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The application of synthetic hydroxyapatite in children and adolescents in various clinical cases

Hydroxyapatite is a calcium phosphorate containing hydroxygene groups (OH^-) with Ca/P proportion of 1.67 and the corresponding chemical formula $Ca_{10}(PO_4)_6(OH)_2$. Natural apatite minerals are found in almost all volcanic rocks as well as in metamorphic and sedimentary rocks. Biological apatites are present mainly in bones and teeth of vertebrates. Moreover, they can be found in all pathologically calcified tissues, such as sialolith, cerebrolith, nephrolith, cholelith, urolith, tonsilolith, etc. (7) Hydroxyapatite shows big ability of ion exchange with the following juxtapositions possible:

$Ca^{2+} \leftrightarrow H^+$, Na^+, K^+, Mg^{2+}, Pb^{2+}, Ba^{2+}, Hg^{2+}, Cd^{2+}, Sr^{2+}

$PO_4^{3-} \leftrightarrow SO_3^{3-}$, CO_3^{2-}

$OH^- \leftrightarrow F^-$, Cl^-

Exchanging of OH^- groups with F^- ions stabilizes elementary apatite cell and decreases its solubility. It is thought that fluoride is an element which plays a role in the period of dental enamel creation and its mineralisation. Hydroxyapatite dissolves poorly in distilled water giving slightly alkaline reaction (pH = 8). However, it dissolves well in acids but does not dissolve in alkali. In salt solutions its solubility is higher than in distilled water. It is poorly soluble in saliva.

Bioceramic hydroxyapatite material is characterized by good biocompatibility (2,7,9). It adapts well in a living organism environment, it does not irritate surrounding tissues and does not cause acute or chronic inflammations. It does not interfere with reparatory processes of surrounding tissue but even stimulates its resolution. It is assumed that around each implantation material there occurs specific tissue reaction: 1) if the material is toxic, there occurs tissue necrosis; 2) if the material is not toxic but undergoes biodegradation it may, in the course of the process, get replaced by surrounding or fibrous tissue; 3) if the material is not toxic and biologically inactive, a fibrous capsule forms around it; 4) if the material is not toxic and biologically active, there occurs a firm connection between the material and surrounding tissue.

Bioceramic hydroxyapatite material belongs to the fourth group. It does not show any toxic or carcinogenic activity. There are no features of rejection by the recipient's organism and its biological activity has been confirmed many times. Currently hydroxyapatite material is produced by CHEMA-ELEKTROMET company from Rzeszów. Hydroxyapatite under trademark HA-BIOCER is produced in two forms — granules and powder.

The purpose of the study was to evaluate the possibility of using synthetic

HA-BIOCER hydroxyapatite in treatment of enamel hypoplasia in children and adolescents, manifested by mineralisation disorders, enamel underdevelopment as well as enamel deficiency and oversensitivity and in treatment of enamel fractures and teeth injuries.

MATERIAL AND METHODS

The study comprised 15 patients aged 7 to 13 in whom enamel underdevelopment was found on 82 teeth manifested by discolorations — from milky white to dark brown, and in half of the cases by partial enamel deficiency; 10 patients aged 10 to 14 in whom enamel fractures were found and who suffered from oversensitivity to thermal stimuli, and 14 patients aged 6 to 11 in whom permanent teeth damage type I according to Ellis was found with resulting oversensitivity to chemical, mechanical and thermal stimuli.

In all patients the following procedure was used: paste prepared from HA-BIOCER powder and physiological salt originally attached by the manufacturer was applied in all patients 5 to 6 times with intervals of several days. All patients were instructed to apply Biochem preparation at home (powder for daily teeth care from CHEMA – ELEKTROMET from Rzeszów).

RESULTS

After applying the HA BIOCER paste 5 to 6 times in all patients we observed smoothing and lighting of hypoplastic places as well as significant decrease or removal of sensitivity to thermal, chemical and mechanical stimuli on all teeth. Clinical observation lasts 12 months.

DISCUSSION

Results similar to own studies, decrease of pain symptoms due to enamel oversensitivity, were obtained by K n y c h a l s k a -K a r w a n (1, 3, 4, 5, 8, 10). In the studies on using various dental materials biocompatibility of hydroxyapatite with dental tissues were stressed (2, 6, 8, 9).

CONCLUSIONS

The application of hydroxyapatite stimulates processes of remineralisation in places of decalcification and causes removal of tooth oversensitivity to thermal and mechanical stimuli by closing the open dentinal tubule. HA-BIOCER preparation causes smoothing and lighting of hypoplastic foci, improves aesthetic appearance and is not toxic to patients.

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SUMMARY

The possibility of application of HA-BIOCER synthetic hydroxyapatite in the treatment of enamel hypoplasia in children and adolescents manifested by mineralisation disorders, enamel underdevelopment, enamel deficiency and oversensitivity to mechanical, thermal and chemical stimuli was evaluated. The possibility of applying the same preparation in case of enamel fractures and teeth injuries type I according to Ellis was also examined.

It was found that the application of hydroxyapatite stimulates processes of remineralisation in decalcified places. It also causes removal of tooth oversensitivity to thermal and mechanical stimuli by closing open dentinal tubules or decrease in their size. HA-BIOCER preparation brings about smoothing and lighting of hypoplastic foci, improves aesthetic appearance and is not toxic to patients.

Zastosowanie syntetycznego hydroksyapatytu u dzieci i młodzieży w różnych przypadkach klinicznych

Ocenie poddano możliwość zastosowania syntetycznego hydroksyapatytu HA-BIOCER w leczeniu hipoplazji szkliwa u dzieci i młodzieży, objawiającej się zaburzeniem mineralizacji, niedorozwojem szkliwa, brakiem szkliwa i nadwrażliwością na bodźce mechaniczne, termiczne i chemiczne. Badano również możliwość zastosowania tego preparatu w przypadku pęknięć szkliwa i urazów zębów – głównie I kl. wg Ellisa.

Stwierdzono, że stosowanie hydroksyapatytu stymuluje procesy remineralizacji w miejscach odwapnionych, jak też powoduje zniesienie nadwrażliwości zęba na bodźce termiczne i mechaniczne poprzez zamknięcie otwartych kanalików zębinowych lub ich zmniejszenie. Preparat HA-BIOCER powoduje wygładzenie i przejaśnienie ognisk hipoplastycznych, poprawia wygląd estetyczny i jest nietoksyczny dla pacjentów.