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*Hardness of impregnated deciduous dental tissue  
evaluated by DIAGNOdent*

The course of dental caries in the deciduous teeth is essentially different from its course in the permanent teeth. That is due to different anatomy and morphology of the deciduous teeth. Analogically to permanent teeth the tooth enamel of the deciduous teeth is composed of prisms and interprismatic substances, however, in the permanent teeth its layer is thicker. The enamel covers the entire crown evenly: in all anatomical hollows as well as cusps and enamel ledges the layer of enamel is of the equal thickness. In the deciduous teeth the enamel layer is by half thinner in comparison to the permanent teeth. In addition to that, the deciduous teeth have the birth line well preserved. It separates the enamel mineralised during the foetal life from the layer mineralised after birth.

The dentin is built up of fibrous mineralised ground substance and numerous fields of lesser mineralisation or the areas where mineralisation has not been accomplished (interglobular spaces and Tomes granular layer). In the deciduous teeth the layer of dentin is by half thinner than in the permanent teeth, the birth line is also present. The root covers a very thin layer of cement. This is a primary cement, fibrous and acellular. The pulp is built of connective tissue, immature, of embryonic type and contains prominent horns situated closer to the enamel-dentin line than in the permanent teeth. The pulp occupies a larger space proportionally to the hard dental tissue than in the permanent teeth.

In the deciduous teeth the pulp chamber is larger in proportion to the total tooth size than in the permanent teeth. Recesses of the chamber roof are prominent, directed towards the cusps on the occlusal surfaces of the deciduous molars and towards the incisal edge of the incisors and canines.

Different morphology and histology account for different course of dental caries in the deciduous and permanent teeth. In the deciduous teeth dental caries develops rapidly, the walls of the pulp chamber are damaged within a very short time and the disease spreads onto the pulp. Therefore, it is essential to have frequent dental check-ups and to treat early signs of caries developing in the deciduous teeth. There are two types of dental caries affecting the deciduous teeth: *early decay* that develops soon after the deciduous tooth has erupted. It begins on the labial surfaces close to the neck and on the occlusal surfaces of the molars and progresses onto the other surfaces; *caries circularis* that attacks front teeth mainly. It begins on the labial surfaces in the cervical area and progresses onto the proximal and palatal surfaces circulating around the tooth neck.

Dental caries may be due to improper nutrition during pregnancy and diseases on the maternal side as well as the anatomical structure of the hard dental tissue of the deciduous teeth, nutritional errors, i.e. sweet beverages and soft food between main meals aside improper oral hygiene habits observed among the youngest children (1).

Both types of dental caries lead to cavities, not too deep but very large. Therefore the treatment of choice is to impregnate the dentin with silver nitrate applied with Lugol's solution as a precipitator, 6% solution of pirogalusic acid, 20% glucose, eugenol, 4% hydrochinon or tincture of iodine. Metallic silver or its compounds are thus precipitated (2). Other method involves painting the decayed areas with preparations of high fluoride content.

The aim of the study was to determine the hardness of dental tissue affected by dental caries after it had been impregnated with silver nitrate and 10% Lugol's solution as the precipitator.

## MATERIAL AND METHODS

The investigation was carried out in 10 patients, 2–7 years old, of town/rural mix. Clinical examination of the teeth revealed 68 deciduous teeth with active foci of dental caries, which were qualified for impregnation procedure. The condition of hard dental tissue affected by caries was assessed by DIAGNOdent. It is a laser apparatus designed to evaluate the degree of tooth mineralisation (3, 4, 5, 6). Hardness is expressed in two-digital figures, which are interpreted according to Hibst and Paulus's scale as:

0°	00–08	no caries
1°	09–15	changes up to $\frac{1}{2}$ external enamel layer
2°	16–30	changes over $\frac{1}{2}$ external enamel layer
3°	31–50	changes up to $\frac{1}{2}$ external dentin layer
4°	51–99	changes over $\frac{1}{2}$ external dentin layer

In the first dental examination the scale was used to measure the depth of caries. In the second and third examination it was used to interpret the figures obtained within the foci of caries after impregnation.

The first examination by DIAGNOdent was performed prior to impregnation, the second after three procedures of impregnation and the third, after a series of subsequent impregnations (5 procedures). The teeth were impregnated 5 times at week intervals with silver nitrate and 10% Lugol's solution as the precipitator. Silver iodide, hardly soluble and strongly bactericidal was precipitated in the reaction. It hardened softened carious tissue by binding organic particles and made the tooth more resistant to cariogenic agents.

The first examination with DIAGNOdent was performed on 68 teeth, during the second however, only 29 teeth were examined since half of the patients withdrew from the project. Additionally, the children participating in the project were surveyed. The questions were addressed at their parents, who were asked to attempt the following: 1) child's nutritional habits including: • bottle-feeding, if yes for how long • if the baby was given "sweet dummy" between main meals • the frequency of eating sweets by the child • the number of meals the child has during the day; 2) child's oral hygiene habits such as: • the frequency of toothbrushing • how often the toothbrush is changed • if the child brushes teeth himself / herself.

## RESULTS

The results are presented in four tables and 3 graphs. In total 29 teeth were impregnated, examined with the use of DIAGNOdent and the results interpreted. In the first examination (Table 1) performed prior to the treatment 26 teeth out of 29 had 4° dental caries, i.e. over  $\frac{1}{2}$  external dentin layer affected by caries, in 2 teeth 3° caries was diagnosed, i.e. up to  $\frac{1}{2}$  external dentin layer and in one tooth 2° caries, i.e. over  $\frac{1}{2}$  external enamel layer affected.

Table 1. Number of teeth affected by different degrees of caries progress on the first examination (initial)

Degrees of caries progress		4°	3°	2°	1°	0°
Patient I	number of teeth with caries	6	1	1	0	0
	% teeth with caries	75	12.5	12.5	0	0
Patient II	number of teeth with caries	4	1	0	0	0
	% teeth with caries	80	20	0	0	0
Patient III	number of teeth with caries	5	0	0	0	0
	% teeth with caries	100	0	0	0	0
Patient IV	number of teeth with caries	2	0	0	0	0
	% teeth with caries	100	0	0	0	0
Patient V	number of teeth with caries	9	0	0	0	0
	% teeth with caries	100	0	0	0	0

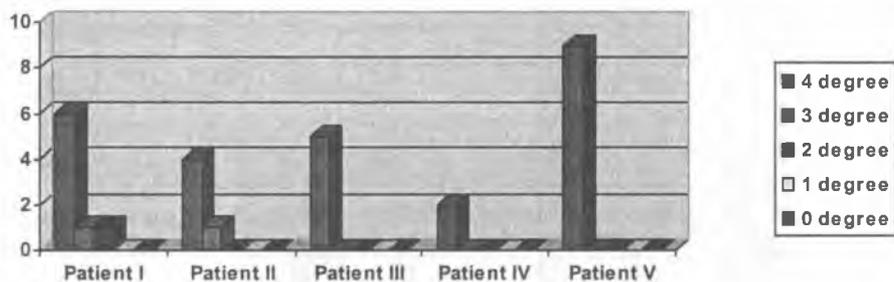


Fig. 1. Number of teeth affected by different degrees of caries progress on the first examination (initial)

The results of the survey (Table 2) found that two children out of five were bottle-fed, one for 12 months and the other for 2 years. None of the children was given a "sweet dummy". All the children were given sweet beverages between the main meals. One child has three meals daily, two had 4 meals and two more than four meals a day. Four children brushed their teeth twice daily, one child once a day. One child had the toothbrush changed every month, three every two months and one every three months.

Table 2. Survey results

Patient	Bottle-feeding, if yes for how long	If the baby was given "sweet dummy" between main meals	The frequency of eating sweets by the child	The number of meals the child has during the day	The frequency of toothbrushing	How often the toothbrush is changed
I	no	no	yes	4	2	once in every 3 months
II	yes	no	yes	>4	2	once in every 2 months
III	yes	no	yes	4	2	once in every 1 month
IV	no	no	yes	>4	2	once in every 2 months
V	no	no	yes	3	1	once in every 2 months

On the second examination (Table 3) performed with DIAGNOdent 9 teeth out of 29 had 4° caries, 4 teeth – 3° caries, 11 teeth – 2° caries and 5 teeth – 1° caries.

Table 3. Number of teeth affected by different degree of caries progress on the second examination

Degrees of caries progress		4°	3°	2°	1°	0°
Patient I	number of teeth with caries	2	2	4	0	0
	% teeth with caries	25	25	50	0	0
Patient II	number of teeth with caries	1	0	2	2	0
	% teeth with caries	20	0	40	40	0
Patient III	number of teeth with caries	2	0	1	2	0
	% teeth with caries	40	0	20	40	0
Patient IV	number of teeth with caries	0	0	2	0	0
	% teeth with caries	0	0	100	0	0
Patient V	number of teeth with caries	4	2	2	1	0
	% teeth with caries	44.25	22.25	22.25	11.25	0

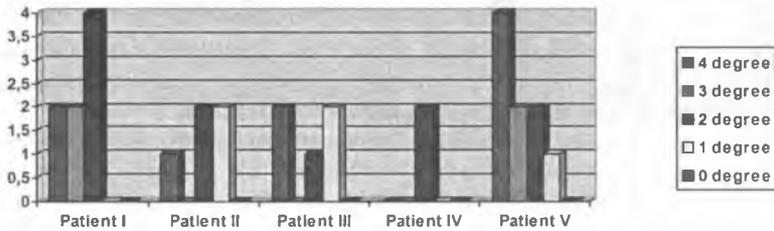


Fig. 2 Number of teeth affected by different degree of caries progress on the second examination

On the third examination (Table 4) 1 tooth had 4° caries, 5 teeth – 3° degree caries, 5 – 2° caries, 6 teeth – 1° caries and 12 teeth – 0° caries (according to Hibst and Paulus’s scale).

Table 4. Number of teeth affected by different degree of caries progress on the third examination

Degrees of caries progress		4°	3°	2°	1°	0°
Patient I	number of teeth with caries	0	3	1	1	3
	% teeth with caries	0	37.5	12.5	12.5	37.5
Patient II	number of teeth with caries	0	1	1	2	1
	% teeth with caries	0	20	20	40	20
Patient III	number of teeth with caries	0	0	1	1	3
	% teeth with caries	0	0	20	20	60
Patient IV	number of teeth with caries	0	0	0	0	2
	% teeth with caries	0	0	0	0	100
Patient V	number of teeth with caries	1	1	2	2	3
	% teeth with caries	11.1	11.1	22.2	22.2	33.4

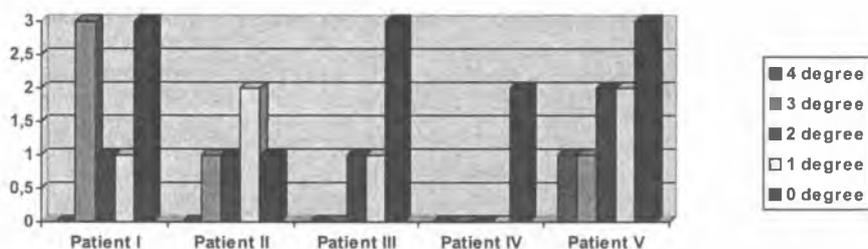


Fig. 3. Number of teeth affected by different degree of caries progress on the third examination

## DISCUSSION

The examination of five children revealed 29 teeth with active foci of dental caries, mean 5.8 carious teeth per child. Such a pretty bad condition of teeth diagnosed in the youngest children may result from bad nutritional habits. The main factors responsible for that include excessive consumption of sweet beverages and snacking between main meals. Improper oral hygiene is significant in that respect too. Parents show too little concern for proper oral hygiene of the deciduous teeth, which is proved evidently by total lack of hygiene prior to the eruption of the deciduous teeth in the group of children examined. Another important fact is that toothbrushing is left to children who clean their teeth without any supervision by an adult and most frequently they do it improperly (1).

Bad nutrition and improper oral hygiene combined with little resistance of deciduous hard dental tissue to chemical conditions in the oral cavity lead to the development of carious foci and rapid progress of the disease. The course of caries is more dynamic in the deciduous teeth than in the permanent ones and it affects several tooth surfaces at the same time. Since caries foci are extensive and of relatively little depth, it is difficult to achieve adequate retention for the filling material. That is why impregnation of the diseased dental tissue is the treatment of choice. The procedure is painless and does not produce negative reactions in children. Unfortunately penetration of the tissues with silver compounds causes black – brownish discolouration, which is an undesirable effect for aesthetic reasons. The effectiveness of impregnation depends upon the proper technique (2). Up till now the effectiveness of the procedure has involved subjective evaluation by the dentist. Now it is possible to use a laser DIAGNOdent to determine the degree of tissue hardness in an objective and repeatable way.

On the first examination (initial) the hardness of carious tissue was evaluated in 29 teeth of which 26 presented the highest 4° of carious changes, i.e. deep cavities according to Hibst and Paulus's scale. On the next examination after three procedures of impregnation 4° caries was determined in 9 teeth only. It means that "hardening" of the diseased tissue by 1° was achieved in 17 teeth. On the third examination after a series of five impregnations only 1 tooth had 4° caries and the other teeth revealed "hardened" structure of dental hard tissue. It is noticeable that 12 teeth were found to have 0° caries, which means mineralisation of tissues was achieved analogical to the degree of normal hardness in healthy enamel.

## CONCLUSIONS

1. Main causes of carious foci in the deciduous teeth include bad nutritional and oral hygiene habits.
2. Impregnation is the treatment of choice undertaken in case of extensive cavities in the deciduous teeth.

3. DIAGNOdent provides objective evaluation of the degree of dental tissue hardness.

4. If properly performed the impregnation of the diseased hard dental tissue of the deciduous teeth provides satisfactory hardness and inhibits considerably and even arrests further development of dental caries completely.

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#### SUMMARY

The aim of the study was to evaluate the degree of hardness of dental tissue affected by caries and impregnated with silver nitrate and 10% Lugol's solution as a precipitating agent. The condition of hard tissues was determined with the aid of DIAGNOdent. In total 29 teeth with various degree of caries progress were evaluated. After a series of 5 procedures of impregnation mineralisation of the tissue increased in all cases. In case of extensive cavities the procedure was the treatment of choice, which slowed the progress of caries considerably, even arrested it. The survey carried out among the parents revealed that dental caries developing in the deciduous teeth mainly results from bad nutritional habits and improper oral hygiene.

#### Ocena twardości impregnowanych tkanek zębów mlecznych z zastosowaniem aparatu DIAGNOdent

Celem pracy było określenie stopnia twardości tkanek zębów z chorobą próchnicową, poddanych zabiegowi impregnacji przy użyciu azotanu srebra i stącalnika w postaci 10% płynu Lugola. Stan twardych tkanek badano przy użyciu aparatu DIAGNOdent. Badaniu poddano 29 zębów z różnym stopniem zaawansowania choroby próchnicowej. Po pięciu zabiegach impregnacji we wszystkich przypadkach uzyskano wzrost mineralizacji tkanek. W przypadku rozległych ubytków zabieg ten był postępowaniem z wyboru, pozwalającym na znaczne zmniejszenie tempa przebiegu choroby próchnicowej lub nawet jej zahamowanie. Z badań ankietowych przeprowadzonych wśród rodziców wynika, że głównymi przyczynami rozwoju próchnicy w zębach mlecznych są złe nawyki żywieniowe i nieprawidłowa higiena.