

Title	In vitro assessment of the effectiveness of self-etching adhesives for the restoration and prevention of root surface caries
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論 文 内 容 の 要 旨

【目的】

Higher prevalence of exposure of the root surfaces to the oral environment increases the risk of root surface caries in elderly people, and it is important to establish effective treatment and preventive measures for root surface caries to promote oral health of this group of people. Since access to carious lesion and moisture control are difficult, the use of self-etching adhesives with simple manipulations is considered to be useful to provide better prognoses when restoring root surfaces. In addition, resin coating of dentin has proved to have protective effects against demineralization, so that self-etching adhesives are expected to be effective to prevent the occurrence of caries on roots.

The objectives of this study were (1) to determine how effective contemporary self-etching adhesives are for restoring roots; (2) to assess the effectiveness of their application on cementum to prevent from demineralization ; and (3) to examine an experimental surface-coating material for the latter purpose.

【方法ならびに成績】

To determine the bonding stability of proprietary self-etching adhesives, morphology of the interfaces on sound and caries-affected dentin produced by five single-step adhesives ; Adper Prompt L-Pop (AD), Absolute (ABS), One-Up Bond F (ON), Clearfil Tri-S Bond (S3), Reactmer Bond (RE), and a two-step system Clearfil SE Bond (SE) was analyzed immediately and 24 h after restoration using SEM. The bonding ability of each adhesive was also examined by measuring microtensile bond strength (MTBS) using restorations of the cavities prepared on roots. AD and ABS with aggressive etching effects showed integrity of the interface regardless of time elapsed from the moment of restoration, similarly to SE. Mild and intermediately strong single-step adhesives, ON, S3, and RE exhibited defects at the bonding interface immediately after restoration, indicating less stability at the initial stage. Especially RE, which involves glass-ionomer reaction as the major part of the setting mechanism,

showed fragile interface to both dentin substrates, at the early stage. There were no significant differences in the MTBS values among the five single-step adhesives for both storage periods, while the two-step system SE demonstrated significantly greater values than the single-step systems ($p < 0.05$, ANOVA, Fisher's PLSD test).

Serving as a reference frame to confirm the necessity of intensive preventive measures for root surface caries, the vulnerability of root surface to acid was investigated by acid challenge tests, in which the cementum and enamel specimens obtained from human extracted molars were exposed to buffer solutions of pH 5.5-6.8 at 37°C for 4 weeks. Both enamel and cementum showed complete demineralization under pH 5.5. For cementum, demineralization was observed for 43% of the specimens at pH 6.3, and 29% at pH 6.5 and 6.8, while no demineralization was observed for enamel at pH 6.3-6.8. Cementum was confirmed to be more vulnerable to acid compared with enamel, exhibiting demineralization at pH 6.8 and lower under the present experimental condition.

To assess the effectiveness of application of self-etching resinous materials on prevention of root surface caries, proprietary self-etching adhesives (AD, S3) or an experimental coating material (EC), which consisted of a mild self-etching primer and a multifunctional acrylate-based resin, was applied on the cervical roots of extracted teeth and the acid challenge tests were performed using pH 5.5 acetate buffer. A dentin sealer, Seal & Protect (SP), was also tested for comparison. In addition, the surface-coating and the morphology of the adhesive-cementum interface produced by each material was observed using SEM, and the MTBS to cementum was compared. After immersion in acid buffer, demineralized areas were produced for most of the specimens covered with AD or S3, some of them exhibiting extended demineralization patterns. On the contrary, none of the EC or SP specimens demonstrated demineralization. The morphological analysis showed that all the materials covered the cementum surface, but the coating thickness of EC was significantly greater than those produced by AD or S3 ($p < 0.05$, ANOVA, Fisher's PLSD test). Although the formation of hybridized layers was observed for all the materials (7-9, 1-4, 4-6, and 2-4 μ m thick for AD, S3, EC, and SP, respectively), those formed by AD were porous in comparison with the tight structures produced by the others. EC showed significantly lower MTBS values compared with AD or S3, showing cohesive fracture in resins.

【総括】

To conclude on composite resin restorations of roots using single-step self-etching adhesives, those with strong etching effects are considered to be advantageous over mild self-etching systems to obtain stable bonding from an early stage. However, they do not surpass the two-step self-etching systems in terms of morphological stability and bond strength to dentin. A simplified manipulation should not be considered first when choosing a treatment method at the detriment of the stability of restorations in cervical root dentin.

It was confirmed that the vulnerability of cementum to acid was high, and the need of preventive measures against demineralization of the root surface was strongly suggested. The tested proprietary single-step self-etching adhesives demonstrated limited effects to protect roots from demineralization. Although the MTBS values to cementum were low, the proposed experimental coating material was able to prevent root surfaces from acid demineralization by producing an integral hybridization with cementum and a moderately thick surface-coating, suggesting its possible effectiveness to prevent root surfaces from caries.

論文審査の結果の要旨

本研究は、歯根面の修復とう蝕予防におけるセルフエッチング型接着性レジンの有用性について *in vitro* で評価したものである。

その結果、修復直後から安定した接着界面を獲得するためには、強い脱灰作用を有するセルフエッチングシステムの使用が有効であることが示された。また、セルフエッチングプライマーとアクリレートレジンを組み合わせた試作コーティング材の適用により、酸による歯根面の脱灰を効果的に抑制できることが明らかにされた。

以上の研究成果は、接着性レジンをを用いた歯根面の修復処置とう蝕予防に関しての貴重な知見を提供するものであり、本研究は博士（歯学）の学位授与に値するものと認める。