Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.intl.elsevierhealth.com/journals/jden

A 7-year randomized prospective study of a one-step self-etching adhesive in non-carious cervical lesions. The effect of curing modes and restorative material

Jan W.V. van Dijken [a,*], *Ulla Pallesen* [b]

[a] *Department of Odontology, Faculty of Medicine, Umeå University, Umeå, Sweden*
[b] *School of Dentistry, Faculty of Health Sciences, University of Copenhagen, Denmark*

ARTICLE INFO

Article history:
Received 1 June 2012
Received in revised form
14 August 2012
Accepted 27 August 2012

Keywords:
Adhesion
Clinical
Curing techniques
Dental material
Resin composite
Restoration
Self-etch

ABSTRACT

Objective: The aim of this study was to evaluate the clinical retention of a one-step self-etching adhesive system (Xeno III) in Class V non-carious cervical lesions and the effect of restorative material and curing techniques on longevity of the restorations.

Materials and methods: A total of 139 Class V restorations were placed with the self-etching primer Xeno III and a resin composite (Tetric Ceram) or a poly-acid modified resin composite (Dyract AP) in non-carious cervical lesions without intentional enamel involvement. The materials were cured with a conventional continuous light, a soft-start or a pulse-delay curing mode. The restorations were evaluated at baseline, 6, 12, 18 and 24 months and then yearly during a 7 year follow-up with modified USPHS criteria. Dentine bonding efficiency was determined by the percentage of lost restorations.

Results: During the 7 years, 135 restorations could be evaluated. No post-operative sensitivity was reported by the participants. Overall relative cumulative loss rate frequencies for the adhesive system at 6 and 18 months and 7 years, independent of curing technique and restorative material, were 0.8%, 6.9% and 23.0%, respectively. The self-etching adhesive fulfilled at 18 months the full acceptance ADA criteria. Tetric Ceram showed at 7 years a 20.9% loss of retention and Dyract AP a 25.0% loss rate (Log rank $p = 0.48$). The loss rates for the 3 curing techniques: continuous, soft start and pulse delay were 17%, 27.9% and 24.4%, respectively (Log rank $p = 0.52$). No secondary caries was observed.

Significance: The single-step self-etching adhesive showed acceptable clinical long-time retention rates to dentine surfaces independent of restorative material and curing technique used.

1. Introduction

All current dimethacrylate-based dental resins produce volumetric shrinkage during polymerization. The radical cross-linking process transforms the uncured shapeable resin composite (RC) into a stiff and hard solid. During the first viscous-plastic phase of polymerization shrinkage, stress is transmitted through the restoration and applied to the bonded marginal interfaces.[1] If the strength of the bond is weak, a gap will develop between the restorative material and the tooth. Before the gel point is reached, stresses developed from the

* *Corresponding author at*: Department of Odontology, Dental School Umeå, Umeå University, 901 87 Umeå, Sweden.
Tel.: +46 90 7856034/7856226; fax: +46 90 770580.
E-mail address: Jan.van.Dijken@odont.umu.se (van Dijken Jan WV).
0300-5712/$ – see front matter
http://dx.doi.org/10.1016/j.jdent.2012.08.017

monomer reaction in the low modulus material can be released by flow from the unbonded surfaces.[2] A variation of the reaction kinetics may influence the interplay of decreasing flowability, change in volume, and increase in stiffness, which may result in variations of the build up of internal stresses. Gap formation has been associated with continuous, high light intensity exposure.[3] Faster polymerization with a high intensity increase the elastic modulus of the RC material, increase shrinkage stress and enamel crack formation.[3] The effects of polymerization stress are stated to result in clinical negative effects like microleakage, marginal discolouration, fracture of tooth and/or RC, post-operative sensitivity and recurrent caries.

In the late 1990s, several authors have suggested that reduced light-intensity will delay the onset of the gel point and prolongs the early stage of setting in which the major part of shrinkage occurs. A slower rate of conversion may provide a higher flow capability from the unbonded surface, reducing interfacial stress formation.[4] The visco-elastic response of resin-based restorative materials may also be influenced by their initial E-moduli, as a result of differences in matrix monomers and filler loading. Several curing techniques have been suggested using low energy levels during the initial exposure, which may increase pre-gelation time.[5–7] Soft-start techniques can be divided in stepped, ramped or pulse-delay. In the stepped technique, the curing light provides low energy during the first 10 s, followed by full intensity for the further duration of the exposure. Ramped curing techniques initiate output at a low level, and then gradually increases to maximum intensity over a short period, after which it remains on this level. Significant reduction in gap formation was shown in vitro when using these soft start techniques.[5,6] In the pulse-delay technique, advocated only for the outer filling layer, a low level intensity is delivered for a short time (3 s, 200 mW/cm^2). This is followed by a delay for finishing and polishing and a final long exposure at full intensity (600 mW/cm^2). The conversion in the deeper layers is thought to slowly continue during the delay period.[3,8] A reduction of cavosurface gap formation and enamel fractures have been reported.[3,7,9] These techniques are thought to significantly delay gel point formation without affecting the final degree of conversion. Few, all short time, studies have reported the in vivo effect of the stress decreasing curing techniques on restoration or bonding durability.[10–13]

In the multi-step etch-and-rinse adhesive systems the etching and primer application steps are critical and clinical success is partly operator related. Self-etching adhesives are more user-friendly and less technique sensitive. The simultaneously etching and primer infiltration of the tooth tissues of the self-etching adhesives, eliminate the risk of over-etching and over-drying and reduce the risk of postoperative sensitivity. Although their short time bonding ability has been reported, the long-term durability is not well studied.[14–17] The clinical retention of polyacid modified resin composites, materials with lower elasticity modulus compared to traditional resin composites, bonded with self-etching adhesives showed moderate to low retention rates in non-carious cervical lesion studies.[13,18]

The aim of this study was to investigate a one-step self-etching adhesive in combination with a RC material or a poly-acid resin-modified resin composite (PMRC and the effect of curing mode on durability in non-carious cervical lesions. The first hypothesis tested was that restorations performed with the PMRC show similar clinical retention compared to those with RC. The second hypothesis tested was that there is no difference between the curing techniques.

2. Materials and methods

During the period October 2002–May 2003, all patients attending the author's PDHS clinic at the dental school Umeå, for who treatment of non-carious cervical lesions was indicated were requested to participate in the study. No patient was excluded because of caries activity, periodontal condition or parafunctional habits. Each patient provided informed consent to participate in the study. The study was approved by the ethics committee at the University of Umeå. A total of 139 class V restorations were placed in 60 patients, 33 men and 27 women with a mean age of 61.5 year (min–max 43–84). All restorations were placed in dentine lesions without any intentional enamel involvement, by one experienced operator, familiar with adhesive dentistry. Forty-seven restorations were placed in anterior teeth and 92 in posterior teeth, 58 in premolar and 34 in molar teeth. Fifty-eight in the maxilla arch and 81 in the mandibular. A single-step, two bottle, self-etching primer (Xeno III; Dentsply/DeTrey, Konstanz, Germany; lot nr 0206001237) was evaluated in combination with two different restorative resinous materials, a conventional hybrid resin composite (Tetric Ceram; Ivoclar/Vivadent, Schaan, Liechtenstein; lot E17820) and a poly-acid modified resin composite (PMRC) (Dyract AP, Dentsply/DeTrey; batch nr 0203001190). After the operative procedure decision, the six RC-curing mode subgroups were allocated to the lesions in a randomized way by taking blinded for each lesion a paper from a bowl. Each paper had a number referring to a list, made in advance, with all the planned number of restorations for all subgroups.

Xeno III is a two part based adhesive system. Liquid A contains water, ethanol, HEMA, UDMA and BHT (2,6-di-tert-butyl-p hydroxyl toluene) and nanofiller. Liquid B contains UDMA, CQ, EPD (p-dimethylamino ethyl benzoate) and two new patented monomers Pyro-EMA (tetramethacryloxyethyl pyrophosphate and PEM-F (pentamethacryloxyethyl cyclophospazen mono fluoride).

2.1. *Operative procedure*

The operative field was isolated with cotton rolls and a saliva suction device. Before conditioning, the lesions were cleaned preoperatively from plaque and/or saliva if necessary with a polishing paste. The adjacent gingiva was retracted by gingival retraction instruments or matrix bands when necessary to secure unrestricted contamination free access to the field. No bevel was placed. Application of the primer was performed according to the manufacturer's instructions. After mixing, the primer was applied active for 20 s, followed by carefully air drying for at least 5 s to remove the solvent and taking care not to thinnen the primer layer. The layer was then light cured for at least 10 s (Astralis 7, HP curing mode