Evaluation of composite restorations in hypomineralised permanent molars: a four year clinical study

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ABSTRACT. Aim The objective of this investigation was to evaluate the clinical performance of composite restorations in enamel hypomineralised posterior teeth. Methods 52 composite restorations were placed in 52 permanent molars of 46 children, aged 8-10 years. All the teeth were clinically diagnosed as hypomineralised and restorations were placed on two or more surfaces of the teeth, including cusps. All treated teeth had at least 2 sound surfaces, thus excluding defective teeth with total disruption of the crown. The materials used were a hybrid composite and a fourth generation one-bottle adhesive material and manufacturer’s instructions were carefully followed. The restorations were initially evaluated 7 days after the treatment and subsequent evaluation was performed at 12, 24, 36, 48 months. Clinical evaluation of the restorations was made according to the criteria of Ryge [1980].

Results In 6 cases, postoperative complaint was relieved after occlusal re-adjustment at the second appointment, 7 days later. At the end of the 48 months study period, 49 restorations were available for evaluation, all with full retention. Radiographically there was no periapical pathology. Problems were found in colour match in 10, surface appearance in 3 and anatomic form in 4 restorations. Hypersensitivity was recorded in 17 teeth after one week and in 3 teeth one year later. All teeth were sensitivity free after two years and until the end of the study period. Conclusions Composite resin restorations using contemporary materials, in certain cases of hypomineralised permanent molars, can be an acceptable restorative procedure with satisfactory long-term results.

KEYWORDS: Composite restorations, Hypomineralised molars, Clinical study.

Introduction

Hypomineralisation (opacity) is a qualitative developmental defect of the enamel, produced by incomplete enamel mineralisation and maturation below the enamel surface that is intact at the time of eruption. The defect reveals a variable degree of alteration in the translucency of the enamel, that has initially normal thickness and can be white, yellow or brown. The border of the defect varies and can be demarcated or diffuse. Enamel surface may break down after eruption, due to masticatory forces, leaving sharp boundaries [Alaluusua et al., 2002]. In permanent teeth, hypomineralisation can occur independently or can coexist with hypoplasia in one or more teeth depending on the time, the duration, the susceptibility of the individual and the severity of the prenatal, perinatal or postnatal insult.

Enamel hypomineralised molars are frequent in children. In a study of 497 children aged 11 years in The Netherlands, 10% of them revealed hypomineralised molars, while 8% had two or more teeth affected [Weerheijm et al., 2001]. Additionally in a study of 516 8 years old children, in Sweden, 18.4% revealed at least one molar with enamel defects, while 15% had more than one tooth affected, indicating systemic aetiology [Jalevik, 2001]. In a similar study in Finland 19.3% of 488 children, 7 to 13 years old, revealed defective molars [Leppaniemi et al., 2001].

This high prevalence of hypomineralised molars has for many years challenged the dental profession, in terms of treatment. Stainless steel crowns (SSC) traditionally were and still are the treatment of choice, particularly in severe cases, such as shown in Figure 1, in the mixed and early permanent dentition [Welbury,
Other possible treatment modalities include controlled extractions, indirect alloys, glass-ionomers cements, which have also been investigated and are still in use nowadays in certain situations [Mahoney, 2001].

Recently parents have been more concerned with the poor aesthetics of SSC. This attitude has resulted in investigation of other possible conservative treatment options, using the modern tooth coloured materials, although there are no long-term studies investigating the longevity of these restorations. The aim of this clinical study was, therefore, to evaluate the clinical performance of complex composite restorations placed on permanent hypomineralised molars with defective enamel, for a period of 48 months.

**Materials and methods**

The study involved 52 composite restorations, placed in enamel hypomineralised permanent molars of 46 children, aged 8-10 years with mean age 8.84±0.75 years (SD). Teeth were diagnosed as having chronological enamel hypomineralisation of systemic origin and were allocated to take part in the study according to each child’s compliance to the recall visits and to the clinical evaluation of the defective tooth. Only teeth having more than two (of the total five) surfaces involved, including cusps, were admitted to the study. All treated teeth had at least two sound surfaces, thus excluding defective teeth with total disruption of the crown. Some 31 of the teeth had never been restored before, whereas the remaining 21 had previous failed amalgam restorations (Fig. 2). The possible aetiology of the defects in these 46 children is shown in Table 1; information was obtained by taking detailed medical history of the patients and their mothers, with the help of the patient’s medical records. In most cases other molars were also affected and in 34 out of 46 (78.2%) there was also involvement of the permanent incisors.

The clinical protocol used in this study was always the same and performed by the same clinician (NAL), whereas the recall examination was conducted by the second author (AC). The placement of the composite restoration included the following clinical steps:
- adequate local analgesia;
- rubber dam;
- removal of all carious tissues together with possible previous, failed amalgam restoration and enamel easily penetrated by probe.

At the end of cavity preparation, clinically sound enamel (although sometimes discoloured) was observed in the cavity surfaces. Placement of self adjusted band and wooden wedge(s), application of total acid etch technique for 30 seconds...
polymerization and removal of band were carried out. Then initial shaping of the restoration using diamond burs, removal of rubber dam and final shaping of restoration including checking of the occlusion with the help of recording blue paper were performed. An application of fissure sealant on the restoration surface, in order to enhance marginal integrity, completed the restoration. Finally, instructions were given for proper medication in case of postoperative pain. All restorations were reviewed one week later for further occlusal adjustments, if needed.

All 46 children were recalled every 6 months for preventive care including topical fluoride, oral health instructions and dietary advice. A clinical and radiographic evaluation was made every 12 months and the final assessment at 48 months (Figs. 3a, b, c). A typical appearance of another tooth, after 4 years, is shown in Figure 4. The clinical criteria of Cvar and Ryge [1980] for evaluating the restoration were used throughout the course of study. According to these criteria for every parameter tested various clinical features are evaluated. A stands for a restoration that meets all standards in all evaluated features, B stands for a restoration that needs further observation as one or more features are defective but not unacceptable, and C stands for a restoration that should be replaced because one or more features are not of acceptable quality.

ANOVA one-way statistical analysis was used for evaluation of the differences. Sensitivity was recorded according to patient’s answers, in a scale of two severity levels: level 1 was sensitivity only during mastication; level 2 was mastication sensitivity together with occasional sensitivity. The examiner also recorded sensitivity levels, after blowing the tooth with cold air.
Results

In the first clinical examination one week after the placement of each restoration, it was found that in 6 cases, postoperative complaints were reported by the patient, which was relieved after occlusal re-adjustment in the second appointment. Forty-eight months later, 49 out of the 52 initial restorations were available for evaluation. These included 18 restorations with two surfaces involved and 31 restorations with three surfaces. Full retention in all the available restorations at the end of the study period was observed, while in periapical radiographs no pathology was found.

In detail (Table 2), all the restorations examined clinically after 12 months were rated Ryge A. Considerable differences could be noticed, however, concerning the colour match, when 8 of the 49 restorations were rated Ryge B. The difference was statistically significant (F=264.87, p<0.01).

The majority of the restorations examined clinically after 24 months were rated A. Considerable differences could be again noticed in the colour match (9 of 49 were rated B), which was statistically significant (F:193.43, p<0.01). One restoration was rated B for surface appearance and one more for anatomic form.

After 36 months, the majority of the restorations were rated A, the main difference being again in colour (10 rated B), while two more restorations were rated B in anatomic form (3 in total). The difference was statistically significant only for the colour match (F: 189.17, p<0.01).

Finally, after 48 months, most of the restorations were still rated A in all the parameters examined, with the main difference remaining in colour (10 out of 49). Two more teeth were rated B in surface appearance (3 in total) and one more for anatomic form (4 in total). The difference was statistically significant only for the colour match (F: 208.20, p<0.01). In all four examinations, in every parameter no restoration was rated C, meaning there was no need for replacement.

As regards hypersensitivity in the restored teeth (Table 3), from the total of 52 teeth treated, 38 were recorded as having level 1 and 9 having level 2 at baseline, before composite restorations were placed. One week later, only 14 restored teeth were recorded having still level 1 hypersensitivity, while level 2 dropped to only three teeth. At the one year follow-up, from the teeth with level 1, only three remained with mastication hypersensitivity, while no tooth revealed level 2. Two years later, all teeth were sensitivity free, and that was the case at the third and final annual examinations.

<table>
<thead>
<tr>
<th>RATING</th>
<th>BASE</th>
<th>12 months</th>
<th>24 months</th>
<th>36 months</th>
<th>48 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface appearance</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Colour match</td>
<td>49</td>
<td>49</td>
<td>0</td>
<td>0</td>
<td>48</td>
</tr>
<tr>
<td>Marginal adaptation</td>
<td>49</td>
<td>49</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Anatomic form</td>
<td>49</td>
<td>49</td>
<td>0</td>
<td>0</td>
<td>48</td>
</tr>
<tr>
<td>Secondary caries</td>
<td>49</td>
<td>49</td>
<td>0</td>
<td>0</td>
<td>49</td>
</tr>
</tbody>
</table>

*Rating based on criteria of Ryge [1980]

Table 2 - Results of clinical evaluation of composite resin restorations in permanent molars after 12, 24, 36, 48 months.

<table>
<thead>
<tr>
<th>Hypersensitivity level</th>
<th>BASE</th>
<th>1 week</th>
<th>12 months</th>
<th>24 months</th>
<th>36 months</th>
<th>48 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>38</td>
<td>14</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Level 2</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3 - Hypersensitivity recordings in hypoplastic permanent molars restored with composite resin after 12, 24, 36, 48 months, according to patient’s report.
Discussion

The main goal of dental therapy of enamel defective permanent posterior teeth in children is the creation of an acceptable dentition. This should be with good occlusion, good aesthetics, pain or sensitivity free, in order to produce by the time of adolescence a result that will be easily restored permanently. The best trouble-free clinical solution for enamel defective permanent posteriors in children has so far been the application of SSC. However, as aesthetics is important and many children or their parents strongly dislike a SSC, so composite resin restorations have been proposed as an alternative solution, at least in cases without total disruption of the crown. But there are very few reports in the literature dealing with these contemporary techniques using modern adhesives [Li, 1999; Mahoney, 2001].

The main difficulties in restoring enamel defective teeth with composite resins are found in the hypomineralisation/opacity group. Teeth in the hypoplastic group present fewer clinical problems, as enamel mineralisation is usually normal and therefore acid etch and adhesion techniques work similarly to normal enamel [Vadiakas and Oulis, 1994; Soares et al., 2002]. Macroscopic and SEM studies [Suckling et al., 1989] have shown that in hypoplastic teeth only the surface of the enamel is defective, associated with a reduced enamel thickness, rounded defect borders and smoothly curved enamel prisms, leaving intact the underneath enamel matrix.

Overall, in the case of enamel defective teeth, the following clinical facts are of great importance, when we consider treatment alternatives. Dentine is normal, the enamel defects are mostly localized, all types of enamel defects are occasionally coexisting due to complex aetiology. Finally, very often these enamel defects are deep and approach dentine [Slavkin, 1988; Suckling, 1989].

Recent histological and biochemical studies have shown that even in severely affected hypomineralised molars the defective area extends from the cusps cervically about half of the buccal and lingual sides, leaving a cervical border of normal enamel. Additionally, Ca, P concentrations and mean Ca/P ratio are lower than normal but still not minimal, while carbon, Mg and K concentrations were higher [Jalevik and Noren, 2000; Jalevik, 2001]. Similar results concerning the macroscopic findings in hypomineralised molars were also previously reported in SEM studies [Suckling et al., 1989]. Any biochemical findings are the result of alterations of the enamel matrix proteins, amelogenins and enamelin, which play major roles in the structural organization and mineralisation of the developing enamel [Seow, 1991; Wright et al., 1997].

The great difference between composite restorations completed in the past and those used at present is the widespread use of modern adhesive materials. It is well documented that in complex composite restorations, most of the problems of the past referred to by clinicians were due to microleakage in the enamel/dentine and composite interface, caused by the absence of good adhesion [Cox, 1994]. On the contrary, modern adhesive conditioners remove interprismatic substance from the enamel, remove, penetrate or solubilize the dentine smear layer, open the dentinal tubules and demineralize the dentinal surface. A hybrid layer is formed at the end of the adhesive process between the dentine and the resin [Swift, 1998]. Most of the fourth/fifth generation systems achieve mean shear bond strength to enamel and dentine approaching or exceeding 20 mpa, [Triolo and Swift, 1992; Kanca, 1997; Swift et al., 1998]. Additionally, they do not produce any significant pulpal response [White et al., 1994; Torstenson, 1995; Bouillaguet et al., 1996; Stanley et al., 1997]. They also minimize microleakage [Holtan et al., 1994] and produce reduced postoperative sensitivity [Watanabe et al., 1991].

Combining the above characteristics of enamel defects and adhesives’ performance, it can be concluded that in clinical practice, when considering placing composite restorations on enamel defective teeth, great attention should be given to the removal of all possible clinically defective enamel.

Keeping in mind that many enamel hypomineralised defects are approaching dentine in certain areas, which is normal, we can hypothesize that the clinical success of composite restorations, revealed in this study, may be a result of enhanced adhesion of the composite to the dentine. Additionally, removal of all clinically defective, soft enamel helps the composite resins to adhere to the remaining, possibly normal enamel.

Concerning the hypersensitivity of these defective teeth, it is well known that using modern adhesives, hybridization of vital dentine prevents postoperative hypersensitivity. They also completely seal the tooth restoration interface to prevent bacterial infection of the underlying substrate [Cox et al., 1995].
Conclusion

In children, composite restorations with contemporary materials in posterior permanent teeth with enamel hypomineralisation reveal good long-term performance and may be a good alternative treatment achieving all the treatment goals referred before, including all what refers to aesthetics. This clinical solution, however, refers only to the type of restoration described in this study, in defective teeth without complete disruption of the crown, cases where stainless steel crowns or controlled extractions may be the solutions of choice.

References


