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Non-Operative Treatment of Non-Cavitated Approximal Carious Lesions of Primary Molars

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Abstract: ***Aim:*** ***To assess the clinical success rate of microinvasive caries infiltration technique with low viscosity resin in non-cavitated approximal carious lesions in primary molars after one year.*** ***Material and Methods:*** ***The study included 16 children, aged 4-7 years. They were divided into two groups according to individual caries risk assessment. Twenty primary molars were with non cavitated approximal carious lesions within the enamel to the outer third of dentin (E1, E2, D1). These lesions were demonstrated and evaluated according to the depth using diagnostic bite-wing X-rays. Bite-wing radiographs were taken also at 6 and 12 months after the application for evaluation of the infiltration method. The clinical application of infiltrant (Icon ® Caries Proximal, DMG) was conducted according to the manufacturer`s instruction. In order to analyze the results a test of difference between two relative proportions and alternative test was used.*** ***Results:*** ***The results of the study showed that the caries infiltration technique with Icon was least suitable for use in primary molars with non-cavitated approximal carious lesions in children with high caries risk.***

Keywords: caries infiltration, ICON® DMG, non cavitated approximal caries lesions, primary molars

1. Introduction

Two major achievements in dental science have changed the traditional approach of Black lying down rules for the treatment of dental caries over 100 years. These are: (1) The development of adhesive dentistry and progress towards dentin adhesion. (2) The adoption of caries as a disease process that can be controlled and managed [7].

The concept of minimally invasive dentistry has developed based on these achievements. Today it is assumed that demineralized but non-cavitated enamel and dentin can be "cured" without applying classical cavity preparation according to Black, with his step "extension for prevention" [17]. This requires early diagnosis of lesions in order to implement modern non surgical approach to their treatment.

Approximal carious lesions are permanent clinical problem in the primary dentition. Research shows high incidence of approximal caries lesions of primary molars - from 25 to 52% with increasing of the age. These lesions are the main cause for filling and extraction in primary dentition [1]. Operative treatment of these lesions is connected with the removal of a considerable amount of healthy tooth structure in order to reach the irreversibly damaged tissue [16, 18].

In 1975 Davila et al. proposed a technique for arresting the carious lesions using infiltration with low viscous resin method [1]. This technique has major advantages, especially in terms of the approximal lesions [7]. The philosophy of the technique is based on the fact that inside the carious lesion the porosity of the "lesion`s body" is becoming a route for cariogenic acids and dissolved minerals. Researchers reach the idea that these diffusion pathways can be closed using a light curing resin and thus the progression of carious lesion to be delayed or even stopped [9, 14, 15]. Enamel crystals in the lesion are covered with this resin and remain protected from the further dissolving. Moreover, the fragile crystalline core in “the body of the lesion” is stabilized by a plastic matrix and cavitation can be avoided [1, 8, 14]. Since 2009 on the market there has been the only one especially made for this purpose infiltrant - ICON®(DMG).

The aim of this study is to apply and follow-up clinically the success rate of the microinvasive technique of infiltration with low viscosity resin of non-cavitated approximal carious lesions in primary molars for a period of one year.

To achieve the aim, the following tasks were set:

- To apply in clinical setting the microinvasive infiltration technique for non-cavitated approximal carious lesions on 20 primary molars using professional kit ICON® (DMG, Hamburg, Germany)
- To determine the success rate of this infiltration technique in two groups of children – children with moderate and children at high caries risk.

Working hypothesis that we tested during the study was that the method of infiltration with ICON is equally successful for children with moderate and children at high caries risk in the primary dentition.

2. Material and Methods

The study included 16 children aged 4-7 years with primary teeth which have non-cavitated approximal lesions. Informed consent for participation was signed by parents.

a)Criteria for selection of children

- **Children at moderate and high caries risk** - individual assessment (assessment was made applying the tool for caries risk assessment used in the Department of Paediatric Dentistry, FDM, MU-Sofia).
- **Children with active participation** - children, who after the procedure should maintain oral hygiene by brushing using fluoride toothpaste and dental floss.

b)Criteria for selecting teeth

- **Primary teeth with non-cavitated approximal carious lesions** in the enamel up to the outer third of dentin according to bitewing X-rays (E1, E2, D1 – according to the manufacturer's instructions of ICON®).
- **"Active lesion"** - according to the Papilla Bleeding Index (PBI) score of Saxer and Muhleman (score 1, 2, 3, 4). Bleeding after probing the sulcus is a sign of inflammation. We accept the hypothesis that when there is inflamed gingiva and papilla, the approximal carious lesion is active.

In order to select teeth bite-wing radiographs for diagnosis of non-cavitated approximal lesion and evaluation of its depth were made with X-ray apparatus for dental X-rays Siemens, model 8458747 x 1744 with the following parameters: 70 kV/7 mA. Films Primax RDX-58E soft with size 2/3 and 3/4 cm were used with X-ray holders Kerr/Kwik - bite with ring. Interpretation of the X-ray image was made by a specialist radiologist, using light box and magnification of 2.5 x.

To assess the success of the method of infiltration bitewing radiographs at 6 and 12 months after the application of infiltrant were made. To ensure comparability between the X-ray image from diagnostic radiography and those at 6 and 12 months, X-rays were made using the same equipment and parameters, which are entered in an individual card that accompanies the patient.

The radiographic criteria for determining the depth of approximal carious lesions (by Kidd et al. [13] were compared with those of the manufacturer of Icon (E1, E2, D1) :

D1: radiolucency in the outer half of the enamel = E1
D2: radiolucency in the inner half of enamel, including lesions that extend to, but not beyond the enamel-dentin border = E2
D3: radiolucency in dentine – radiolucency beyond enamel-dentine border, but no visible involvement of dentin = D1

Clinical application of infiltrant (ICON® Caries Infiltrant Proximal, DMG) is done according to the manufacturer's instructions:

- teeth are professionally cleaned using dental prophylaxis paste and floss;
- "Gingival protect " paste is placed in order to isolate the soft tissues from etch gel and monomer of the resin and to protect from entering of blood, saliva and sulcus liquid in the operative field during the procedure;
- teeth are separated with special separators in order to create access to the proximal carious lesions;
- etch gel is applied for 120 s and after that it is removed by washing with air – water spray. The lesion is dried rigorously for a further 15 seconds with an air spray. To improve the drying of the lesion, an ethanol (Icon-dry) is placed over it for 15 seconds and evaporated using pressurized air (for 15 seconds);
- application of infiltrant (ICON®-Infiltrant) with a new applicator is made. The applicator is removed after 3 minutes and the contact area is cleaned from the residue of the material with interdental floss. Infiltrant is light cured for 40 seconds in the buccal, oral, and the occlusal surfaces. In order to improve the impermeability of the coating the infiltrant should be additionally applied for a second time for 1 minute. After removing the excess of the resin and after light curing the separating wedge is removed.

2.1 Filling in the Patient's Card

ICON material is not radiopaque. To record the infiltrated surfaces and the depth of the lesions during treatment, a card is completed and this card accompanies the patient at review appointments. This card is a component of the professional kit and contains:

- header - the name of the patient;
- dental chart – the treated area is charted;
- the treated tooth, the treated surface, the depth of the lesion and the date of the operation are recorded;
- the results of the bitewing radiographies are recorded too.

2.2 Instruction for Patients

- After the procedure is completed, the children and their parents were instructed to maintain personal oral hygiene using a toothbrush and fluoride toothpaste and interdental floss according to the routine methods.
- Clinical examination was done by two doctors, experts in paediatric dentistry. "Calibration" of the research team was done in advance.

2.3 Statistical Methods

In order to analyse the hypothesis two tests for assessment of the proportions of success were used:

- Test for difference between two relative shares - based on approximation by a normal distribution;
- Alternative test -Fisher exact **p** estimation.

3. Results

Table 1 shows the distribution of groups of children and teeth with approximal lesions, according to the risk of caries - a group of children and teeth with a moderate and high risk of caries development. Bitewing radiographs determined the depth of carious lesions - E1, E2, D1.

Table 1: Distribution of children and teeth with approximal non-cavitated carious lesions

Study Groups	*Caries risk*				*Non-cavitated approximal lesions*		
	Moderate		High				
	children	teeth	children	teeth	E1	E2	D1
Children with primary teeth (4-7 years old)	7	9	9	11	7	10	3

The results of "success" and "failure" treatment after an application of non-cavitated approximal carious lesions with

infiltrant ICON® and one year of follow-up are presented in Table 2.

The main criterion for "success" was the lack of change in the size of the carious lesions according to bite-wings made at 6 and 12 months in comparison with the initial/diagnostic one. 60 bitewing radiographs were analysed; 20 of them were diagnostic, and 40 - control radiographs (20 radiographs were made 6 months after, and 20 were made 12 months after the application).

Another criterion for success was lack of inflammation (bleeding) adjacent to the treated caries lesion.

Table 2: Level of success rate and failure after treatment of non-cavitated approximal lesions in primary teeth with ICON®

Caries risk	Number of teeth treated	After 6 months		After 12 months		Total	
		success	failure	Success	failure	success	failure
Moderate risk	9	8 89%	1 11%	7 88%	1 13%	7 78%	2 22%
High risk	11	5 45%	6 55%	2 40%	3 60%	2 18%	9 82%
Total	20	13 65%	7 35%	9 69%	4 31%	9 45%	11 55%

Test to assess the differences between the occurrence of success of treatment 6 months and 12 months after the application and respectively the total score for both groups (of moderate and high caries risk) is applied. Table 3 presents the estimated p values for the difference between the groups with moderate and high risk at 6 months and 12 months.

Table 3: Values for difference between groups with moderate and high risk at the 6th month and the 12th month

	Difference between groups with moderate and high risk of caries	
Success at 6-th month	0.055	
Success at 12-th month	0.087	p>0,05
Total	0.015	p<0,05

- There was no significant difference between the estmated relative shares in the success at 6 months and 12 months. For primary teeth tested method of infiltration is equally successful for both intermediate tests - on the 6th and 12th month.The limit value for 6 months (p = 0.05, Table. 3) is impressive.
- End-rated relative shares were statistically significantly different from each other (78% vs. 18%), i.e tested method of infiltration has a significantly better success rate for primary teeth in patients with moderate risk compared to those at high risk (Table 2).
- The findings were confirmed by two tests conducted.

4. Discussion

Treatment of caries using infiltration with low viscosity resin is a relatively new microinvasive treatment method with enormous potential in paediatric dentistry [12, 23, 27]. Short-term clinical results show good effectiveness of the method in caries lesions of approximal surfaces in permanent teeth. Arresting of development of the lesion within 1 to 2 years is reported [2, 4, 5, 9].

According to our research the high scores of "unsuccess" after administration of caries infiltration technique with ICON® in primary dentition we can explain with the following: children with primary dentition (because of their age) have lower efficiency of caries prevention - insufficient and inefficient food and oral prophylaxis. All this leads to higher risk of deepening of the approximal lesions.There is a possibility for misbelief concerning the fact that infiltrant will fulfill its purpose and only for six months after the application we have seen rapid complications of dental caries. Another possible precondition is the accuracy of X ray diagnostics, combined with the characteristics of the structure and the degree of mineralization of the primary teeth. Primary teeth are characterized by a low degree of mineralization of enamel and dentin [13] and actually the diagnosed approximal caries using bite-wing method is more advanced and there is no indication for using infiltration technique. The survey results show that Icon® is less suitable for treatment of primary teeth with initial approximal caries in high caries risk children. This rejects our hypothesis that infiltration is equally successful regardless of degree of caries risk.

We understand that our experience in the application of the infiltration technique is currently too limited. We need to continue the follow of the cases in time and to increase their number in order to become more confident and convinced of the long-term best clinical outcome of infiltration technique for approximal lesions in the primary dentition.

5. Conclusions

Progress in the evidence-based clinical dentistry provides sufficient facts for reducing the invasive techniques for dental caries treatment especially in childhood. Due to this, there is a great interest in the development and introduction into clinical practice the alternative non invasive or minimally invasive methods, materials and procedures that are equivalent or even more effective than those based on recovery after the drilling. According to the knowledge of the staff, the present study is the first survey concerning the success of the ICON® in treatment of non cavitated approximal carious lesions in primary dentition of children in the country. Research in this direction should continue in order to answer the question why impregnation in primary teeth is not particularly successful in clinical terms. Another question arises - whether the application protocol for primary and permanent teeth should not be different because of the characteristics of structures. This question is not discussed by the manufacturers and is not available in application protocol concerning primary and permanent teeth.

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