Infiltration Therapy - an Alternative to Fluoride Varnish Application for Treatment of White Spot Lesion After Fixed Orthodontic Treatment

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Very often, after a fixed orthodontic treatment, when the doctor removes the brackets, he notices the occurrence of white chalky spots on the facial surface of teeth and around the orthodontic rings. The purpose of this study was to monitor the evolution of the white spots lesion (WSL) arising during fixed orthodontic treatment, during a period of 6 months. After debonding, 60 selected patients were randomly divided in 3 equal groups and received different therapeutic conduct, as follows: Group nr. 1 n=20 received topical fluor applications with Profluorid Varnish; Group 2 n=20 did not receive any special treatment, but was instructed upon the correct dental brushing which must be done 2 times per day. For group no. 1 and 2, the WSL were measured with DD (DiagnoDent pen) immediately after take-off (L0), at 3 months (L3) and after 6 months (L6). Group 3 n=20 received treatment by infiltration, and the DD measurements were performed immediately after take-off (L0). The shape and size of WSL were also recorded on patient files. DD readings were subject to statistical analysis and compared between groups at the time point L0, L3 and L6 and between groups at each time point using repeated measures one-way ANOVA (α=0.05). Data were processed by the statistical software SPSS (ver. 13.0). The mean conclusion of this study is that Icon DMG is the most effective in restoring the damaged enamel structure in one single meeting/sitting, the aesthetic appearance being clearly superior towards the other adopted alternatives.

Keywords: white spot lesion, demineralisation, infiltration therapy

The decision to seek an orthodontic treatment should be knowingly taken by the prospective beneficiary. He must know very clearly the difficulties that will arise during the treatment, difficulties that are related to the application of the means in oral-dental hygiene. Children, who are subject to the treatment contrary to their wish, will not give enough attention to the hygiene practices and the consequences can be very unpleasant. Movable and removable dental restorations can cause gingival and labial irritation, which makes brushing very painful. Sometimes, gingival hyperplasia occur, which enhances bacterial plaque retention, by setting up a real vicious circle: inflammation - difficulty of brushing - multiplying of microorganisms - more pronounced inflammation - pain - refusal to continue treatment. In patients with fixed orthodontic appliances, the application of measures in their oral-dental hygiene become even more complicated due to the presence of brackets, wire arches, rings, ligatures, elastics, etc. It is therefore essential to raise awareness in patients about the need to apply rigorously the measures for oral-dental hygiene in order to prevent demineralization, and in more severe cases even the periodontal diseases.

Very often, when the doctor removes the brackets, he notices the occurrence of white chalky spots on the facial surface of teeth and around the orthodontic rings [1]-[4]. This unaesthetic aspect can be physiologically diminished in time by the remineralization of the surface due to the disappearing areas that retained the plaque and because of enhancing local hygiene. The ion exchange between enamel and saliva, its superficial surface area is remineralized. There are but few cases where unaesthetic chalky white appearance remains permanently [2]. Periodical fluoridation by topical applications, the usage of toothpastes and of chewing gums with fluoride also lead to attenuation of the white chalky spots, but they do not lead to their complete disappearance [5, 6]. The microabrasion of these lesions was recommended in the past, but in this case the treatment involved dental hard tissue loss which later had to be replaced by some composites [7].

In the recent years, doctors recommend the treatment of WSL (white spot lesion) by infiltration immediately after taking-off the brackets, using very fluid composites which penetrate the microporosities of enamel [8].

The purpose of this study was to monitor the evolution of the white spots lesion (WSL) arising during fixed orthodontic treatment in terms of aesthetics and to measure the degree of demineralization of enamel in the WSL brackets immediately after taking-off the brackets, and then every 3 months, according to the adopted behavior/conduit. That is why some patients were the beneficiaries of periodical fluoridation; some others were only given indications referring to the brushing, while the third group received the treatment by infiltration.

Because fluoride therapy is not always effective in the advanced stages and the filling technique almost always sacrifices significant amounts of healthy tooth structure, we used an entirely new, revolutionary material for treatment of WSL on smooth surfaces.
Experimental part

Materials and methods

A total number of 62 patients took part in this study, who were beneficiaries of fixed orthodontic treatment. These patients were informed about the study and gave their consent to participate in it. The selected patients did not have dental fluorosis, or WSL in the vestibular surfaces of the teeth before starting the orthodontic treatment, pigmentation spots due to antibiotics, nor metabolic disease or periodontal disease. Also, for this study there were involved only the patients who, after taking-off their brackets and having performed a professional cleaning, presented at least 2 WPL in different teeth. Immediately after the brackets take-off, the vestibular surfaces of the teeth were scanned by DiagnoDent Pen device (KaVo, Biberach, Germany), and the values obtained by scanning WSL were noted, and will be compared with those recorded later. The age of patients at the beginning of treatment was between 13 and 22, and the fixed orthodontic treatment duration was 18 ± 4.3 months.

The DiagnoDent Pen (DD) is a laser fluorescence device that has been developed for more objective caries diagnosis [9]. Diagnosis using this device is based on the fact that the fluorescence emitted from carious surfaces is greater than that emitted from sound surfaces when they are irradiated with a laser beam with a wavelength of 655 nm. Changes in the tooth substances associated with progression of the carious process are reflected in an increased amount of fluorescent light. The cause of this increased level of fluorescence was the presence of chromofores associated with bacteria present in the infected tooth structure. A numerical value (0-99) is assigned to the degree of fluorescence as an indicator of the extent of caries. Values between 2-10 mean: no active lesions, 10-25: initial enamel carious lesion, 25-35: superficial dentinal caries and values over 35: deep dentinal caries. Because of the high values recorded (over 35), 2 of the patients were excluded.

The remaining 60 patients, were randomly divided in 3 groups and received different therapeutic conduct, as follows:

Group nr. 1 n=20 received topical fluor applications with Proflurid Varnish (VOCO GmbH) in single Dose, a fluoride containing dental desensitising varnish with 5% NaF. We chose this colophony based varnish (with 22,600 ppm fluoride) because the fluoride ion, together with the calcium ions accumulated in the tubes, causes a precipitation of calcium fluoride which effectively seals the tubes. Proflurid Varnish also causes calcium fluoride deposits to form on the tooth surface. This deposits protect the tooth from acid attacks, promote remineralisation and contribute to the long term formation of fluorapatite. Xylitol, which has also a proven cariostatic effect in addition to its taste enhancing properties, is also added to the varnish.

Prior the varnish fluoride application, it is recommended a professional prophylaxis or at least the teeth should be cleaned with a toothbrush. After that, the teeth must be isolated with cotton rolls to prevent recontamination with saliva. A small brush or applicator is then used to apply the varnish. The varnish will set on contact with the slightly moist teeth. The patient is instructed to avoid brushing for the rest of the day; normal hygiene procedures can begin again the following day. This procedure was repeated every month during a period of 6 months.

The measurements with DD were performed immediately after take-off (L0), at 3 months (L3) and after 6 months (L6). Also, the shape and size of WSL were recorded on the patient files. For the values measured with DD to be conclusive, the teeth were brushed professionally, isolated and dried. The device was calibrated according to manufacturer’s instructions. Then WSL were scanned over the whole surface, being recorded the maximum value - peak for each tooth.

Group 2 n=20 did not receive any special treatment, but were instructed upon the correct dental brushing which must be done 2 times per day. Also, the DD measurements were performed immediately after take-off (L0), then at 3 months (L3) and after 6 months (L6). The shape and size of WSL were recorded on patient files.

Group 3 n=20 received treatment by infiltration, and the DD measurements were performed immediately after take-off (L0). The shape and size of WSL were also recorded on patient files.

The material used for infiltration was: Icon DMG. Icon Resin Infiltrant for smooth surfaces is particularly wellsuited for orthodontic patients after bracket removal. Unless white spots are being treated shortly (1-2 months) after bracket removal, it is recommended that the etching process is performed two times. If a white spot is still visible after the Icon-Dry has been applied, then a third etching process is recommended. The microinvasive treatment of early lesions is limited to lesion depth up to D (based on radiographic lesion depth classification according to bitewing x-rays).

The Icon composition is: Etch gel: Hydrochloric acid, pyrogenic silicic acid, surface-active substances; Icon-Dry: 99% ethanol and Icon-Infiltrant: Methacrylate-based resin matrix, initiators, additives.

Before the start of treatment, the teeth must be cleaned, isolated with a rubber dam or with cotton rolls and dried. The etching process takes 2 minutes. An ample amount of Icon-Etch is applied on the lesion site and let sit for 2 minutes. If necessary, excess material is removed with a cotton roll. Unless white spots are being treated shortly (1-2 months) after bracket removal, it is recommended that the etching process is performed two times. If a white spot is still visible after the Icon-Dry has been applied, then a third etching process is recommended. For topical white spots an area of 2 mm beyond the lesion site is etched. At the discretion of the dentist the entire smooth surface area can be etched and infiltrated in case of large area white spots as they occur after bracket removal. After etching, the teeth are rinsed with water for at least 30 seconds and dried with oil-free air. An ample amount of the Icon-Dry is applied on the lesion site and let sit for 30 seconds. Dry with oil-free and water-free air. When wetted with Icon-Dry the whitish opaque appearance of the enamel should diminish. If this is not the case repeat the etching step a second or third time for 2 minutes each and rinse and dry the teeth again. The Icon-Infiltrant must not be applied under direct operating light as this may cause material to set. An ample amount of Icon-Infiltrant is applied on the etched surface by turning the shaft and let sit for 3 minutes. The excess material is removed with a cotton roll or similar. Then the infiltrate is light-cured for 40 seconds. The infiltrate is applied for a second time and let sit for 1 minute and then light-cured for at least 40 s.

Results and discussions

For the group 1 and 2, the DD readings were subject to statistical analysis and compared between groups at the time point L0, L3 and L6 and between groups at each time point using repeated measures one-way ANOVA (p<0.05). Data were processed by the statistical software SPSS (ver. 13.0).

The recorded data from measurements made by DD in the three intervals of time are given in table 1.
Enamel remineralization is enhanced in the potential of saliva due to the presence of mineral ions (Ca and PO₄). Remineralization can occur spontaneously in about 50% of cases. However, this process is much slower than the topical application of fluoride, which requires 3 applications of acid etching to allow the infiltrate penetrate deeply into the enamel partially remineralized during this period.

For group 3, after treatment of infiltration performed according to the study, with 1, 2 or 3 applications of acid etching, in just one meeting it was acquired the recovery of the enamel surface which was remineralized during the fixed orthodontic treatment. These patients were the most satisfied patients, because the visible improvement of their physiognomic appearance was achieved in the same session with the brackets taking-off.

Conclusions
According to the results obtained with this study, we have come to the following conclusions:
- monthly topical application of Profluorid Varnish with a concentration of 5% NaF reduces significantly, almost completely the WSL which appeared after the fixed orthodontic treatment, if the registered data with DD fall between 2 and 25 (which represents the limit of the initial carious lesion of the enamel);
- the topical action of saliva upon the structure of remineralized enamel during the orthodontic treatment has partial effects, at 30% of patients WSL being still present after 6 months off;
- the infiltration method with Icon DMG is the most effective in restoring the damaged enamel structure in one single meeting/sitting, the aesthetic appearance being clearly superior towards the other adopted alternatives.

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The L0 stage, the recorded data were similar (1 test p>0.05), but at stage L3 and respectively L6 there are significant differences between the recorded values in group 1 and 2: p<0.05 for L3 and p<0.01 for L6. Initially at stage L0, the recorded values in the 3 groups were similar, 19.76±4.89 in group 1, 18.40±5.30 in group 2, and respectively 19.34±4.78 in group 3. At L3 stage there are already significant differences between group 1 and 2, namely an improvement of 5.61±4.89 in group 1 and 2.42±5.30 in group 2. At L6 stage, the differences are already higher, respectively: 7.41±4.89 in group 1 and 3.65±5.30 in group 2.

The topical applications of fluoride (in group 1) restore the enamel structure by converting the hydroxyapatite into fluorapatite through the ionic substitutions game, but also by precipitation of calcium fluoride on the surface of enamel, that protects the underlying hydroxyapatite from the acid attack [10-12]. The cariostatic effect of fluoride is increased by frequent topical applications, repeated mechanism. However this process is much slower than the precipitation of the mineral ions on enamel, that protects the underlying hydroxyapatite from the acid attack [10-12]. The cariostatic effect of fluoride is increased by frequent topical applications, repeated

| Table 1 |
| DD recorded values comparison at the 3 point measurements |
| DD values | group 1 n=20 | group 2 n=20 | p values |
| L0 | 19.76±4.89 | 18.40±5.30 | 0.197 |
| L3 | 14.15±4.14 | 15.98±4.50 | 0.045 |
| L6 | 12.35±4.75 | 14.75±5.14 | 0.004 |
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