BULLETIN OF STOMATOLOGY AND MAXILLO-FACIAL SURGERY OF
Vol 19, No.2

DOI: 10.58240/1829006X-2023.19.2-112

REVIEW ARTICLES

RESIN INFILTRATION FOR MINIMALLY INVASIVE TREATMENT OF INITIAL CARIES AND NON-CARIOUS SPOT LESIONS: LITERATURE REVIEW

Kuzmina Irina Nikolaevna,[1] Said Daria Shorshevna,[2] Pazdnikova Nadezhda Konstantinovna [3]*

1 Professor, Head of Preventive Dentistry Department, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russia
2 Assistant of Preventive Dentistry Department, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russia
3 Associate Professor of Preventive Dentistry Department, Moscow State University of Medicineand Dentistrynamed after A.I. Evdokimov, Moscow, Russia

*Corresponding author: N.K. Pazdnikova; Associate Professor of Preventive Dentistry Department, Moscow State University of Medicine and Dentistry named after A.I. Evdokimov, Moscow, Russia;
e-mail: nadezhda-nk@mail.ru

Received: *Feb. 26, 2023;* ***Accepted:*** *Mar. 27, 2023;* ***Published:*** *Apr. 15, 2023*

Abstract

A concept of minimal intervention dentistry focuses on dental caries prevention, managing risk factors, detection of initial caries lesions and minimally invasive treatment. The article presents the possibilities, indications and advantages of Icon resin infiltration in the treatment of initial dental caries and non-carious spot lesions. Based on data from previous studies it is effective, painless and aesthetic method. After resin infiltration of enamel lesions the integrity of the tooth is preserved, the restoration of luster, transparency and color of the enamel is observed, the microhardness and surface roughness of the demineralized area increased to the values of intact dental tissues. Icon infiltration can be used for the treatment of initial non-cavitated dental caries on proximal and smooth surfaces of teeth as well as for the aesthetic treatment of non-carious spot lesions.

Keywords: *dental caries, non-carious lesions, minimally invasive treatment, Icon, caries infiltration*

Introduction

According to the World Health Organization dental caries is still a main public health problem worldwide. Dental caries affects all age groups in almost all countries, starting with the eruption of the first teeth (deciduous teeth/primary dentition) and, after eruption of the permanent teeth, increasing in prevalence until late adulthood (permanent teeth), then remaining at high levels until older age.[50]

The approach to dental caries treatment has changed dramatically in recent years, evolving from traditional restorative treatment to prevention and non-invasive or minimal intervention dentistry.[28] The increase of modern requirements for the diagnosis of initial dental caries entails the improvement of treatment methods. An innovative approach is focuses on dental caries prevention, managing risk factors, detection of initial caries lesions and their minimally invasive treatment with maximum preservation of intact tooth structures.[14,25]

The requirements for teeth preparation with the improvement of filling materials have gradually changed. The enhancement of the adhesive properties of composite materials made it possible to move away from the traditional preparation according to Black to the tooth preserving preparation approach, which is important in the treatment of proximal caries lesions.[49] Considering that any restorative treatment involves the tooth in a cyclical process of treatment and often subsequent retreatment, such invasive intervention is critical for the long-term preservation of the tooth.

It is also concluded that iatrogenic preparation damage is a frequent side-effect of operative intervention with proximal caries lesions, and represents a dental health problem, since the damage increases caries progression and the perceived need for restorative therapy of the adjacent teeth.[41]

Therefore, special attention should be paid to early diagnosis and subsequent non-invasive or minimally invasive treatment of non-cavitated caries lesions.[17]

In preventive strategies several methods for non-invasive treatment of non-cavitated caries lesions (from the first signs of enamel demineralization to non-cavitated dentine caries) have been proposed: enamel remineralization with fluoride- and calcium-containing agents, the application of silver diamine fluoride solution and the use of dental sealants.[7,9,19]

The enamel remineralization contributes to the prevention or non-invasive treatment of white spot lesions. This technique is effective because the protein matrix within the lesion is preserved that allows remineralization process. If this method is ineffective the use of additional methods of treatment is required.[25,39]

In recent decades silver diamine fluoride has been used for non-invasive treatment and arresting dental caries in primary teeth. This technique is recommended by international and national dental associations due to its high efficacy. However, it causes darkening of caries lesions, up to persistent black staining and does not restore the anatomical shape and function of decayed teeth. Therefore, parents often refuse to use this non-invasive caries treatment technique in primary teeth in children.[24]

White spot lesions are early signs of demineralization under an apparently intact enamel surface layer. These early enamel lesions show a whitish appearance as a result of an increased porosity within the lesion due to mineral loss. Plaque removal and topical fluoride application can result in arresting early carious lesions. Though the caries progression may be stopped the whitish appearance often remains as the remineralization is superficial and there is still a porous lesion body underneath. In addition to those stains can be incorporated into the lesion with the result of a brownish appearance of the lesion (brown spots) which often leads to even more esthetic deficiencies. Treating non-cavitated white spot lesions may include tooth bleaching, micro-abrasion, composite fillings or even prosthetic restorations like veneers. All these options are quite invasive implying tooth structure loss.[22]

Resin infiltration has made possible an innovative method of treating initial carious lesions that reflects perfectly with the concept of minimal intervention dentistry. Infiltration of carious lesions represents a new approach to the treatment of non-cavitated lesions of proximal and smooth surfaces of deciduous and permanent teeth. The major advantage of this method is that it is a non-invasive treatment, preserving tooth structure, masking the whitish appearance of the lesions and that it can be achieved in a single visit.[28]

The resin infiltration is an alternative non-invasive method of the initial dental caries treatment based on experiments conducted in the 70s.[42]

This concept has been modernized and a light-curing polymer of a low viscosity and a higher penetrating power began to be used for the treatment of non-cavitated caries lesions. The polymer fills all microspaces of demineralized tissues and arrests the progression of caries lesion. The affected tooth structures impregnated with infiltrant are comparable in aesthetic and mechanical properties to those of intact ones.[10]

In all cases of initial caries, both in active and stable forms, a large number of cariogenic bacteria producing lactic acid are detected in the zone of enamel lesion and often on its surface. The enamel infiltration method is based on arresting caries progression by closing the pores in the enamel, which are the pathways for the penetration of acids and the exit of dissolved minerals.[41,46]

First infiltration system was presented by a two-stage treatment technique. At the first dental appointment, an orthodontic rubber ring was inserted into the interdental space to separate the contact and provide

access to the proximal surface of the tooth. On the second appointment (after 1-2 days), the infiltration method was performed by etching the enamel surface with phosphoric acid and applying the GLUMA bonding system.

The need for repeated visits and discomfort from the presence of an orthodontic ring in the oral cavity, insufficient depth of etching with phosphoric acid and thus poor penetration of infiltrant deep into the lesion caused that many dentists and patients refused to use this treatment method.[27]

The modern resin infiltration technique was developed in the 2000s by Prof. H. Meyer-Lueckel and Dr. S. Paris. While doing research at the Charite Clinic (Charite Berlin) and the Kiel University (CAU, Germany), together with DMG. They significantly improved the infiltration method and developed not only the material itself, but also offered a kit of accessories that greatly facilitates the procedure for the dentist and the patient. Many clinical and laboratory studies have been carried out to improve every step of this technology.[31,32,35-38]

Currently the Icon resin infiltration (Infiltrant Concept) is successfully used for minimally invasive treatment of dental caries.

Icon Kariesinfiltrant *(DMG, Germany)* includes: *Icon-Etch* (contains 15% hydrochloric and pyrogenic silicic acid), *Icon-Dry* (99% ethanol), *Icon-Infiltrant* (methacrylate-based polymer).

DMG company produces two Icon systems for use on smooth and proximal surfaces (Figure 1).

Figure 1. Icon systems for smooth and proximal surfaces

Icon Kariesinfiltrant – vestibular includes: special vestibular applicator tips for use on smooth surfaces that will not be dissolved under the hydrochloric acid unlike microbrush fibers (Figure 2A).

Icon Kariesinfiltrant – approximal includes: proximal applicator tips with one-sided perforation for application of Icon-Etch and Icon-Infiltrant as well as plastic dental wedges, that allows the material to be applied to the treated surface without affecting the intact surface of the adjacent tooth (Figure 2B).

Figure 2. Applicator tips designed to apply Icon-Etch and Icon-Infiltrant on smooth (A) and proximal (B) surfaces

Steps of resin infiltration for treatment of proximal caries lesions:

1. Clean the affected tooth surface and adjacent teeth. Remove all cleaning residue with water spray. Apply rubber dam. Introduce one of the enclosed dental wedges into the interproximal space to obtain separation of the teeth.
2. Screw the proximal applicator tip onto the Icon-Etch syringe and insert into the proximal area. Apply Icon-Etch with a slight excess to the lesion site. Make sure that the green side of the proximal tip faces in the direction of the surface to be treated. Let Icon-Etch to act for 2 minutes.
3. Remove the applicator tip from the interproximal space. Aspirate off Icon-Etch and rinse with water at least 30 seconds. Dry thoroughly with air that is free of oil and water.
4. Screw the applicator tip onto the Icon-Dry syringe and introduce into the proximal area. Apply Icon-Dry onto the lesion and allow set for 30 seconds. Dry carefully with air that is free of oil and water. Carry out visual inspection within step 4. The whitish opaque lesion discolorations must

diminish significantly when applying Icon-Dry, otherwise repeat steps 2-4 (up to two times).

5. Turn off the direct operating light to prevent premature polymerization of Icon-Infiltrant. Screw the proximal applicator tip onto the Icon-Infiltrant syringe and insert into the interdental space. Make sure that the green side of the proximal tip faces in the direction of the surface to be treated. Apply Icon-Infiltrant with a slight excess to the lesion site. Allow Icon-Infiltrant to penetrate for 3 minutes.
6. Remove the applicator tip from the interproximal space. Remove excess material with dental floss. Light cure from all sides at least 40 seconds.
7. Screw a new proximal applicator tip onto the Icon-Infiltrant syringe. Repeat the application of Icon-Infiltrant and let set for 1 minute;
8. Remove the applicator tip from the interproximal space. Remove excess material with dental floss. Light cure from all sides at least 40 seconds. Remove the wedge and rubber dam. Use polishing strips for the surface finish.

The resin infiltration on smooth surfaces is carried out by a similar method. Icon-Etch and Icon-Infiltrant are applied using vestibular applicator tips for smooth surfaces.

To carry out the procedure, a completely dry field is required, the tooth surface is dried with oil-free air at the stages, since the liquid can change the composition and properties of the material[5]. The use of a rubber dam is mandatory, because it ensures the dryness of the working field, which affects the effectiveness of the procedure, and it also protects the gums and oral mucosa from hydrochloric acid and Icon-Infiltrant. The scarf for the rubber dam must be latex, since non-latex scarves can be dissolved during the infiltration procedure. If caries lesions on the vestibular surfaces are treated isolation with a liquid dental dam can be used in case of an allergy to latex or the inability to use a rubber dam.

The disappearance of white spots after surface drying and Icon-Dry processing is the criterion for sufficient etch depth. The etching process should be repeated if the pseudo-intact surface layer is too thick and whitish opaque lesion discolorations remains after ethanol application. It is allowed to etch the lesion area up to three times for 2 minutes. The application of the Icon-Infiltrant to the affected surface is possible only after a noticeable masking of the spots (at the Icon-Dry processing stage).

It is important to control the presence of excess infiltrate, as it can create micro-roughness, which will negatively affect the result of infiltration[37]. It is recommended to remove excess material with a cotton roll and/or dental floss from smooth surfaces and with a dental floss from proximal surfaces. To apply technique infiltration technique on vestibular surfaces, the use of matrices to prevent the leakage of infiltrant into interdental spaces might be useful. The treated surface should be polished with strips and polishing cups in order to create the smoothest surface after infiltration.

Dynamic monitoring with regular X-ray control (at least once a year) is necessary after Icon enamel infiltration. Since Icon is not a radiopaque material, it is mandatory to fill out a special form for each treated tooth to be recorded in the medical card, as well as to inform the patient. To carry out a photo protocol before and after treatment as well as at follow-up examinations are recommended. Thus, the process of communication with the patient will be optimized and the effectiveness of the infiltration procedure will be evaluated.

The use of an intraoral LED camera with the technology of quantitative light-induced fluorescence has permitted to determine that the fluorescence intensity after the Icon infiltration of initial caries lesion returns to the figures of intact tooth structures, which indicates the restoration of density in the area of caries lesion. This is very important for the aesthetic treatment result.[28]

Advantages of Icon infiltration for treatment of initial caries lesions[3,30,43,47]:

- removal of the pseudo-intact layer of enamel up to 50 microns in 2 minutes due to chemical treatment of caries lesion with hydrochloric acid that creates conditions for infiltrant penetration;
- high fluidity of infiltrant, which contributes to the penetration of infiltrant into the depth of the lesion;
- creation of a smooth surface, which significantly reduces the adhesion of plaque and promotes the natural remineralization of enamel;

- impact on the microflora due to the termination of oxygen access that results in stabilization of carious process;
- restoration of the structure, microhardness and density of dental structures, thus the enamel becomes more resistant to bacterial acids, which reduces the probability of caries progression;
- preservation of intact tooth structures;
- restoration of the natural color and luster of enamel in the area of caries lesion that allows to get an aesthetic result;
- painless procedure, i.e. anesthesia is not required;
- one visit treatment, possibility to treat several teeth at the same time;
- the duration of the procedure is 15-20 minutes, so it can be successfully used in children;
- convenience of the method through the use of specially designed applicator tips.

Dental examination using a monocular or binocular loupe, intraoral LED video camera, as well as laser fluorescence and transluminescence methods, significantly improve the quality of dental caries diagnosis. For successful diagnosis of proximal dental caries, it is necessary to use radiographic images where the presence of hidden carious cavities is clearly visualized. These diagnostic methods allow to determine the depth of the caries lesion and optimize the choice and tactics of non-invasive treatment.[18]
To determine the indications for Icon infiltration, the score system of proximal caries lesions radiographic classification by depth should be used *(Mejare I., 1999)*:

- E1 – radiolucency in the outer half of enamel;
- E2 – radiolucency in the inner half of enamel;
- D1 – radiolucency in the outer third of dentin;
- D2 – radiolucency in the middle third of dentin;
- D3 – radiolucency in the inner third of dentin.

Indications for Icon infiltration of caries lesions[25]:

- non-cavitated proximal caries lesions of enamel and the outer third of dentin (scores E1, E2 and D1 according to the radiological classification by depth);
- initial dental caries on smooth surfaces provided with preserved enamel surface layer (white spot carious lesions, post orthodontic white spot lesions).
- non-carious spot lesions (dental fluorosis, hypoplasia, amelogenesis imperfecta, molar-incisor hypomineralization).

Contraindications for Icon infiltration of caries lesions:

- allergic reaction on Icon components;
- progression of caries lesions to the middle and inner layers of dentin (scores D2-D3);
- impossibility of the working field isolation;
- cavitated enamel and dentin caries.

The effectiveness of the minimally invasive treatment with Icon of initial enamel caries has been proven by numerous studies.
Caries infiltration originally was developed to arrest non-cavitated caries lesions. One positive side-effect of the treatment is that the whitish color of enamel lesions disappears during and after infiltration as the infiltrated resin reduces the light scattering between the enamel crystals. In this way lesions can be camouflaged and an esthetic improvement can be achieved quite easily with only minimal substance loss. With the infiltrant the porosities in the lesion body are occluded. Therefore, this treatment may be used not only to arrest enamel lesions but also to improve the esthetic appearance of buccal white spots.[21]
Resin infiltration can be considered a safe and effective treatment to reduce progression of initial proximal caries. Thus, the progression of initial proximal caries within 1 year after Icon infiltration was detected radiographically only in 4.7% of teeth. A high quality of infiltration was found for the marginal adaptation. In contrast to the improvement of colour at the one-week recall, the infiltrated surfaces showed a statistically significant increase in the discoloration within the following year.[1]
Randomized controlled clinical trials revealed that the radiographic progression of E2-D1 scored proximal caries lesions was observed only in 7% of teeth in the test group after 18 months of Icon infiltration and in 37% of teeth in the control group with placebo treatment. After 3-years follow-up, 4% of test lesions and 42% of control lesions had progressed. The

authors concluded that resin infiltration of proximal caries lesions is efficacious in reducing lesion progression.[31,35]

Proximal infiltration is an effective preventive and minimal invasive method in adolescents. No dental plaque accumulation and gingival bleeding were observed after proximal infiltration in most cases. At annual recalls, plaque scores remained constant. The gingival status in adolescents remained steady and no differences in tooth shape and contour were detected. Discoloration was detected in 19% of treated teeth in 1st year recall and was constant at annual intervals. The radiographic evaluation of the bitewing radiographs showed no progression of lesions from baseline to the 4-year recall.[5]

A randomized controlled split-mouth study was performed to assess the efficacy of resin-infiltrated lesions covered by fluoride varnish (FV) versus FV treatment only on proximal lesions of deciduous molar teeth. After 1 year, 31% of the test lesions and 67% of the control lesions showed signs of progression according to the ICDAS scores. Radiographically, 23% of the test lesions and 62% of the control lesions had progressed. The clinical and radiographic therapeutic effect of both resin infiltration/FV over FV alone was >35% and significant. Thus, resin infiltration in conjunction with fluoride varnish seems promising for controlling proximal lesion progression on deciduous molar teeth.[11]

White spot lesions are non-cavitated caries lesions that are often observed in the esthetical visible area. During orthodontic treatment with fixed elements (brackets) plaque retention is increased resulting in a higher risk for new white spot lesions. Infiltration during orthodontic treatment leads to arrest lesions progressing at an earlier stage of treatment, significantly reduces the number of caries lesions and its progression during active long-term orthodontic treatment[23]. It has been shown that resin infiltration of demineralized enamel does not affect the bond strength of orthodontic brackets.[40]

Post-orthodontic white spot lesions are a significant aesthetic challenge. Slightly visible initial lesions often completely remineralize in saliva, since fixed elements have been removed. However, deeper lesions cannot be visually masked by saliva and fluoride alone. They remain visible for life. Thus, for severe lesions more invasive treatments are indicated.

Resin infiltration was proven to be an effective treatment for masking post-orthodontic white spot lesions after removal of braces. Immediately after Icon infiltration 22.9% of teeth were classified as completely masked, whereas 77.1% of teeth were classified as partially masked and no tooth unchanged. The area of enamel demineralization decreased immediately by an average of 61.8%, after 6 weeks – by 60.9%. The surface color of infiltrated lesions remained stable after 12 months.[13]

It's evident that Icon infiltration permitted the masking of white spot lesions and made initial caries lesions indistinguishable from intact enamel, with the greatest effect after 8 weeks of treatment. After a new acid challenge, the lesions infiltrated with low viscosity resin presented the lowest means of colour change.[48]

Discoloration on smooth surfaces of teeth can be associated not only with dental caries development. The cause of visual disturbances and white or brown spots appearance may be non-carious lesions of teeth not associated with the negative influence of plaque microorganisms. These lesions can occur before eruption (dental fluorosis, hypoplasia, amelogenesis or dentinogenesis imperfecta) and after eruption of teeth (abrasive teeth wear, wedge-shaped defect, dental erosion).[25]

Previously teeth whitening has been a method of choice for masking enamel spots in particular with fluorosis, but this alone is not enough to achieve a high-quality aesthetic result in most cases of natural tooth color change. Invasive methods of treatment such as composite restorations and ceramic veneers often require substantial preparation of dental tissue and also involve multiple patient visits.

A number of studies have been carried out shown that Icon infiltration can be recommended for aesthetic treatment of non-carious enamel spot lesions, such as dental fluorosis, hypoplasia (including traumatic hypomineralization), molar-incisor hypomineralization (MIH), amelogenesis imperfecta.[8,33,43,47]

In milder fluorosis, the shallower subsurface porosities are usually adequately infiltrated and the esthetic results commonly satisfying. In moderate or severe fluorosis, the aesthetic treatment should begin with a whitening procedure as well as an initial mechanical wear of the surface of the affected enamel

might be required before resin infiltration, that is followed by increments of composite resins.[20,51]

The histopathology of traumatic hypomineralization is similar to that of white spots and fluorosis. It involves also subsurface hypomineralization under a relatively well-mineralized surface layer. Either superficial or deep infiltration is effective in treatment of traumatic hypomineralisation. MIH is not indicated for the Icon infiltration treatment. Nevertheless, infiltration of MIH lesions often leads to significant improvements of aesthetics and has a positive impact of patient's quality of life.[21]

The data indicate stabilization of the wedge-shaped defect development after Icon infiltration of the affected area, which allows to consider this method as the preserving minimally invasive technique for treating the initial forms of the wedge-shaped defect.[15] However, additional clinical studies are required to determine the effectiveness of this procedure in the treatment of other non-carious lesions.

According to the results of a laboratory study, the mean hardness values for demineralized enamel treated with Icon was significantly higher than untreated lesions. SEM showed irregular, pitted and rough demineralized enamel surface with destruction of enamel rods and dissolution of enamel crystals. After Icon application, the surface showed complete blockage of enamel rods with resin infiltration.[12]

Enamel surface treated with the resin infiltrant showed approximately the same microhardness and surface roughness as sound enamel, indicating that this material might be suitable for the treatment of enamel subsurface lesions. After the resin infiltration with Icon the enamel microhardness and surface roughness of the demineralized area of teeth increased to the values of intact dental tissues.[45]

Due to pathological changes that affect the enamel refractive index, the light suffers deviation and reflection inside the lesion, creating an optical maze which is over-luminous and responsible for the whitish aspect on the affected areas. The refractive index of enamel impregnated with Icon-Infiltrant is comparable to intact enamel. Micropores are filled with infiltrant and the color of the affected area is brought into line with intact enamel, at the same time the material-tooth border is not observed. The color stability and microhardness of the infiltrant resin provided suitable material for treating white spot lesions.[4,6]

The infiltrant is transparent and colorless and white spots are masked due to a change in the refractive index, as a result the original color of the tooth is restored. In vitro studies have demonstrated that immediately after infiltration teeth appear lighter, but then acquire and retain their natural color for a long time.[34,44]

However, the use of Icon infiltration alone will not be effective enough in teeth with deep spot lesions. The deep infiltration protocol has been proposed in which the external lesion surface should be previously removed using mechanical abrasion with aluminum oxide sandblast or a rotary diamond bur. This procedure grants access to the lesion body, allowing penetration of the resinous monomers. In addition, the border area can be gently removed, preventing the halo effect after the infiltration. The area is then covered with a composite restoration if necessary.[2]

When introducing a new technology, it is important for researchers and practitioners to evaluate both the effectiveness of the technique and its convenience and the willingness of patients and dentists to use this treatment method.

Icon resin infiltration is not laborious to be carried out by a dentist of any qualification and is applicable in daily practice due to convenient full kit of materials and application system. Nevertheless, dentists at various steps of Icon application may claim their experienced difficulties in cleaning the proximal surfaces of teeth, applying rubber dam and wedging the teeth for inserting applicator tips.

A survey of patients showed positive feedback from Icon application. It has been particularly noted that this minimally invasive approach produces the desired aesthetic result.[16,29]

Questioning conducted by Preventive Dentistry Department in the Moscow State University of Medicine and Dentistry named after A.I. Evdokimov has showed that the majority of dentists evaluate the Icon resin infiltration as relatively simple method in comparison with the traditional filling. In questionnaire survey dentists mentioned that in all infiltration procedure the greatest difficulty was experience installing rubber dam, but not a technique itself. Only 7% surveyed patients found the procedure to be tiring and lengthy, while more than 60% found it

fast, pleasant or comfortable. Most dentists (93%) would like to apply this method in their practice.[26]

Conclusion

Based on previous clinical and laboratory studies, it can be concluded that resin infiltration is an effective minimally invasive method for the treatment of initial dental caries and non-carious spot lesions. After Icon application the integrity of the tooth is preserved, the restoration of luster, transparency and color of the enamel is noted, the microhardness and surface roughness of the demineralized area increased to the values of intact dental tissues. The inhibition of caries progression by resin infiltration is readily accepted by most dentists and patients and should now be considered as an alternative to invasive restorations in the treatment of initial dental caries on proximal and smooth surfaces of teeth as well as in the aesthetic treatment of non-carious spot lesions.

REFERENCES

1. Altarabulsi MB, Alkilzy M, Petrou MA, Splieth C. Clinical safety, quality and effect of resin infiltration for proximal caries. *European Journal of Paediatric Dentistry*. 2014;15(1):39-44. PMID: 24745591

2. Attal JP, Atlan A, Denis M, Vennat E, Tirlet G. White spots on enamel: treatment protocol by superficial or deep infiltration (part 2). *Int. Orthod.* 2014;12(1):1-31. doi: 10.1016/j.ortho.2013.12.011

3. Bergstrand F, Twetman S. A review on prevention and treatment of post-orthodontic white spot lesions-evidence-based methods and emerging technologies. *The Open Dentistry Journal.* 2011;5:158-162. doi: 10.2174/1874210601105010158

4. Borges AB, Caneppele TM, Masterson D, Maia LC. Is resin infiltration an effective esthetic treatment for enamel development defects and white spot lesions? A systematic review. *Journal of Dentistry*. 2017;56:11–18. doi: 10.1016/j.jdent.2016.10.010

5. Caglar E, Kuscu OO, Hysi D. Fouryear evaluation of proximal resin infiltration in adolescents. *Acta Stomatologica Croatica*. 2015;49(4)304-308. doi: 10.15644/asc49/4/5

6. Chen M, Li JZ, Zuo QL, Liu C, Jiang H, Du MQ. Accelerated aging effects on color, microhardness and microstructure of ICON resin infiltration. *European Review for Medical and Pharmacological Sciences.* 2019;23:7722–7731. doi: 10.26355/eurrev_201909_18981

7. Cochrane NJ, Shen P, Byrne SJ, et al. Remineralization by chewing sugar-free gums in a randomized, controlled in situ trial including dietary intake and gauze to promote plaque formation. *Caries Research.* 2012;46:147–155. doi: 10.1159/000337240

8. Crombie F, Manton D, Palamara J. et al. Resin infiltration of developmentally hypomineralised enamel. *International Journal of Paediatric Dentistry.* 2014;24(1):51-5. doi: 10.1111/ipd.12025. Epub 2013 Feb 15

9. Cury JA, Tenuta LM. Enamel remineralization: controlling the caries disease or treating early caries lesions? *Brazilian Oral Research.* 2009;23(1):23–30. doi: 10.1590/s1806-83242009000500005

10. Doméjean S, Ducamp R, Léger S, Holmgren C. Resin infiltration of non-cavitated caries lesions: a systematic review. *Medical Principle and Practice: international journal of the Kuwait University, Health Science Centre.* 2015;24(3):216-221. doi: 10.1159/000371709

11. Ekstrand KR, Bakhshandeh A, Martignon S. Treatment of proximal superficial caries lesions on primary molar teeth with resin infiltration and fluoride varnish versus fluoride varnish only:

efficacy after 1 year. *Caries Research.* 2010;44(1):41-46. doi: 10.1159/000275573

12. El Meligy OAES, Alamoudi NM, Ibrahim STE, Felemban OM, Al-Tuwirqi AA. Effect of resin infiltration application on early proximal caries lesions in vitro. *Journal of Dental Sciences.* 2021;16(1):296-303. doi: 10.1016/j.jds.2020.04.005

13. Feng CH, Chu XY. Efficacy of one year treatment of Icon infiltration resin on post-orthodontic white spots. Journal of Peking University. 2013;45(1):40-43. PMID: 23411517

14. Frencken JE, Peters MC, Manton DJ. et al. Minimal intervention dentistry for managing dental caries – a review: report of a FDI task group. *International Dental Journal.* 2012;62.:223–243. doi: 10.1111/idj.12007

15. Gazhva SI, Yakubova EYu, Gazhva YuV, Repina EA. Primeneniye minimalno invazivnoy tekhniki infil'tratsii v lechenii nachal'nykh form klinovidnogo defekta. *Dental Forum.* 2020;4:14-15

16. Glazer HS. Treating white spots: new caries infiltration technique. *Dentistry Today.* 2009;28(10):82-85. PMID: 19845304

17. Gomez SS, Basili CP, Emilson CG. A 2–year clinical evaluation of sealed noncavitated approximal posterior carious lesions in adolescents. *Clinical Oral Investigations.* 2005;9:239-243. doi: 10.1007/s00784-005-0010-7

18. Granko SA, Lopatin OA, Yesman A., Barannikov SV. Opyt mikroinvazivnogo lecheniya kariyesa metodom infil'tratsii emali materialom «Icon» (DMG). *Sovremennaya stomatologiya.* 2010;2:43-47.

19. Griffin SO, Oong E, Kohn W, et al. The effectiveness of sealants in managing caries lesions. *Journal of Dental Research.* 2008;87:169-174. doi: 10.1177/154405910808700211

20. Gugnani N, Pandit IK, Goyal V, et al. Comparative evaluation of esthetic changes in nonpitted fluorosis stains when treated with resin infiltration, in-office bleaching, and combination therapies. *Journal of Esthetic and Restorative Dentistry.* 2017;29(5):317-324. doi: 10.1111/jerd.12312

21. Icon smooth surface. Case Reports. DMG: https://ru.dmg-dental.com

22. Kim S, Kim EY, Jeong TS, Kim JW. The evaluation of resin infiltration for masking labial enamel white spot lesions. *International journal of paediatric dentistry.* 2011;21(4):241-248. doi: 10.1111/j.1365-263X.2011.01126.x

23. Kosyuga SYu, Botova DI. Opyt primeneniya sistemy infiltratsii u patsiyentov na ortodonticheskom priyeme. *Dental Forum.* 2017;4:42-43

24. Kurkina ON, Maslak EE, Kurkina VM, Pyshnenko VR. Vospriyatiye roditelyami lecheniya kariyesa vremennykh zubov u detey s primeneniyem diaminftorida serebra. *Dental Forum.* 2020;4:38-39

25. Kuzmina EM, Yanushevich OO. Profilakticheskaya stomatologiya: Uchebnik - M. *Prakticheskaya meditsina.* 2016;544

26. Kuzmina IN, Fidler TV, Said DSh. Klinicheskoye primeneniye metoda infiltratsii dlya lecheniya kariyesa proksimal'nykh poverkhnostey zubov. *Rossiyskaya stomatologiya.* 2017;1:50

27. Kuzmina IN, Pazdnikova NK, Benya VN, Kuznetsov PA. Primeneniye metoda infil'tratsii dlya lecheniya nachalnykh form kariyesa zubov. *Dental Forum.* 2018;2:45-49

28. Lasfaraues JJ, Bonte E, Guerrieri A, Fezzani L. Minimal intervention dentistry: part 6. Caries inhibition by resin infiltration. *British Dental Journal.* 2013;214(2):53-59. doi: 10.1038/sj.bdj.2013.54

29. Markowitz K, Carev K. Assessing the appearance and fluorescence of resin-infiltrated white spot lesions with caries detection devices. *Operative*

Dentistry. 2018;43(1):10-18. doi: 10.2341/16-153-L

30. Mazur M, Westland S, Guerra F, Corridore D, Vichi M, Maruotti A, Nardi GM, Ottolenghi L. Objective and subjective aesthetic performance of Icon treatment for enamel hypomineralization lesions in young adolescents: A retrospective single center study. *Journal of Dentistry*. 2018;68:104-108. doi: 10.1016/j.jdent.2017.11.001

31. Meyer-Lueckel H, Bitter K, Paris S. Randomized controlled clinical trial on proximal caries infiltration: three-year follow-up. *Caries Research*. 2012;46(6):544-548. doi: 10.1159/000341807

32. Meyer-Lueckel H, Paris S, Kielbassa AM. Surface layer erosion of natural caries lesions with phosphoric and hydrochloric acid gels in preparation for resin infiltration. *Caries Research*. 2007;41:223-230. doi: 10.1159/000099323

33. Munoz MA, Arana-Gordillo LA, Gomes GM, et al. Alternative esthetic management of fluorosis and hypoplasia stains: blending effect obtained with resin infiltration techniques. *Journal of Esthetic and Restorative Dentistry*. 2013;25:32-39. doi: 10.1111/j.1708-8240.2012.00527.x

34. Nobrega D, Harsono M, Finkelman M, Kugel G, Perry R. Bleaching of teeth treated with unique treatment for early caries. IADR/AADR/CADR General Session. San Diego, California. 2011;ID 2549

35. Paris S, Hopfenmuller W, Meyer-Lueckel H. Resin infiltration of caries lesions: an efficacy randomized trial. *Journal of Dental Research*. 2010;89(8):823-826. doi: 10.1177/0022034510369289

36. Paris S, Meyer-Lueckel H. Influence of application frequency of an infiltrant on enamel lesions. *Journal of Dental Research*. 2008;87:1585

37. Paris S, Meyer-Lueckel H, Kielbassa AM. Resin infiltration of natural caries lesions. *Journal of Dental Research*. 2007;86:662-666. doi: 10.1177/154405910708600715

38. Paris S, Meyer-Lueckel H, Mueller J, et al. Progression of sealed initial bovine enamel lesions under demineralizing conditions in vitro. *Caries Research*. 2006;40:124-129. doi: 10.1159/000091058

39. Petersen PE, Kuzmina EM, Margvelashvili VV. Effektivnost primeneniya ftoridov dlya profilaktiki kariyesa zubov v obshchestvennom zdravookhranenii. *Dental Forum*. 2018;2:2-16

40. Phark JH, Choo KM, Duarte S, Sadan A. Influences on bond strength of orthodontic brackets. *J. Dent. Res*. 2010;89(Spec Iss A):1320

41. Qvist V, Johannessen L, Bruun M. Progression of approximal caries in relation to iatrogenic preparation damage. *Journal of Dental Research*. 1992;71(7):1370-1373. doi: 10.1177/00220345920710070401

42. Robinson C, Hallsworth AS, Weatherell JA, et al. Arrest and control of carious lesions: a study based on preliminary experiments with resorcinol-formaldehyde resin. *Journal of Dental Research*. 1976;55:812-818. doi: 10.1177/00220345760550051601

43. Senestraro SV, Crowe JJ, Wang M, et al. Minimally invasive resin infiltration of arrested white-spot lesions: a randomized clinical trial. *Journal of the American Dental Association*. 2013;144:997-1005. doi: 10.14219/jada.archive.2013.0225

44. Shah S, Cakir D, Ramp LC, Beck P, Burgess JO. Color stability and stain resistance of ICON Caries Infiltrant Resin. IADR/AADR/CADR General Session. San Diego, California. 2011;ID 2549

45. Taher NM, Alkhamis HA, Dowaidi SM. The influence of resin infiltration system on enamel microhardness and surface roughness: An in vitro study. *Saudi Dental Journal*. 2012;24(2):79-84. doi: 10.1016/j.sdentj.2011.10.003

46. Terekhova TN, Butvilovskiy AV, Yatsuk AI, Burak ZhM. Infiltratsiya emali – novyy metod minimal'no invazivnogo lecheniya kariyesa zubov. *Stomatologicheskiy zhurnal.* 2010;1:73-76

47. Tirlet G, Chabouis HF, Attal JP. Infiltration, a new therapy for masking enamel white spots: a 19-month follow-up case series. *The European Journal of Esthetic Dentistry*. 2013;8:180-190. PMID: 23712339

48. Torres CRG, Borges AB, Torres LMS, Gomes IS, de Oliveira RS. Effect of caries infiltration technique and fluoride therapy on the colour masking of white spot lesions. *Journal of Dentistry.* 2011;39(3):202-207. doi: 10.1016/j.jdent.2010.12.004

49. Trezubov VN, Arutyunov SD. Stomatologiya: Uchebnik – M. *Meditsinskaya kniga.* 2003;580

50. WHO: Global oral health status report: towards universal health coverage for oral health by 2030. Executive summary. Geneva: WHO. 2022:20

51. Zotti F, Albertini L, Tomizioli N, Capocasale G, Albanese M. Resin infiltration in dental fluorosis treatment – 1-Year Follow-Up. *Medicina (Kaunas).* 2021;57(1):22. doi: 10.3390/medicina57010022

ԻՆՖԻԼՏՐԱՑԻՈՆ ՄԵԹՈԴԻ ԿԻՐԱՌՈՒՄԸ ՍԿԶԲՆԱԿԱՆ ԿԱՐԻԵՍԻ ԵՎ ՈՉ ԿԱՐԻՈԶ ԱԽՏԱՀԱՐՈՒՄՆԵՐԻ ՆՎԱԶԱԳՈՒՅՆ ԻՆՎԱԶԻՎ ԲՈՒԺՄԱՆ ՀԱՄԱՐ

Ի.Ն. Կուզմինա,[1] Դ.Շ. Սաիդ, [2] Ն.Կ. Պազդնիկովա [3]

[1] Պրոֆեսոր, Մոսկվայի Ա.Ի. Եվդոկիմովի անվան պետական բժշկա-ստոմատոլոգիական համալսարանի ստոմատոլոգիական հիվանդությունների կանխարգելման ամբիոնի վարիչ

[2] Մոսկվայի Ա.Ի. Եվդոկիմովի անվան պետական բժշկա-ստոմատոլոգիական համալսարանի ստոմատոլոգիական հիվանդությունների կանխարգելման ամբիոնի ասիստենտ, Մոսկվա, Ռուսաստան

[3] դոցենտ, Մոսկվայի Ա.Ի. Եվդոկիմովի անվան պետական բժշկա-ստոմատոլոգիական համալսարանի ստոմատոլոգիական հիվանդությունների կանխարգելման ամբիոնի դոցենտ,Մոսկվա, Ռուսաստան

Ամփոփում

Ստոմատոլոգիայի ներկայիս միտումները կենտրոնացած են կարիեսի կանխարգելման, կարիեսի ռիսկի գործոնների կառավարման, վաղ փուլերում կարիեսային ախտահարումների հայտնաբերման և դրանց նվազագույն ինվազիվ բուժման վրա: Այս հոդվածը ներկայացնում է Icon ինֆիլտրացիայի համակարգի օգտագործման հնարավորությունները, ցուցումները և առավելությունները կարիեսի վաղ փուլերի և ատամների ոչ կարիեսային ախտահարումների համար:

Կատարված ուսումնասիրությունների արդյունքների վերլուծությունը ցույց է տալիս, որ այս մեթոդը արդյունավետ է և ցավազուրկ, հանգեցնում է բուժման էսթետիկ արդյունքների:

Էմալի ախտահարումները Icon ինֆիլտրատով բուժելուց հետո պահպանվում է ատամի ամբողջականությունը, նշվում է էմալի փայլի, թափանցիկության և գույնի վերականգնումը, էմալի դեմինալիզացիայի ֆոկուսի միկրոկարծրության և կոշտության ցուցանիշները վերադառնում են ինտակ ատամիների հյուսվածքների արժեքներին:Icon ինֆիլտրացիայի մեթոդը կարող է օգտագործվել ատամների պրոկսիմալ և վեստիբուլյար մակերևույթների էմալում և դենտինում կարիեսի սկզբնական փուլերը բուժելու, ինչպես նաև ոչ կարիեսային ախտահարումների էսթետիկ բուժման համար:

ПРИМЕНЕНИЕ МЕТОДА ИНФИЛЬТРАЦИИ ДЛЯ МИНИМАЛЬНО ИНВАЗИВНОГО ЛЕЧЕНИЯ НАЧАЛЬНЫХ ФОРМ КАРИЕСА И НЕКАРИОЗНЫХ ПОРАЖЕНИЙ ЗУБОВ: ОБЗОР ЛИТЕРАТУРЫ

И.Н. Кузьмина,[1] Д.Ш. Саид,[2] Н.К.Паздникова [3]

[1] Профессор, зав. кафедрой профилактики стоматологических заболеваний, Московский государственный медико-стоматологический университет им. А.И.Евдокимова, Москва, Россия

[2] Ассистент кафедры профилактики стоматологических заболеваний, Московский государственный медико-стоматологический университет им. А.И.Евдокимова, Москва, Россия

[3] Доцент кафедры профилактики стоматологических заболеваний, Московский государственный медико-стоматологический университет им. А.И.Евдокимова, Москва, Россия

Резюме

Современные тенденции в стоматологии направлены на профилактику кариеса зубов, управление факторами риска развития кариеса, обнаружение кариозных поражений на ранних стадиях и их минимально инвазивное лечение. В данной статье представлены возможности, показания и преимущества применения системы инфильтрации Icon при лечении начальных стадий кариеса и некариозных поражений зубов. Анализ результатов проведенных исследований свидетельствует, что данный метод является эффективным и безболезненным, приводит к достижению эстетичных результатов лечения. После обработки очагов поражения эмали инфильтратом Icon сохраняется целостность зуба, отмечается восстановление блеска, прозрачности и цвета эмали, показатели микротвердости и шероховатости очага деминерализации эмали возвращаются к значениям интактных твердых тканей зуба. Метод инфильтрации Icon может использоваться для лечения начальных стадий кариеса эмали и дентина проксимальных и вестибулярных поверхностей зубов, а также для эстетического лечения некариозных поражений.

Kuzmina IN, Said DS, Pazdnikova NK. Resin infiltration for minimally invasive treatment of initial caries and non-carious spot lesions: Literature review. *Bulletin of Stomatology and Maxillofacial Surgery*. 2023;19(2):112-123. doi: 10.58240/1829006X-2023.19.2-112