3M℠ Health Care Academy

Repair versus replacement
Repair of composite restorations (1/3)

Bas Loomas, Nijmegen,
The Netherlands

The replacement of defective restorations is a dental treatment that is carried out quite frequently. However, it is associated with a major drawback: In many cases, total replacement requires a complex procedure involving an extension of the preparation. This may lead to a further weakening of the tooth structure leading to increased instability instead of a more durable restoration.

Benefits of Repatir

A minimally invasive alternative is the repair of the existing restoration. In this procedure, the intact part is maintained and only the defective part replaced or the restoration locally extended. As a consequence, much less tooth structure is destroyed so that a negative effect on the pulp and the stability of the tooth is avoided. However, for successful repair, a long-lasting bond has to be established between the old restorative, the tooth structure and the repair material. What is needed for this purpose is not only a high-performance adhesive that bonds to the most diverse substrates and materials like enamel, dentin, porcelain, oxide ceramics, composite and metal. The use of appropriate repair techniques is decisive as well.

What has to be considered is the pre-treatment of the substrate, the selection of the adhesive and the selection of the restorative material. In the following, the focus will be on the repair of resin-based composite restorations using composite.

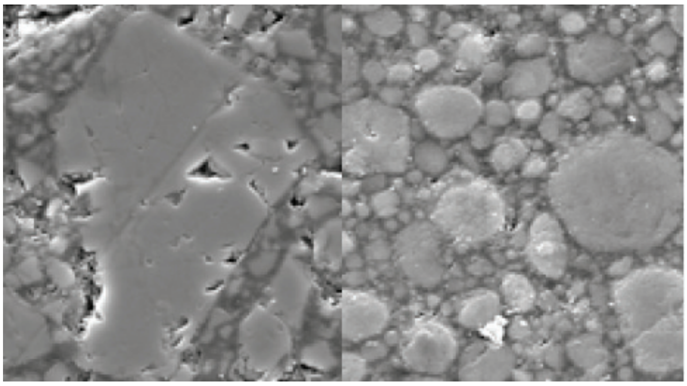
Repair of a defective composite restoration with composite.

Pre-treatment of the old restoration

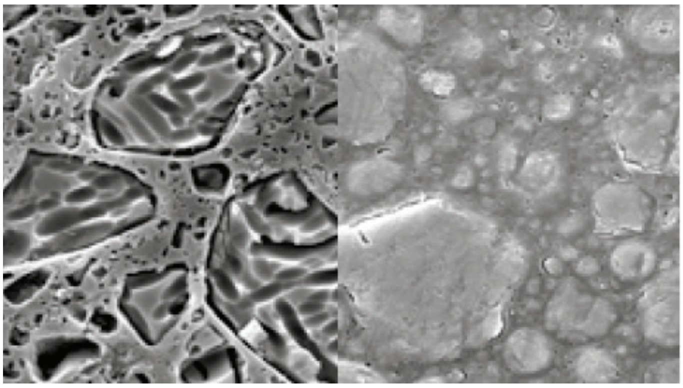
In order to provide sufficient attachment to the old restoration, surface conditioning is required. Different approaches are available to establish macro-mechanical and micro-mechanical retention or a chemical bond. Macro-mechanical retention can be obtained by retention holes, undercuts or by simply roughening the surface with a coarse diamond bur.

Micro-mechanical retention is created by etching with phosphoric acid or hydrofluoric acid and sandblasting or air-abrasion with aluminum oxide powder. A chemical bond may be established between resin and silica glass filler particles by application of special primers, such as silane. In general, the effectiveness of a surface conditioning method strongly depends on the substrate to be treated. But even for resin-based composite restorations, there is no standardized procedure available.

Etching with phosphoric acid, for example, has no direct effect on the surface roughness of a restoration except for glass ionomer cement. Instead, it is used for cleaning of the surface and leads to an improved wettability. Etching with hydrofluoric acid has a direct effect on materials containing glass particles. However, the impact strongly depends on the composition of the fillers: e.g. the effect on barium glass is much stronger than on zirconia clusters[1]. In addition, the use of hydrofluoric acid in the patient's mouth is difficult: any contact with dentin, enamel and soft tissues must be avoided due to the risk of fluoride poisoning and a significant drop in bond strength to enamel and dentin [2, 3].



Effect of phosphoric acid on barium glass (left) and on zirconia clusters after etching for 20 seconds.



Effect of 9.6% hydrofluoric acid on barium glass (left) and on zirconia clusters after etching for 20 seconds.

Scientific evidence

In order to get an idea of the effect of surface treatments on the success of repair procedures, studies have to be conducted. Unfortunately, clinical studies are scarce and most of the repair studies are conducted in-vitro. As there are no guidelines on how to perform in-vitro repair testing, a large diversity of methods and techniques are used by investigators, leading to inconsistent results and conclusions.

Several aspects are of importance: simulation of aging of the substrate to obtain a clinically relevant substrate surface, surface pre-treatment and the type of substrate. In addition, the use of primers, adhesive systems and the selected testing procedure may have an impact on the study results. For correct interpretation of the data, the use of a negative and a positive control group is essential.

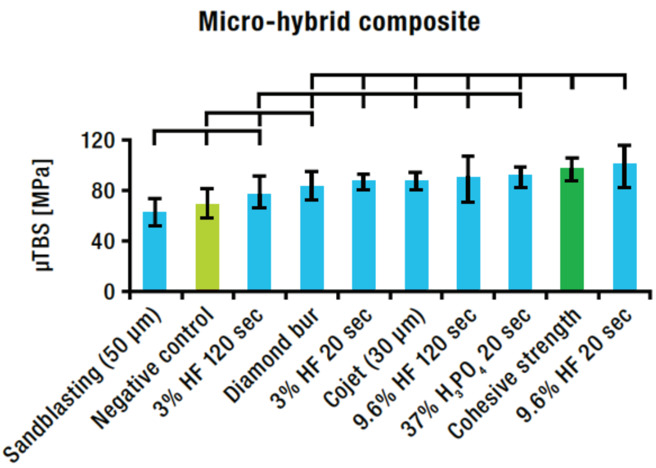
Two in-vitro studies

Since 2007, only two studies are available with a negative and a positive control group: one testing the repair of five composite resins after artificial aging[4] and one focusing on repair of a silorane-based substrate[5]. In the first study, the effect of nine repair procedures was tested: no treatment (negative control), roughening of the surface with a diamond bur, sandblasting with alumina particles, treatment with the 3M™ ESPE™ CoJet™ System, etching with phosphoric acid, etching with 3% hydrofluoric acid for 20 or 120 seconds and etching with 9.6% hydrofluoric acid for 20 or 120 seconds. In addition, the cohesive strength of the tested composites was measured as a positive control. The results are summarized in the tables below. Here, only a small difference was found between the negative and positive control group. There was a large variation between the different repair techniques as well as composites and the effect of the aging procedures is questionable.

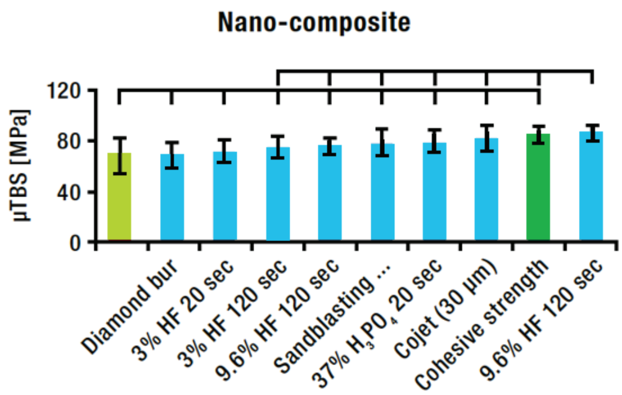
In the study of Palasuk, three different surface conditioning methods – acid etching, aluminum oxide sandblasting and diamond bur abrasion – were tested on one aged substrate (3M™ ESPE™ Filtek™ Silorane Low-Shrink Posterior Restorative). Silane was not applied. Two different repair materials, one methacrylate-based resin composite and a silorane-based material, were used. In this study, the microtensile bond strength achieved after aluminum oxide sandblasting was not different from the cohesive strength of the silorane resin composite. The other tested techniques led to significantly lower values. Here, the effect of the substrate and the potential impact of not using silane have to be discussed.

Conclusion

Due to the varying methodology used in these and other in-vitro repair studies, inconsistent results are obtained and it is impossible to derive a universal repair technique from them. There are too many variables, which prevent specific conclusions. From a comparison of the literature, it may be inferred that air abrasion in combination with the application of a silane primer seems to provide the best surface repair technique independent of the substrate and the repair material. However, more research is needed to confirm this in the nearby future.



Results achieved for a mirco-hybrid composite (containing barium glass fillers) using different repair procedures.



Results achieved for a mirco-hybrid composite (containing barium glass fillers) using different repair procedures.

References

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Contact: Bas Loomans, DDS, PhD b.loomans@dent.umcn.nl

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Building A, 1 Rivett Road
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