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Bonding to MIH-affected teeth – an update.

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Managing teeth with MolarIncisor Hypomineralisation (MIH) is one of the biggest challenges of pediatric dentistry today. An increasing number of patients suffering from MIH are presenting in specialist offices, and these patients are desperately in need of appropriate treatment. The same applies to patients with Deciduous Molar Hypomineralisation (DMH). The etiology of the diseases is still unclear, so that it is impossible to take targeted preventive measures, and official treatment guidelines are yet to be developed.

What is certain is that treatment outcomes are often unsatisfactory if teeth showing typical MIH characteristics – i.e. demarcated opacities ranging from white to yellow/brown, posteruptive surface breakdown and hypersensitivity – are treated in the same way as caries. One of the limiting factors is proper bonding to MIH-affected enamel in the context of restorative treatment.

Different enamel microstructure

The background to this issue is that the enamel of MIH-affected teeth is characterized by a lower mineral and higher protein content, a higher porosity and a significantly reduced microhardness compared to healthy enamel. The darker the enamel, the softer it appears to be. The prism structure of the affected enamel is described as being less dense with wide empty structures and loosely packed apatite crystals (Fig. 1). DMH-affected enamel shows a similar microstructure (Fig. 2).

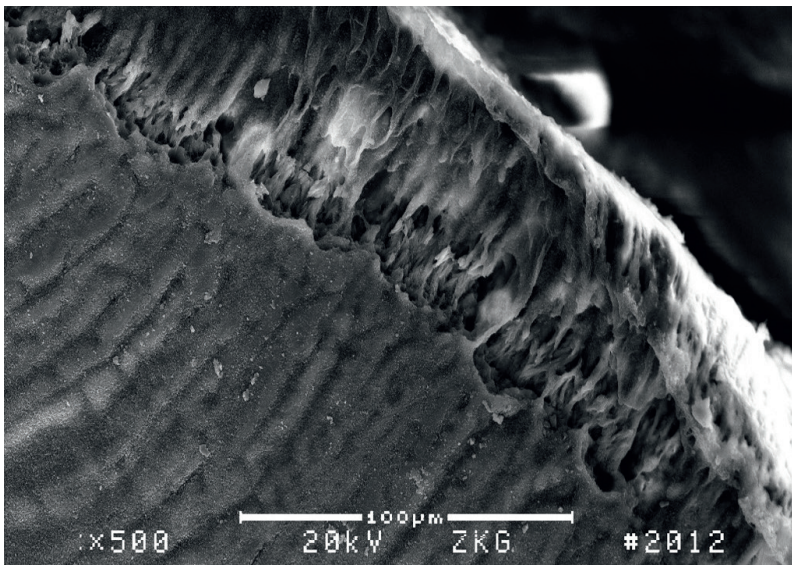

Figure 1: Porous enamel structure of an MIH-affected tooth (magnification: x500).

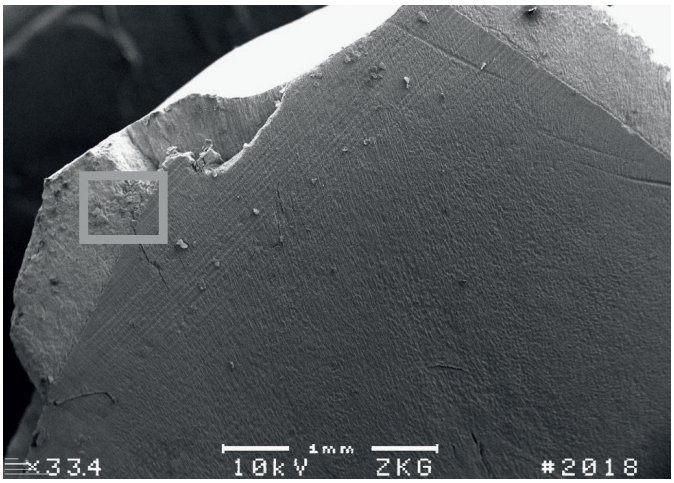

Figure 2a: Microstructure of DMH-affected enamel. Due to the reduced enamel thickness in primary teeth, layer cracks and chippings are more frequently observed.

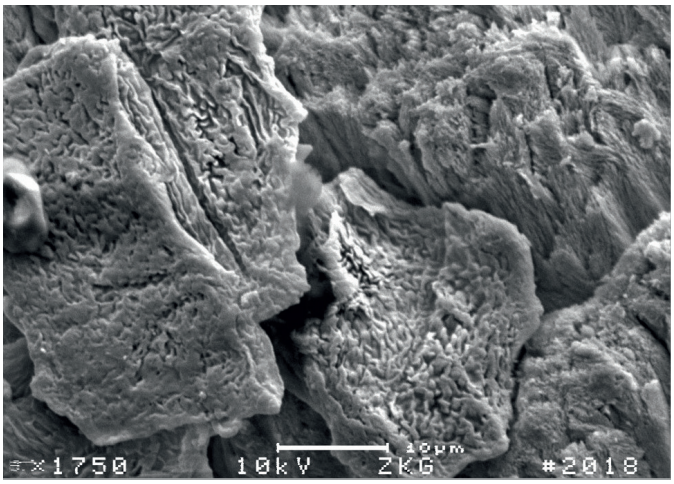

Figure 2b: Magnification (x1750) of the box in Figure 2a. The porosities in DMH enamel are also visible here.

These microstructural particularities lead to a dramatic reduction of a tooth's mechanical properties (hardness, wear behavior, fracture toughness), resulting in little resistance to masticatory forces. In addition, the inhomogeneous surface structure which is lacking a regular pattern in the distribution of the apatite available provides conditions which are unfavorable for bonding. In other words, there is no chance for stable micromechanical interlocking, and chemical bonding does not work reliably with a limited availability and irregular distribution of calcium.

As a consequence, bonded restoration margins tend to disrupt, marginal cracks and fractures occur more often, and a loss of retention may be observed. As dentin bond strength is usually unaffected, the risk of a complete bond failure is not increased. The compromised marginal seal, however, has a negative effect on restoration longevity, as the risk of bacterial invasion and caries development at the margins increases so that repair or replacement of a restoration is often necessary. As a result, patients with MIH are frequently in need of restorative treatment.

The clinical observations regarding a low marginal integrity of adhesive restorations are in line with the results from shear bond testing [1,2]. The in-vitro experiments show that – independent of the bonding agent and the adhesive technique used (self-etch versus total etch) – a significantly lower bond strength is obtained on MIH-affected enamel than on sound enamel [2] (Fig. 3). Bond quality to affected dentin, by contrast, is not compromised [1].

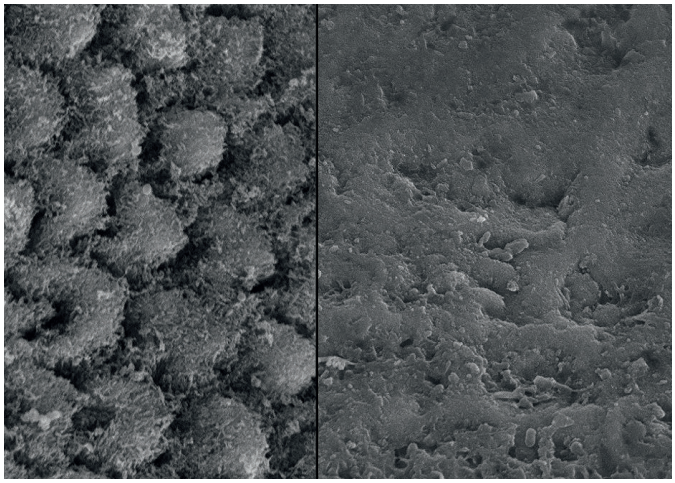

Figure 3: Etching pattern produced by a 60-second etch with phosphoric acid gel on sound enamel (left) and MIH-affected enamel (right). The microretentive pattern produced on the MIH-affected structure is much less pronounced than on the sound tooth structure due to the protein layer on the enamel surface of the MIH-affected tooth.

Bonding strategies

As it seems to be impossible to establish a strong and long-lasting bond to MIH-affected enamel, alternative strategies should be taken into account. One potentially suitable approach is a stabilization of the porous and soft enamel. This might be possible by thoroughly filling or infiltrating the large porosities in the enamel structure with resin prior to the application of the adhesive and the restorative material.

This strategy was tested in an in-vitro study [1]. Here, the MIH-affected enamel was treated with sodium hypochlorite followed by application of a caries infiltrant before initiating the actual restorative procedure. Unfortunately, this measure did not enhance the enamel bond strength and it seemed difficult to predict the depth of infiltration. At the moment, the infiltration depth for these porosities is too low. Additionally, the infiltration of resin is disturbed by the proteins (serum albumin, antitrypsin, or serum antithrombin) inside the porosities. Therefore, further investigations are required in this field.

With no satisfying and clinically proven approach for the stabilization of MIH-affected enamel available to date, there is only one possible clinical recommendation. Whenever feasible without sacrificing too large amounts of tooth structure, cavity preparations should be extended into sound enamel. In this way, it is possible to ensure a high marginal quality of the adhesive restorations as an important precondition for their long-term success. In this context, it is recommended to make use of a modern universal adhesive that contains MDP, e.g. 3M™ Scotchbond™ Universal Adhesive[1]. These MDP-containing adhesives should be used in a selective or total etch mode. Based on our studies, reliable results are obtained (Fig. 4 and 5). The performance is comparable to that of a multi-step adhesive with a simplified procedure[1].

Figure 4: Molar with a severe form of MIH restored with glass ionomer cement. The quality of the restoration margins is poor: marginal breakdown of the cement and leakage has occurred.

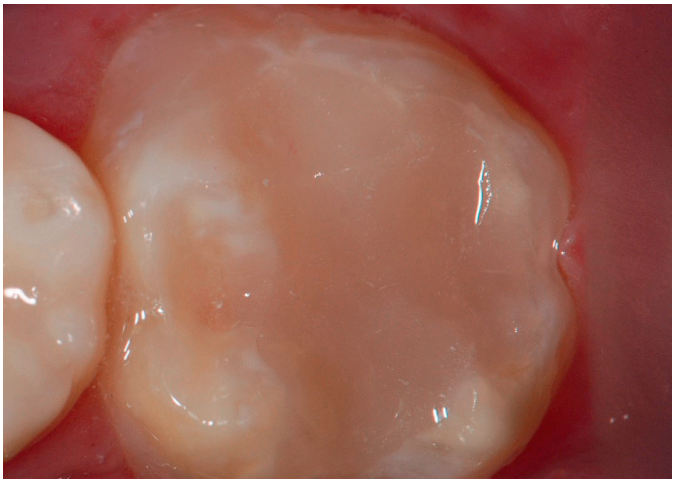

Figure 5: New composite restoration on an MIH-affected molar with restoration margins placed in healthy enamel to provide for a better margin quality.

Conclusion

There is still a lack of knowledge about the etiology of MIH and appropriate treatment approaches which enable the practitioner to preserve large amounts of tooth structure and create restorations that will be stable over time. At the moment, the longevity of direct adhesive restorations can only be ensured if the restoration margin is placed in healthy enamel. Alternative treatment approaches are currently being investigated, and it is particularly important to leave this task to scientists when children are involved.

References

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