-etching Primer

Nikolaos Pandis[a]; Lars Christensen[b]; Theodore Eliades[c]

Abstract: The purpose of this study was to assess the long-term in vivo failure rate of tubes bonded to first and second molars with a self-etching primer (SEF). A total of 810 molar tubes (414 first molar and 396 second molar) were bonded on 135 patients (56 male, 79 female; mean age 14 years) with the 3M Transbond Plus Self Etching Primer. The first-time failures of the tubes were recorded for a mean period of 26 months (range 23–29 months). Failure rates per jaw (maxilla-mandible), tooth (first and second molar), and quadrant (left, right) were analyzed with the χ^2 at $\alpha = 0.05$ level of significance. Significant differences were found in the failure rate between first and second molars (9.66% vs 20%, respectively) as well as maxillary and mandibular molars (7.5% vs 21%, respectively). The combined, total failure rate for first and second molars was 14.80%. No difference was found between male and female failure rates for the molar tubes. First-molar tubes bonded with an SEF may show failure rates comparable with those reported in the literature for tubes bonded with conventional acid etching. (*Angle Orthod* 2005;75:1000–1002.)

Key Words: Molar bonding; Self-etching primer; Failure rate

INTRODUCTION

Recently, a new group of products termed self-etching primers (SEF) has been introduced in orthodontics to facilitate efficiency and simplification of bonding procedures. Several studies and clinical reports[1–3] have described the clinical use of SEF, whereas a recent survey showed that over 20% of practitioners in the United States routinely use them for bonding.[4] Research in the associated field of restorative dentistry reported that the use of SEF produces a less defined enamel etching pattern compared with that resulting from the conventional acid-etching technique.[5] However, no direct correlation between a specific etching pattern and bond strength has been identified.[6] In addition, the bond strength values found with SEF were comparable with those found for enamel conditioned with phosphoric acid.[7]

Several in vitro investigations have indicated that SEF may be less sensitive to water or saliva contamination compared with conventional acid etching.[8–10] Consequently, comprehensive evaluation of bonding to molars has received limited attention in the orthodontic literature and has mainly been concentrated on first molars with very limited or no reference to second molars.[11] Despite the fact that the advantages of bonding relative to banding molar teeth include improved periodontal health and patient comfort, this technique is used less frequently in fixed orthodontic treatment.[11] The most recent survey in the United States shows that 22–30% of orthodontists routinely bond molars.[4]

The purpose of this study was to evaluate the long-term clinical failure rate of molar tubes bonded to first and second molars with an SEF.

MATERIALS AND METHODS

A total of 135 consecutively treated patients (79 female and 56 male; mean age 14 years; range 10–34 years) were included in this study. A total of 810 molar tubes (414 first molar and 396 second molar) (Speed System Orthodontics, Cambridge, Ontario, Canada) were bonded on maxillary (202 first, 197 second) and mandibular (212 first, 199 second) molars. For the mandibular second molars, the miniversion of the molar tube was used as proposed by the manufacturer.

The sound buccal surfaces of the molars were pumiced and rinsed, and extra care was taken to remove any calculus present. This is an important step because with the SEF there is no visibly detectable

[a] Private practice, Corfu, Greece.
[b] Private practice, London, U.K.
[c] Associate Professor, Department of Orthodontics, Aristotle University of Thessaloniki, Thessaloniki, Greece.
Corresponding author: Theodore Eliades, DDS, MS, Dr Med, PhD, 57 Agnoston Hiroon Street, Nea Ionia GR-14231, Greece (e-mail: teliades@ath.forthnet.gr)

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TABLE 1. Failure Rate (%) of the First- and Second-molar Tubes in the Maxillary Arch

	Quadrant		
Tooth	Left	Right	Total
First molar	5.77	8.16	6.93
Second molar	7.01	12.24	9.59
Total	6.39	10.2	

Note: Jaw and tooth cumulative rates reported in Abstract were derived from the mean of value shown in the table.

chalky enamel surface, as in the traditional acid-etching method, and thus, no gross estimate of the etching efficacy is available. Particular care should be taken on displaced and rotated teeth because these are more difficult for the patients to clean properly.

Subsequently, Transbond Plus Self Etching Primer (3M/Unitek, St Paul, Minn) was applied, and the molar tubes were bonded with the Transbond XT adhesive (3M/Unitek). A high output curing light unit, Optilux 501 with the eight-mm turbo and light guide (Ormco, Glendora, Calif), at boost mode, was used to cure each molar tube for a total of 25 seconds (five seconds on the mesial, distal, gingival, occlusal, and between the first and second molar tubes). The curing light output was checked on a regular basis, and the readings were between 900–1000 mW/cm^2 at all times as measured with a curing radiometer that is incorporated in the light curing unit (Optilux). All quadrants were bonded in the same manner.

The initial wire (0.016-inch NiTi) was placed in all cases immediately after bonding followed by various combinations of round and rectangular NiTi and stainless steel wires as treatment progressed. Recording of failed tubes involved only first-time failures, and the observation period was a minimum of 23 months for all cases (range 20–26). All bonding and clinical procedures were performed by the same practitioner. The results of the failure rates were analyzed with χ^2 test at $\alpha = 0.05$ level of significance.

RESULTS

Table 1 illustrates the failure rates (%) for first and second molars bonded in the maxillary arch. Significant differences were observed between the left and right quadrants as well as between the first and second molars. In Table 2, the failure rates (%) of the first- and second-molar tubes in the mandibular arch are depicted (for simplicity, significance is not shown in the table). A significantly higher failure rate was observed for mandibular molar tubes relative to their maxillary counterparts, whereas the right-side second-molar tube was the bond that showed the highest failure rate. No difference was observed between male and female participants with respect to failure.

TABLE 2. Failure Rate (%) of the First- and Second-molar Tubes in the Mandibular Arch

	Quadrant		
Tooth	Left	Right	Total
First molar	6.67	17.76	12.26
Second molar	26.2	35.3	30.65
Total	16.43	26.53	

DISCUSSION

The total failure rate for the posterior teeth was 14.80%, although individual variability ranged as much as 30%. Some of the factors contributing to the higher failure rate are possibly moisture contamination, heavy occlusal contacts, tube base adaptation to the curved buccal molar surface and nonuniform resin thickness.[11] Although it has been proposed that the presence of aprismatic enamel and nonideal etch pattern of posterior teeth also contribute to the lower bond strengths on molars, recent evidence suggests that specific etching patterns are not critical for bond strength.[12]

The results of this study are in agreement with the retrospective study of Millett et al,[11] who analyzed records from 483 patients with 1190 first-molar attachments placed during a five-year period using the light-cured adhesive Transbond XT (3M Unitek) and conventional acid etching for 60 seconds. The overall failure rate in that study was found to be 21%, with 22% on the maxillary molars and 20% on the mandibular molars. Also, Zachrisson[13] recorded failure rates of 18.8% and 29.5% for brackets bonded on the maxillary and mandibular molars, respectively, using the chemically cured adhesive Concise (3M Unitek). However, the study by Zachrisson[13] included some mandibular second molars, which were not bonded until later in the treatment.

In this study, the second molars had the highest rate of failure on all quadrants. Possible explanations for this event may include heavier forces at the posterior segment of arch, heavier occlusal contacts on the mandibular teeth, and difficulty in reaching the buccal surfaces of these teeth because of partial eruption or cheek proximity. Similarly, in the mandible, the failure rate was higher for both first- and second-molar tubes. Possible explanation to the higher failure rate on the mandible could be attributed to occlusal interferences where the maxillary cusps occlude on the mandibular molar attachment. It should be noted that in this study, all lower molars were bonded regardless of interferences with the maxillary teeth. The only case where bonding to lower molars was not performed was with restorations on the buccal molar surface. In situations where the base was partly on the restoration and part-

ly on enamel, bonding was performed as described above. It is likely that if teeth with occlusal interferences had been excluded before the bonding process, the failure rate would have been decreased.

An interesting observation pertains to the significantly higher failure noted on the right side compared with the left, for both first- and second-molar tubes. This could be related to the position of the clinician in relation to the patient, the sequence of the bonding procedure left to right/right to left or the masticatory habits of patients who prefer to chew on the right side.

This observation emphasizes the complex nature of clinical failure protocols. This type of study presents a major advantage related to the profound clinical relevance associated with the fact that the examined variable is the actual survival of bonds. However, this method does not provide an insight into the cause or pattern of failure. Moreover, failure-rate protocols are very demanding from a setup perspective because it is laborious, requires extended monitoring, and as such, it is difficult to be applied in an ordinary practice setup.

On the other hand, large clinical environments, such as those found in educational institutions, carry some unfavorable features such as the intervention of multiple operators, the socioeconomic and dental status of patients seeking treatment in institutions, variations in malocclusion classification and resultant mechanotherapy (use of interarch elastics, variety of archwires, etc). These factors may introduce cross effects from various participant-related parameters such as habits, masticatory forces, which vary with facial type, and diet.

Differences may also be derived from culturally influenced dietary habits, sex or age variants associated with masticatory forces, and thus, a careful selection of participants is necessary for the exclusion of potential confounding variables. There are also several operator-induced parameters, which should be ruled out including handling of materials and bonding procedures. This study involved monitoring and recording of failure rates for 23 months to increase the clinical relevance of the findings, whereas all treatment procedures, bonding, and handling of materials were performed by the same operator to decrease interoperative variability.

CONCLUSIONS

The results of this study suggest that SEF may be effectively applied to bonding first-molar tubes, whereas further research is necessary to verify their effectiveness in second molars, especially in the mandible.

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