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Original Research Article

Remineralizing Effect from Topical Fluoride Treatment on Inicial Lesion of Early Childhood Caries

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Abstract: The starting phase on early childhood caries or circular caries is an initial lesion, known as macula Alba or white spot, which is reversible, stops or reverses (perform biological repairs). In the initial lesion stage (macula alba) with the removal of caries the causative agent (dental plaque) on the one hand, and taking maximum preventive measures on the other hand: proper nutrition of the young child, salivation with normal pH and saliva composition, adequate mechanical and chemical control of dental plaque, by maintaining proper oral hygiene and topical application of fluoride preparations in various forms, conditions are created for the predominance of remineralization processes in relation to demineralization, which compensates for the insufficiency of minerals and may lead to the disappearance of the initial lesion (restutio ad integrum). ***Purpose of the Study investigation*:** Evaluation of ultra-structural enamel changes in the enamel in the starting phase on initial lesion of circular caries - Early childhood caries. It is done with Scanning Electronic Microscope (SEM) evaluation of remineralizing effects in enamel ultrastructure at the stage of initial lesion and superficial form, after topical application of fluoride-based preparation (p-p amino fluoride). ***Material and method***: The investigation was done on laboratory tests on extracted 20 healthy lower incisions and two more groups with 10 upper incisions, where some have topical fluoride compression treatment with SEM (Scanning Electron Microscope), and the others did not have the treatment. After that, we have analysis of the remineralizing effect of fluorides with SEM photo attachments. ***Results:*** In some dental samples we managed to get almost healthy enamel, i.e. complete remineralization process of the inicial lesion. ***Conclusion***: Once again, we have confirmation of one of the many benefits of fluoride in dentistry which is long been known.

Keywords: Remineralizing, Fluoride Treatment, Childhood Caries.

INTRODUCTION

Caries is a multifactorial disease. It usually takes months or even years for a carious lesion to develop. Dental caries is considered to be one of the most common chronic diseases. Dental caries is a dynamic group of complex physical-chemical processes on the tooth surface that occur in vivo, with alternating periods of demineralization and remineralization and numerous inter reaction processes leading to imbalance and loss of minerals [1]. Enamel demineralization is the process of dissolving calcium and phosphate ions from hydroxylapatite crystal, which then pass into the plaque and saliva. Initially, caries affects the hydroxyl apatite crystals and the hydroxyapatite demineralization process takes place [2]. The early stage is the initial lesion, known as macula Alba or white spots, which are reversible [3]. At this stage the caries has not completely penetrated the enamel border. At the moment when it breaks, it spreads along it and then cavitation occurs due to cracking of the enamel surface. Beneath the surface of the initial caries lesion or white spot there is a part with lost minerals just below the intact surface of the enamel. That part with fewer minerals is capable of a reversible remineralization process [3, 4]. Greenstein is a process of deposition of mineral elements primarily calcium and phosphates in the initial carious lesion, which during the demineralization process passed from the surface layers of the enamel to the plaque and saliva [5]. With remineralization, hydroxyl apatite increase [6] and if fluoride is present in the medium, fluoride apathies will

be formed [7]. Remineralization is the treatment for active initial unvaccinated carious lesion, allowing process reversibility or at least stopping progression to cavitation. How successful remineralization will be depends on the predominant, protective, or pathogenic factors [3].

A caries lesion of the enamel occurs in a prolonged period of time when the cumulative negative mineral loss will exceed remineralization (re-incorporation of minerals into the damaged hydroxyl apatite crystals) and the process of demineralization increases the inter crystal spaces [2] as well as the porosity of the enamel. Therefore, in the second stage of the caries lesionoccurrence, at the moment when the caries breaks through the enamel-identical border [7], it spreads along it and then cavitation occurs, i.e. caries.

For the children in early childhood, immediately after the eruption of deciduous teeth (1.5 - 3.5 years), it can occur so-called Caries of the earliest childhood or circular caries, This dental disease is specific for the youngest population, which is a serious problem on a global scale with a high percentage of prevalence [6].

We conducted our own research on the prevalence of circular caries. In 2000, in the central city area of our capital Skopje, in 7 kindergartens, we covered 350 children aged 2-5 years [8]. With single-use examinations, in daylight, we were able to register 19, 71% of circular caries. These results were within the limits of the results obtained from the studies conducted in that period by: Atanasov (1-4 year olds) with 18.81% circular caries, Du, Bian (2-4 years old) with 12%, Louloudiadis- (1-4 years old) -19%, Nikolic (3 years old) 13.2%, Moss- (1-5-3 years old) 3-45% circular caries 1999. In the same children (1.5-3.5 years) we registered a total caries of 33% (circular and classic caries), almost identical to Maatouk's (2-4 years old), a total of 35% in 2001.

In a multi-year study from 2006 to 2011, we diagnosed circular caries in the early stages in an ambulance conditions, at our Children's Clinic and preventive dentistry with a standard clinical examination. The category of younger children aged 1.5-3.5 years was included, so that we can include the initial lesions of the upper incisors, which appear earlier [3].

The prevalence of circular caries has been evidently higher since 2002 when we registered only the already cavitated areas [8], because our examination conditions were more improvised and limited, so it is done with daylight and made with a set for single use, in kindergartens. During the clinical examinations we received an evident higher prevalence of circular caries, because the diagnosis included all initial, initial lesions [3], and the method for their diagnosis will be described in more detail in the section on materials method.

From a preventive dentist practice, early detection (initial lesion) is of particular importance, because at this stage the early caries process can be completely stopped or reversed (biological repair).

MATERIAL AND METHOD

Diagnosing of the initial lesion

Taking into account the fact that the initial stages of circular caries (early childhood caries), have an acute course and occur immediately after the eruption of teeth.We included children of different sexes, aged 1.5 up to 3.5 years at the Clinic for Pediatric and Preventive Dentistry in Skopje.

We have made selection 117 children, with a fully formed milk denture, in which by standard clinical examination, and diagnosed circulrar caries in the early stages: **initial lesion-white spot (macula alba)**.

The diagnosis of the initial lesion - macula alba, is done in the following way:

- Professional removal of soft deposits
- Intensive drying of the vestibular surfaces of the maxillary milk incisions with a 15-second booster

The slight change in the transparency of the enamel in the form of a white spot, without the present cavitation, was diagnosed by inspection as an initial lesion (macula Alba).

LABORATORY RESEARCH

The research is made on the group of children with a fully formed diciduous tooth, and it is formed two basic groups:

- 60 children treated with topical fluoride treatment
- 57 children followed, but did not undergo fluoride treatment

From all of these, 31 children were diagnosed with an initial lesion of the maxillary diciduous incisors.

Out of the same 57 children, after we ascertained the advanced physiological resorption in the observed teeth, we selected 10 of them with initial lesions of circular caries, in which we extracted one maxillary incisior.

For comparison, in the same children, we extracted one control, mandibular incisior, in the phase of the physiological change of the teeth.

Thus, in order to carry out further laboratory tests, we formed untreated samples:

I. Examined group of teeth

- 10 extracted maxillary incisions with initial lesion-white spot (macula alba), and

II. Tooth control group

- 20 extracted healthy mandibular incisiors

The above 60 children, covered with topical fluoride treatment with p-p amino fluoride, were selected with equal attendance at initial stages of circular caries, i.e.:

- 30 children with initial white spot lesion (macula alba) of circular caries

Topical fluoride treatment was performed as follows:

- Professional removal of soft deposits from the tooth surfaces of the maxillary incisions
- Coating with organic fluoride preparation (p-p of amino fluoride), for a period of two minutes, with mandatory use of a dryer so that the liquid is not swallowed.
- Excess fluid leakage by the patient (about 30 seconds)
- It is recommended that the patient not take food or liquid for the next 30 minutes.

We performed this procedure once a week for a period of six months. After completing the six-month topical fluoride treatment, we followed the two groups of children (with initial and superficial lesion) with regular check-ups once a month, until the period of physiological shift of the upper milk inclusions.

When we ascertain the advanced physiological resorption in observations teeth, we selected 10 subjects with initial lesions of circular caries in whom we extracted one maxillary incisior.

In further laboratory tests, we included extracted samples, and it is formed a group of treated samples:

III Examined group of treated samples

- 10 extracted maxillary incisions with initial lesion-white spot (macula alba), and

RESULTS

Evaluation of ultra-structural enamel changes inuntreated specimens of upper primary incisiors. Ultrasound of healthy enamel tooth substance from the dental control group (lower primary incisiors).

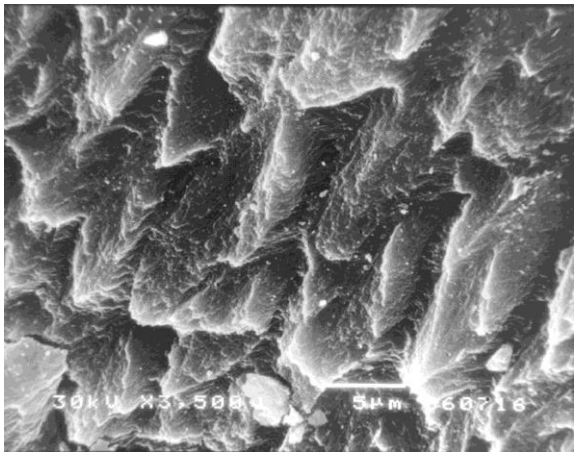

Fig-1: Shows a cross-section of the enamel with a nicemorphological structure of a healthy enamel architecture on which healthy enamel prisms and interprismatic spaces can be seen, were performed by observing (analyzing) the external or vestibular surface of the incisors(3500 times magnification).

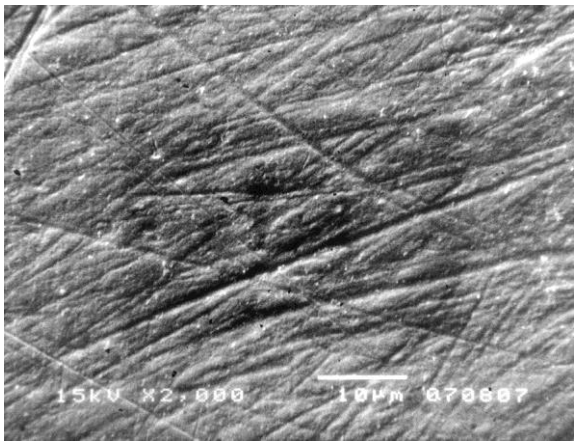

Fig-2: Is presented the longitudinal section ofthe outer surface of healthy enamel. It is homogeneous, flat, with a less wavy appearance. The transverse lines seen on the surface are visible traces of mechanical tooth brushing (2000 times magnification).

Ultrasound changes in the initial lesion (upper primary incisions)

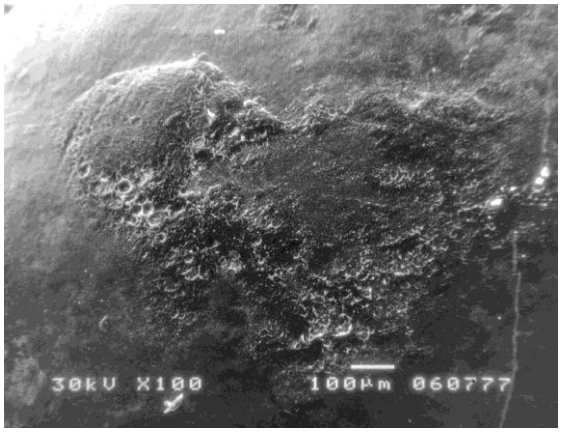

Fig-3: of a slight increase (100 times magnification) is shown initial lesion characteristic of circulatory caries with present demineralization zones

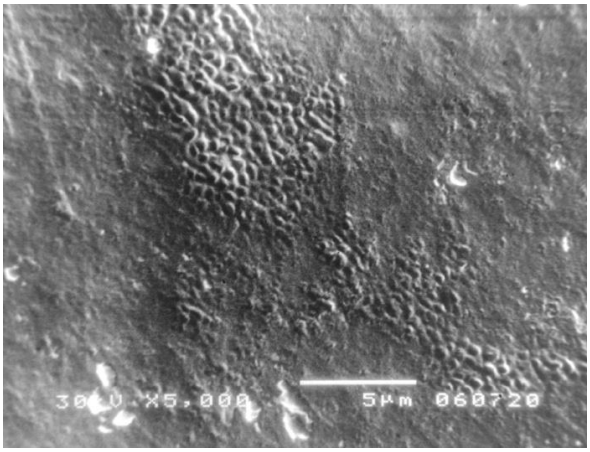

Fig-4: Initional lesion(x5000)

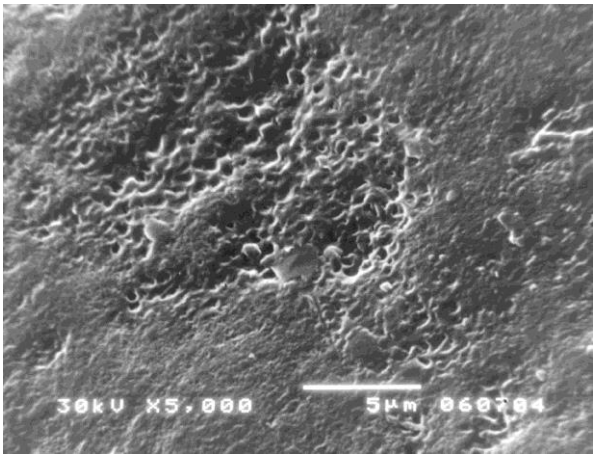

Fig-5: Shows an island of initial demineralization in the initial lesion, and around it is retained and enamel cuticle of a healthy enamel (magnification 5000 times)

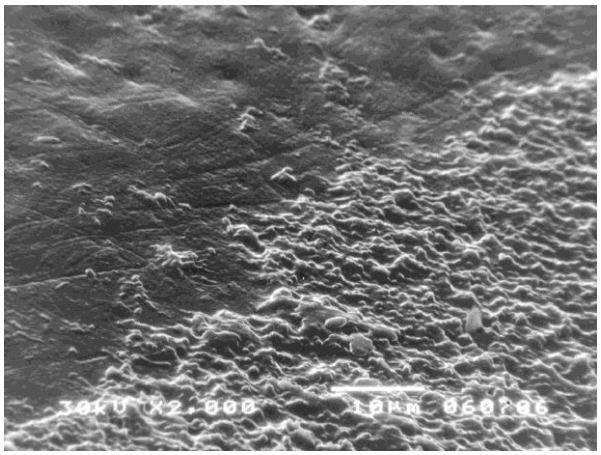

Fig-6: (magnification 5000 times) A boundary between a healthy enamel (top left) and a superficial lesion (botton right)

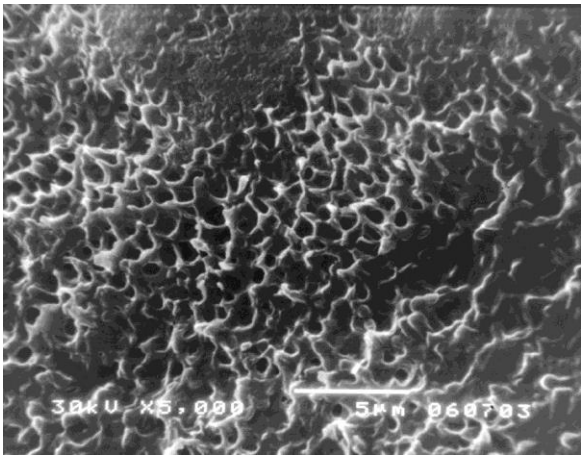

Fig-7: Shows an area of enamel with greater demineralization, with focal loss of prismatic ridges and enlargement of interprismatic ridges indicating a more pronounced initial lesion (magnification 5000).

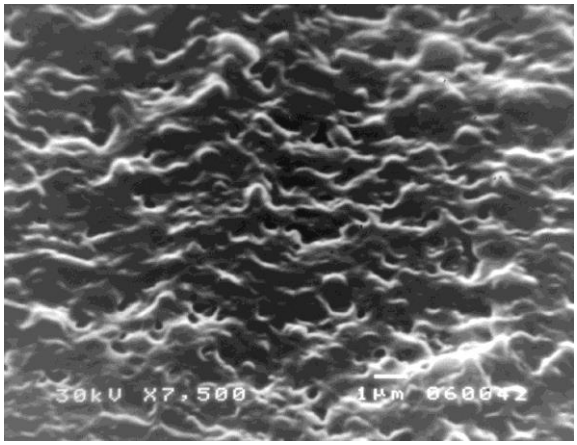

Fig-8: Shows an even larger increase (7500 times magnifying) in a demineralized enamel surface in the initial lesion with rounding and melting of the prismatic ridges. Damaged prisms and dilated interprismatic spaces are seen. An uneven relief is seen on an enamel surface with numerous illuminations, corresponding to expanded (dark) interprismatic spaces. (Magnification 7500). \SEM evaluation of remineralizing effects in enamel ultrastructure after topical fluoride treatment Initial lesion treated teeth (maxillary incisions)

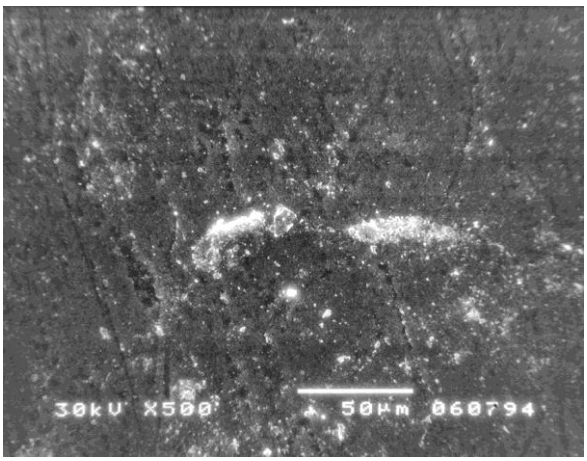

Fig-9

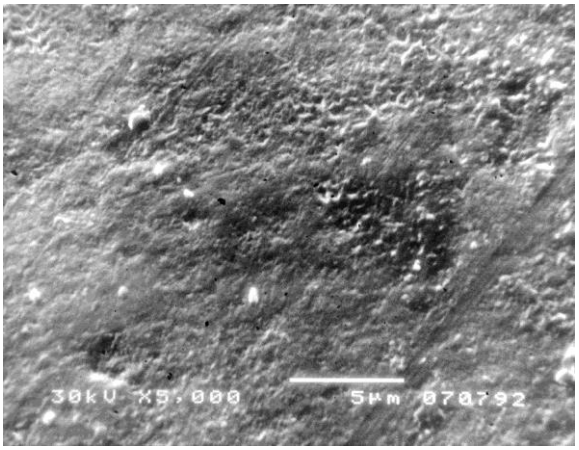

Fig-10

Fig-9. Fig-10: Can be seen the advanced, almost complete remineralization of the initial lesion (white spot), where the enamel residue is similar to the surface of the healthy enamel (magnifying 500 and 5000 times respectively).

In Fig. 11, Fig.12 Can be seen the remineralization process which is solid but incomplete.

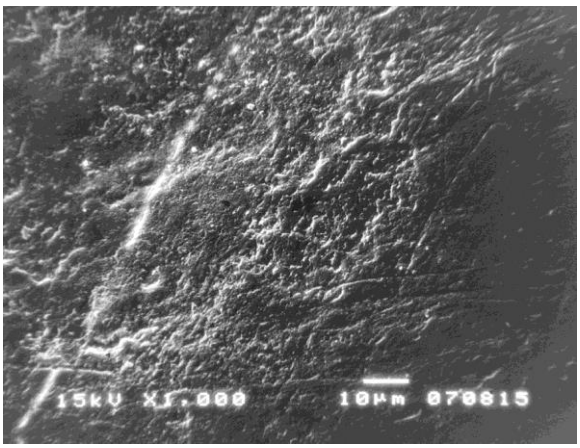

Fig-11: Shows that equalization has been achieved approximately on the smooth healthy enamel and on the surface newly formed prismatic peaks can be seen (increase 1000 times).

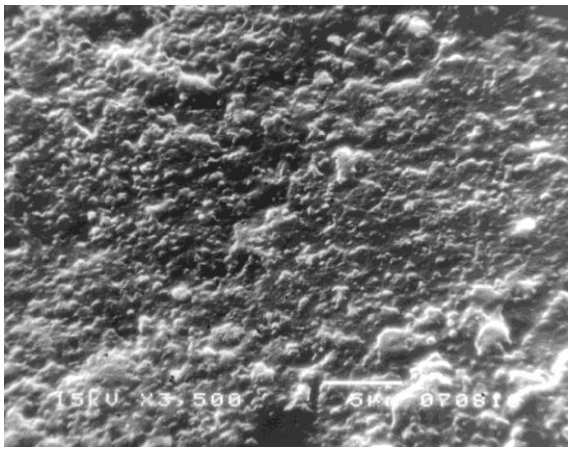

Fig-12: Shows demineralized enamel, similar to healthy enamel, with prismatic ridges on the surface.

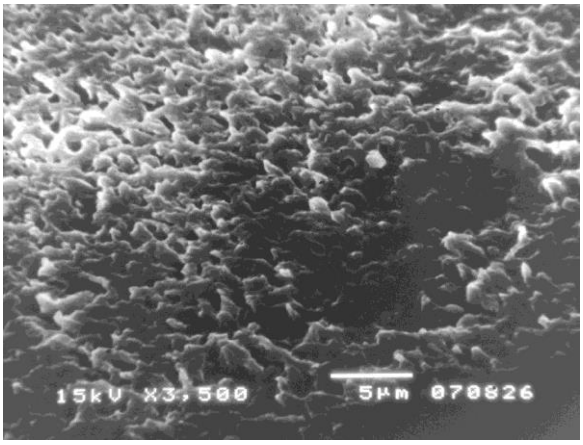

Fig-13: Shows partially repaired prismatic ridges with narrow interprismatic spaces.

DISCUSSION

In the initial lesion stage (macula alba) with the removal of caries the causative agent (dental plaque) on the one hand, and taking maximum preventive measures on the other hand: proper nutrition of the young child [9], salivation with normal pH and saliva composition, adequate mechanical and chemical control of dental plaque[10,11], by maintaining proper oral hygiene [12] and applying topical application of fluoride preparations in various forms, conditions are created for the predominance of remineralization processes [13] in relation to demineralization, which compensates for the insufficiency of minerals and may lead to the disappearance [14] of the initial lesion, i.e. the white spots (restutio ad integrum). However, although remineralization occurs in deeper spots that are no longer white but have a matte or chalky color, remineralization is not complete because ion transport at depth is limited and the body of the lesion is never remineralized [14,15].

For children younger than 18 months, non-invasive treatment of the initial caries lesion today is one of the elements of caries risk management - Guide to caries management intended for dentists and educators, which aims to maintain the health of the tooth structure, and intervention only when indicated [16].

The question arises when it is best and most effective for the dentist to begin local fluoride treatment. Considering the fact that the enamel surface of the newly erupted enamel is not yet fully mineralized, and the teeth are most sensitive to cariogenic nicks in the first few months of eruption, local treatment should begin at age of two years, when most of the deciduous teeth are present and have already erupted [17].

During the eruption of children's teeth, there is an accumulation of plaque over a long period of time [6], because it is impossible to maintain complete oral hygiene for a small child, and also the surface of the

enamel is still porous due to post-traumatic maturation that has just begun. After the teeth are activated, part of the plaque is partially removed from the tooth surface and if oral hygiene is established and the plaque is removed, but in the presence of fluorides, the damaged crystals will be remineralised [13, 14, 18, 11]. However, if the deposits accumulate over a longer period of time on the tooth surfaces, we do not have oral hygiene or the presence of fluorides, demineralization processes will dominate [18, 19], which leads to cracking of the surface layer of the enamel and the initial lesion (white spot) at the level of the enamel, and then progresses in width and depth through the dentin ducts of the dentin and continues to the depth of the dentin [20], with the possibility to occupy the pulp with complications such as: pulpitis, gangrene, periapical abscesses, etc.

So the chances of a white matter being demineralized, or how long it will remain subclinical before programming into a clinically visible carious lesion, will depend on a number of factors, including the fact that caries is a multicellular disease. How successful remineralization will be, depends on the predominant, protective, or pathogenic factors.

Pathogenic factors are the presence and concentration of cariogenic acid genic bacteria [21, 22] (Streptococcus mutants and Lactobacilli), inadequate salivation-reduced secretion and poor composition with acidic saline pH, poor oral hygiene, and improper dietary regime with increased and frequent intake. Protective factors include normal salivation with normal pH and saliva composition, good oral hygiene, and good dietary habits, adequate mechanical and chemical control of dental plaque, use of remineralizing agents and antimicrobials such as chlorhexidine, xylitol, etc.

Many clinical studies around the world date back to the 1960s for fluoride as a prosthetic element in the fight against dental caries. Fluoride can act systemically and locally. Systemic fluorides are ingested, either as supplements or by fluoridated fluids, water, and food that are incorporated into the tooth structure during tooth formation before eruption. Fluoride converts hydroxyapatite from enamel into flour apathies that make the tooth more resistant to caries [13, 17, 18]. However, today the knowledge regarding the action of fluoride is based on the fact that its effect is better and greater if it is used topically.

There are various local fluoride agents in various forms: toothpastes, rinsing agents, solutions, gels, jellies, varnishes, etc. However, it is necessary to emphasize that the frequency of the preparation should be directly related to the patient's risk of caries, and the choice of fluoride preparation should be the choice of the dentist.

CONCLUSION

From the overall SEM analysis of the evaluation of the ultrastructural changes of the enamel dental substance in untreated and treated dental specimens with topical fluoride treatment, as well as the qualitative and quantitative EDS analysis of the mineral composition in individual groups of samples, it is concluded:

- The appearance of ultrastructural changes in the enamel is correlated with the loss of minerals in the tooth substance
- The initial lesion is followed by demineralization and retraction of the prismatic ridges, destruction of the crystals and alteration of their arrangement in the prisms, expansion of the interprismatic spaces between the prisms and a multitude of dark spaces that are more pronounced in a deeper initial lesion.
- In the treated teeth with topical fluoride treatment from the SEM photos, it is concluded that the interprismatic spaces are narrowed, the prismatic ridges are repaired and the surface of the enamel is leveled.

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