Introduction

Despite the significant number of publications on minimally invasive techniques of teeth infiltration in initial caries at the white spot stage, researchers' interest in this issue has not abated [1-3]. Dental fluorosis is a chronic condition caused by excess fluoride, in which there is a disruption of the development of enamel, namely its hypomineralization [4]. One of the recent systematic reviews concluded that infiltration of composite resin with increasing exposure is the best approach in the treatment of dental fluorosis [5].

An in vitro study found that the Icon technique is designed to effectively restore non-cavitary lesions (porosity in de-or hypomineralized enamel), and thus is a conditional "bridge" in the therapy between preventive and surgical treatment methods. Infiltration of the composite resin increases the strength of demineralized enamel [6]. It was also established by spectrophotometry that the infiltration of the composite resin makes optically invisible lesions in the form of white spots with varying degrees of demineralization [7,8]. The results of clinical application indicate the effectiveness of the Icon infiltration method in combination with microabrasion and professional whitening [8], as well as an excellent aesthetic effect for 2 years after treatment [9].

Therefore, this Icon method may be a minimally invasive alternative to various methods of remineralization, especially in pediatric practice. Certain limitations in the application of the Icon method include its relatively high cost.

This publication presents favorable treatment outcomes, obtained within a short time, in the therapy of fluorosis of permanent incisors in a 7-year-old girl after the application of the Icon infiltration method. This clinical case may be of practical interest to dentists in the wider use of this technique in pediatric dentistry, especially in the regions of endemic fluorosis. Before disseminating the results of the treatment, we obtained written informed consent from the patient's mother.

Case report

The mother of a 7-year-old girl, a resident of the Poltava region in Ukraine, presented to the dentist with complaints of an unusual appearance of permanent teeth that have recently erupted, the presence of stains on them. According to the anamnesis of life, the family has a good socio-economic status.

The family consumed water from the municipal water supply network, it should be noted that the whole Poltava region belongs to the fluorine-bearing hydrogeochemical region, where drinking water from many sources has a fluoride content of 2.5 to 8.8 mg/liter. It is believed that the increase in fluoride content in water is due to the contact of groundwater with phosphorite deposits of the Buchak stage, as well as the presence of minerals of the halite group [10]. Systematic Cochrane reviews suggest that even where the fluoride level in water is 0.7 ppm, there is a probability of the presence of signs of dental fluorosis in about 12% of the population [11].

According to the present history, the girl and her mother have never taken systemic fluoride preparations in various forms, or other products with high fluoride content for topical use in the oral cavity, such as toothpaste.

Examination of the oral cavity revealed the presence of white spots on all the first permanent incisors, to a greater extent on the vestibular and to a lesser extent on the oral surfaces (Fig. 1 a, b). Children living in the Poltava region often suffer from dental fluorosis [12]. To diagnose fluorosis, it is important to identify a specific type of lesion, ranging from spotty (chalky spots) to destructive forms, and their symmetrical localization on most or all teeth in areas on the vestibular or oral surfaces closer to the tubercles or cutting edge of the tooth crown. Differential diagnosis of spotty forms is performed with initial caries, hypoplasia of the enamel, and destructive forms with a wedge-shaped defect, erosion of the hard tissues of the tooth, necrosis of
the enamel. The general medical history of this group of patients is usually not burdened by the presence of systemic, genetic or infectious diseases and related treatments. However, there may be a treatment for systemic hypoplasia of temporary teeth complicated by caries. Since the age of 3 years, our patient has been treated with appropriate methods for caries and its complications, namely periradicular periodontitis of the upper temporary incisors and pulpitis of the upper first temporary molars. From the anamnesis of the mother’s life, unfavorable factors were found during pregnancy, and systemic hypoplasia of the patient’s temporary teeth was classified as prenatal.

Clinical examination of the girl’s oral cavity revealed mixed occlusion and signs of systemic hypoplasia, namely the presence of a filling on the smooth vestibular surface of the temporal right canine on the upper jaw, and a symmetrical brown spot on the left canine, as well as the destruction of the crowns of both temporary first molars of the upper jaw, restored with steel crowns a week ago (Fig. 1a). On the temporary right first molar of the upper jaw, the restoration did not meet the clinical and anatomical requirements, in particular, there was an unsatisfactory marginal fit of the compomer restoration (Fig. 2a). There was also a moderate impairment of the eruption of permanent incisors in the upper jaw due to their asymmetric eruption (Fig. 1a), as well as a disruption in the order of eruption of permanent first molars (only molars’ tubercles have erupted recently) relative to the central incisors. Asymmetric eruption of the central permanent incisors can be explained by past endodontic intervention in temporary incisors of the upper jaw.

This patient was diagnosed with fluorosis, according to the classification of Thylstrup and Fejerskov, this clinical case can be assessed on a scale of 3-4 points, with a higher score of damage to the upper incisors, which may be caused by the previous endodontic intervention of temporary incisors (Fig. 1a). In addition, we diagnosed a defect in the compomer restoration of the temporary first molar of the upper jaw on the right.

First of all, the treatment plan consisted of infiltration of composite resin (Icon, DMG) of the crown surfaces of all permanent incisors that erupted.

The first objective of the treatment was resin infiltration (Icon, DMG) for all erupting permanent incisors.

The sequence of the infiltration technique of composite resin into dental tissue is the etching of the enamel surface and subsequent sealing of the lesion with low-viscosity high-permeability composite resin, followed by photopolymerization. In our clinical case, Icon infiltration was performed according to the manufacturer’s instructions, but with some modification, which involved repeated etching. Its necessity was explained by the possibility of predicting the effect of resin infiltration: if the use of ethanol does not change color or no white spots disappear, it means that white spots will not disappear after the application of resin infiltration as well, therefore, etching is repeated [13]. Before the treatment, the tooth surfaces were cleaned with an air abrasive system with glycine-containing Clinpro Glycine Prophy Powder 3M ESPE. To isolate the teeth from the oral fluid, a liquid rubber dam was used instead of the lassic one, as there was an incomplete eruption of the crown of the incisor in the upper jaw (Fig. 1a).

White spots disappeared in all teeth, but the incisor retained a small area of opacity (Fig. 1c), as a result of inaccuracy in the application of the liquid rubber dam. Nevertheless, clinically there is a significant aesthetic improvement after infiltration of the composite resin (Fig. 1c, d). The next visit is scheduled in three and six months to assess clinical outcomes.

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**Fig. 1** Visible effect of fluorosis treatment using minimally invasive Icon infiltration technique:

a) permanent central incisor of the maxilla on the left with the applied liquid rubber dam before treatment;  
b) permanent central mandibular incisor before treatment;
c) permanent central incisor of the maxilla on the left after treatment;

- d) permanent central incisor of the mandible after treatment.

The second point of the treatment plan was to restore the temporary first molar of the upper jaw with a standard stainless steel metal crown after partial removal of the compomer restoration and preparation of the outer walls of the tooth crown. The crown was fixed on polycarboxylate cement (Fig. 2a, b). Standard stainless steel metal crowns are the most common method used to repair severely damaged temporary tooth crowns [14].

The patient and her mother approved the results of the treatment, which was expressed in effective cooperation during treatment and restoration of the patient’s self-esteem after the presentation of treatment outcomes. There were no side effects or complications during treatment.

Discussion

Defects in the development of enamel are manifested in the form of visual deviation from its normal translucent state, which occurs due to defects in its formation and which are characterized as hypoplasia, immature, hypomineralized enamel. Dental fluorosis is a pathology caused by excessive fluoride intake during the formation of enamel, which can lead to discoloration due to increased porosity of enamel lesions. Despite the presence of increased fluorine compounds, some other components are present in drinking water, namely iron [15] and lead [16], resulting in impaired enamel mineralization [17]. However, the effect of dysfunction of transport enzymes of these ions is the most convincing hypothesis [18, 19].

Until the 2010s, the treatment of fluorosis was somewhat limited [20]. Existing treatments have included bleaching, restoration with composite restorations or veneers, microabrasion [21], remineralization therapy [22] and/or systemic microelements, calcium glycerophosphate, vitamins, and bioactive supplements [23-25]. Since 2000, various products based on the method of remineralizing therapy with calcium phosphate preparations have been offered on the dental market. Their effect is mainly based on increasing the natural remineralizing ability of oral fluid, and it has limited application. The use of vitamins and bioactive supplements has been examined in a number of animal studies [24, 26], but we suggest that their preliminary use for teeth, in general, is quite empirical.

The front group of permanent teeth as an area that is extremely important in the aesthetic perception of the face as a whole, is prone to dental fluorosis (in the childhood, at the age of 20 to 30 months, it was affected by excessive doses of fluoride due to endemic factors). Some treatments, such as whitening permanent teeth in primary school children, can lead to a significant destruction of the enamel, and accordingly, its complete restoration with the use of surgical methods.

The Icon agent for infiltration of carious lesions in the early stages was presented in Germany in 2009 by Professors H. Meyer-Lueckel and Dr. S. Paris [27], and it is rated as painless and minimally invasive. This agent is a special composite resin for filling and sealing demineralized enamel, without excessive loss of healthy enamel. Icon was an innovative product for the microinvasive treatment of early cariogenic lesions in the proximal and vestibular areas of dental crowns. In addition, since 2012, a significant number of practical and scientific studies on the clinical action of Icon have demonstrated a quick, simple and painless effect after its use in the form of fluorosis. Composite resin completely fills the pores inside the enamel, replacing the lost mineral structure of the tooth and interrupting the progression of the lesion, blocking further penetration of any substances into the pore system. Greater efficiency of this method is observed in a combination of methods of microabrasion with the subsequent infiltration in comparison with a combination of methods of microabrasion and remineralization [28]. In addition, the Icon infiltration treatment method is usually much less aggressive and expensive than the restoration method.

We used the Icon infiltration method and obtained fast and reliable results, which was key in choosing the treatment approaches in this clinical case.
There were no restrictions as to the application of this approach in this clinical case. In the scientific literature, there is an unconfirmed theory that the prevalence of fluorosis and its severity increases over time after tooth eruption. However, recent studies have shown that very mild, mild and moderate fluorosis tends to decrease in severity in adulthood and then slows down at the age of twenty. Given this information, the clinical effect reported by the manufacturers after treatment with Icon might be even longer than the declared period of 2 years after treatment for fluorosis [9].

In conclusion, we believe that there are currently no alternative treatments for fluorosis in pediatric dentistry, and we intend to extend the use of this technique in pediatric dentistry in regions of endemic fluorosis.

References


### Список літератури


Summary

The Icon technique is designed to effectively restore non-cavitory lesions (porosity in de- or hypomineralized enamel). Infiltration of the composite resin increases the strength of demineralized enamel. The results of clinical application indicate the effectiveness of the Icon infiltration method in combination with microabrasion and professional whitening, as well as an excellent aesthetic effect for 2 years after treatment.

The Icon method may be a minimally invasive alternative to various methods of remineralization, especially in pediatric practice. Certain limitations in the application of the Icon method include its relatively high cost.

This publication presents favorable treatment outcomes, obtained within a short time, in the therapy of fluorosis of permanent incisors in a 7-year-old girl after the application of the Icon infiltration method. This clinical case may be of practical interest to dentists in the wider use of this technique in pediatric dentistry, especially in the regions of endemic fluorosis. Before disseminating the results of the treatment, we obtained written informed consent from the patient's mother.

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Key words: composite resin, infiltration, fluorosis treatment, paediatric dentistry.
7-річної дівчинки після застосування методу інфільтрації Icon, отримані в стислій термін. Цей клінічний випадок може відкрити практичну зацікавленість лікарів-стоматологів у ширшому використанні методики Icon у дитячій стоматології, особливо на територіях ендемічного флюорозу. Перш ніж поширити результати лікування, авторами отримано письмову інформовану згоду від матері пацієнтки.

Авторами застосовано інфільтраційний метод Icon і отримано швидкі й надійні результати, що було ключовим у обранні підходів до лікування в наведеному клінічному випадку.

Обмеження щодо застосування зазначеного підходу в описаному клінічному випадку були відсутні. Відома непідтверджена теорія в науковій літературі, що поширеність флюорозу і його тяжкість зростають із часом після прорізування зубів. Однак у недавніх дослідженнях зазначається, що дуже легкий, легкий і помірний флюороз має тенденцію до зниження тяжкості в підлітковому віці. Ця тенденція продовжується і в молодому дорослому віці, а далі сповільнюється при досягненні двадцятирічного віку. Ураховуючи цю інформацію, зазначений виробником клінічний ефект після лікування Icon може бути навіть тривалішим, ніж заявленний у 2 роки після лікування флюорозу.

Підсумовуючи, автори висловлюють думку, що натепер у дитячій стоматології відсутні альтернативні методики лікування плямистої форми флюорозу, і мають намір розширити застосування цієї мето- дики в дитячій стоматології на територіях ендемічного флюорозу.

Ключові слова: композитна смола, інфільтрація, лікування флюорозу, дитяча стоматологія.