Microabrasion of teeth with discoloration resembling hypomaturation enamel defects: four- year follow up

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Microabrasion with 18% HCl and pumice to remove enamel dysmineralization and improve esthetics is an accepted and effective treatment. This technique can probably be extended even to generalized defects resembling hypomaturation amelogenesis imperfecta that appear on all erupted teeth. Five children aged 9 to 11 with two types of enamel-hypomaturation probably due to developmental defects were treated successfully by microabrasion, with marked improvement of the discoloration. The patients were followed for up to four years. During this period, no tooth-sensitivity or staining was noted. The teeth looked healthier and shinier.
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INTRODUCTION

Enamel microabrasion is a conservative simple technique to eliminate enamel defects such as brown or white opacities, fluorotic-like discoloration and decalcification lesions.[1-12] By repeatedly applying 18% HCl in a pumice slurry to the discolored enamel, discoloration gradually disappears. After remineralization, the freshly exposed enamel attains normal color and surface characteristics. Dr. Walter Kane was the first to describe this treatment in 1916. He used 18% HCl liquid and heat to eliminate brown stain. Modifications of this technique were later developed by McCloskey (18% HCl without heating)[1] and Croll and Cavanaugh (18% HCl and pumice)[2,3] the latter method has become very popular in recent years.[4-10] Some authors believe that this technique is more successful in eliminating brown hypomineralized than white mineralization defects.[11,12]

Although microabrasion is widely used also in mild fluorotic-like discoloration, resulting from a disturbance in the maturation stage of the enamel development, this technique has not been used in patients with moderate hypomaturation defects, which affect all erupted teeth, possibly due to various systemic disturbances. The impaired enamel is expressed clinically by white opaqueness or yellow staining of the hypomatured enamel, in conjunction with disappearance of the natural enamel gloss, resembling that described for hypomaturation type of amelogenesis imperfecta or systemic fluorosis.[13,14] The common treatment for children who suffer from severe enamel discoloration include full coverage crowns,[15,16] however, child patients may be too young or unwilling to accept such an elaborate treatment plan.

The purpose of this report is to document the esthetic benefit of microabrasion in five children with moderate enamel dysmineralization resembling two different types of hypomaturation amelogenesis imperfecta: snow capped and pigmented autosomal recessive sub-types. Two families with different types of discoloration were treated; one with white and the other with brown discoloration. A follow-up of 2.5 to 4 years is presented.

PATIENTS AND METHODS

Two families with two different types of discoloration were treated.

Brown discoloration: two patients

A 10-year-old girl, who had chalky opaque yellow-to-brown discoloration of her permanent teeth, presented for treatment (Figure 1). She had a brownish discoloration, which became more severe with time and was very disturbing socially. Due to social problems of the girl, her mother asked for treatment.

The second patient was her 8-year-old brother, who had a similar problem. Initially, he was not disturbed by

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Figure 1. Teeth of the girl with brown discoloration, case no. 1, before treatment.



Figure 2. Teeth of the boy with brown discoloration, case no. 2, before treatment.

his esthetic appearance, but later on, when the white opacities on his permanent teeth turned yellow, he decided to improve his appearance (Figure 2). Both were treated by microabrasion. A 2-year-old sister, who had the same condition in her primary teeth and later on her erupted-permanent incisors was not treated.

The medical history of the patient was unremarkable. An analysis of the family pedigree revealed that only these three siblings were affected. The mother reported of another possible affected cousin, however he was not available for clinical examination. The children were born and lived on a kibbutz (a communal settlement). The water in the kibbutz were not fluoridated (0.1 ppm). Therefore, all the children received fluoride supplementation at the kindergarten and at school. The dose-regimen for fluoride supplementation was: 0.25 mg F for ages 6 months; 2 years, 0.5 mg F for ages 2 to 3 years and 1.0 mg F for ages 3 to 14 years. This regimen was meticulously observed. The fluoride supplementation was distributed every day (by the teachers), 6 days a week. The children did not receive the fluoride tablets on Saturdays, holidays or on vacations. The children on this kibbutz used mainly two kinds of toothpaste for children that were available in the kibbutz shop. The toothpaste contained 1000ppm F^-. The amount of toothpaste used was described by the mother as "a tiny amount, the size of a little drop". The children used toothpaste from the age of 11 months, when the first tooth erupted. Topical fluoride gel was applied once a year from the age of 8 years. These patients did not use fluoride rinse.

White discoloration: three patients

Three siblings of the same family, two 9-year-old twin boys and an 11-year-old boy, with white discoloration of the teeth were treated by microabrasion. The white opaque discoloration was noticed only after eruption of the permanent teeth. One of the boys had the condition on all his maxillary teeth (Figure 3), while in the other two, only the maxillary incisors were affected (not shown). The teeth were of normal size without dental sensitivity. Bitewings and periapical radiographs showed normal structures. Due to complaints of social problems from the children, the mother turned for treatment.

Medical histories of the children were unremarkable. An analysis of the family pedigree revealed that only three out of the four siblings were affected (their only sister showed no evidence of this condition), with no other family member affected. These children were also born and lived on the same kibbutz and received fluoride supplementation similar to the previously mentioned patients. Topical fluoride gel was applied once a year from the age of 8 years. The patients did not use fluoride rinse. Dental history of the affected children showed no trauma to primary teeth.

Considerations of treatment modalities

The patients insisted on esthetic improvement of their front teeth. Several treatment modalities were considered: composite resin coverage without grinding the enamel surface would have resulted in bulky teeth and in persistence of the underlying discoloration. In addition this treatment had a possibility for poor retention. Other treatment possibilities were: porcelain laminates, porcelain crowns, or resin crowns, which necessitate grinding of the superficial or entire enamel. In addition these treatments would be relatively expensive and would require prolonged treatment. The children were too young for these treatments, and together with the parents preferred short and inexpensive treatment. Several considerations supported the microabrasion-treatment in these cases.

First, the enamel of these patients was of normal depth and was hard enough to resist probe penetration. Secondly, the alternative treatment in these cases was composite resin restorations of the anterior teeth after girding the superficial enamel mechanically. The advan-



Figure 3. Teeth of the boy with white discoloration, case no. 3, before treatment.



Figure 4. Case no. 1, one week after treatment.



Figure 5. Case no. 1, four years after microabrasion and after orthodontic treatment of the upper jaw. Her lower incisor was extracted for orthodontic purpose.

tages of using microabrasion in these cases were the higher esthetic improvement of the remaining underlying enamel, possibly less enamel abraded and the chance to avoid any future treatment. In these cases, the concern about an unexpected extensive enamel abrasion was not relevant, since the option of composite restoration would be still applicable.[17] The expectation for substantial esthetic improvement of the teeth by microabrasion was justified in these cases since hypomaturation disorders such as fluorosis, were shown to benefit considerably by microabrasion.[18]

Microabrasion treatment

Since the treatment of microabrasion on teeth with generalized discoloration is not common, it was decided to treat, as a first step, only the maxillary incisors. The patients and parents consented to the treatment, after the microabrasion technique was thoroughly discussed, mentioning the possibility of enamel abrasion, questionable success and alternative possibilities.

The microabrasion was performed as described by Croll.[2] Briefly, before treatment, the teeth were isolated with rubber dam, the gums covered with petroleum jelly and the face by protective glasses and a towel. Fresh HCl (37%, Sigma, Rehovot, Israel) was mixed with an equal volume of water in a Dappen dish. Then flour of pumice was added to the mixture to form a thick, moist paste. The HCl slurry was applied on the areas of discoloration for 10 seconds and then rinsed for 20 seconds with a water-stream. The slurry was applied by a rotating rubber prophy cup in a slow-speed handpiece (10:1 gear reduction angle at 500 rpm) with very light hand pressure. This procedure was repeated approximately 6 to 8 times according to the clinical disappearance of the discoloration.[7] After each application, the enamel-depth was carefully evaluated in order to prevent notable enamel loss.

In the case of white dysmineralization, considerable amount of enamel was removed. However, this amount is unlikely to be of clinical or esthetic importance. At the end of treatment, the teeth lost the white and brown discoloration, and had a frosty appearance. The teeth were then coated with Duraphat (Inpharma A.S, Drammen, Norway).[7] In the 10-year-old girl with brown dysmineralization, teeth were etched one week later with 37% phosphoric acid and a layer of bonding material was placed over the buccal surfaces of the treated teeth to prevent future enamel discoloration. This treatment was not done on any of the other patients.

The girl with the brown discoloration and the three brothers with white discoloration were followed for 4 years (Figures 4, 5, 7); one boy with brown discoloration was followed for 30 months (Figure 6).

During the follow-up period of all patients, staining did not reoccur, the teeth were without sensitivity, looked harder in consistency, healthier and shinier (Figures 4-7). Furthermore, within the last year, the boy with white discoloration and the girl with brown discoloration underwent orthodontic treatment, including attachment of brackets on the labial surface of the



Figure 6. Teeth of the boy with brown discoloration, 30 months after microabrasion.

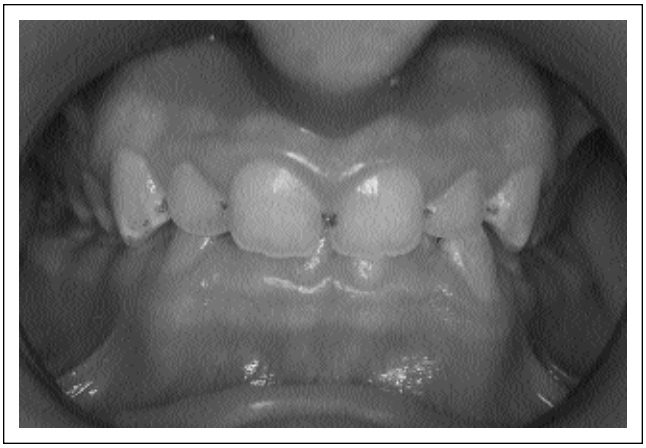


Figure 7. Teeth of the boy with white discoloration -Three years after microabrasion and immediately before orthodontic treatment. The proximal surfaces of the upper front teeth are with extrinsic "black pigmentation".

treated maxillary incisors. The girl with brown discoloration needed re-bonding of her brackets several times from the upper canines and premolars, which were not treated. However, the attachment of the brackets to the treated incisors did not fail.

DISCUSSION

During the maturation stage of tooth development, water and protein are removed from the enamel extracellular matrix, and allow increased hydroxyapatite crystal formation.[14] Hypomaturation defects are associated with retention of 2 to 5% of the enamel matrix protein compared to only 0.01-1% in normal enamel.[19-21] *In vitro* extractions of these proteins during the maturation stage allow continued crystallite growth.[22-23] Hypomaturation enamel defects may be a result of many disorders characterized by alterations in the enamel ultrastructure. These conditions include hereditary defects such as amelogenesis imperfecta, hypomaturation type,[19,21] systemic disturbances such as fluorosis[18] as well as localized insults.[24,25] The differential diagnosis between these etiologies is based on past dental history, on the distribution of the affected teeth and on family history. The etiology of the enamel hypomaturation of the presented cases is not completely clear. The past dental history of the patients (absence of dental trauma or localized infection), the generalized appearance of the opacities and the similar location on all the permanent teeth ruled out localized trauma or infection. The absence of a family history, other than affected siblings in one family does not fully support the possibility of a genetic trait.

Nevertheless, many genetic defects are a result of recent mutations, and the expression of three siblings in each family may support this possibility.

Systemic disturbances, such as fluorosis, are another possibility. However, medical history with no systemic diseases that may have caused generalized enamel hypoplasia and the patient history of strict regimen of fluoride supplementation, (supervised brushing and use of a small amount of toothpaste) argue against the possible diagnosis of fluorosis. Moreover, these families live on a kibbutz where 450 more children (out of 2500 adults) have received the same fluoride regimen, ate the same food and about half of them used the same fluoride toothpaste, yet none other had any expression of fluorosis. Out of all the children in this kibbutz, only the two described families were affected. Although these facts do not support the diagnosis of fluorosis, this possibility can not be completely ruled out.

The exact mechanism by which microabrasion eliminates enamel discoloration and improves the appearance of dysmineralized enamel is not completely clear. However, it may be that during microabrasion, the acid dissolves also the residual organic material (including the pigmentation) and the loosely mineralized tissue. After the dissolution, fluoride and salivary minerals enable correct "impact remineralization" of the enamel.[26] Another possible explanation to the success in treating hypomatured-enamel is the fact that the newly microabraded surface reflects and refracts light from the teeth in such a way that mild imperfections in the underlying enamel are blurred.[9,27,28]

Another factor that may partially explain the benefit of microabrasion even to enamel affected by hypomaturation type of amelogenesis imperfecta is the depth of the enamel defect. In snow-capped sub-type, the defect reportedly affects only the outer enamel.[29] One study reported that also in pigmented autosomal recessive subtype, the area of hypomineralization occupied only the outer 0.4 to 0.5 mm of the enamel thickness,[30] although others found that the pigmentation was not confined to the outer third of the enamel.[31] The differences between the above mentioned studies may be attributed to different severity of the disease.

The results of the microabrasion treatment in the five patients presented are surprising and gratifying. At

the end of the microabrasion treatment, the enamel developed a glass-like sheen, which caused the teeth to have healthier optical properties, even after 4 years (Figures 5 to 7). Not only did these children obtain dramatic improvement in the appearance, but they did so without dental discomfort or soft tissue irritation. Both parents and children were extremely pleased with the improvement in the color and texture of the teeth.

Microabrasion-treatment in patients with generalized hypomaturation defects raises the concern about the amount of enamel that is removed during this procedure. Previous research regarding the amount of enamel loss with the microabrasion technique reported amounts of 46-360 μm, where enamel loss of 12 μm occurred after initial application and an average of 26 μm after each successive application. Most researchers believe that this is a safe technique and that sufficient enamel remains.[3,8,11,30-32] Several factors can contribute to increased enamel loss during microabrasion, such as, using a rotator cup, increasing time, pressure or number of applications, all of which, have an additive effect.[31] Hypomatured enamel would be even less resistant to microabrasion, therefore, extreme care should be taken when treating these teeth. It is suggested that enamel, which is easily penetrated with an explorer, would not be a good candidate for microabrasion treatment. In the present cases, we used 6 to 8 applications of 20 seconds, with minimal pressure. The amount of enamel removed during the procedure was not evaluated. However, in the case of white discoloration considerable amount of enamel was removed. Nevertheless, this amount is unlikely to be of clinical or esthetic importance.

CONCLUSION

This clinical report documents the successful esthetic result of microabrasion treatment in five patients with moderate discoloration due to hypomaturation defect resembling two different types of amelogenesis imperfecta. Additional clinical studies should be performed in order to establish guidelines for microabrasion. The guidelines should include: selection of patients, the types and severity of enamel developmental disorders that can benefit from this treatment, the optimal age for the treatment, the length of time and number of applications for a safe treatment. In addition, the long-term effect of treatment on the enamel (appearance and resistance to abrasion) and pulp tissue should be assessed.

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