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Fluoride in dental practice

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ABSTRACT

Fluoride occurs naturally in our environment and we are exposed to it every day. In the right doses, it is very effective and helpful. Fluorine has many valuable functions, besides as enamel strengthening, it has bacteriostatic effect. However, in comparison to positive effects, fluoride can be toxic to the patients. The effect of fluoride on retention and prevention of caries is very significant, which has been proved in scientific studies.

INTRODUCTION

According to WHO (World Health Organization) dental caries is a local, pathological process of intra-vitreous origin, leading to decalcification of enamel, breakdown of hard tooth tissues and consequent formation of cavity [1].

Fluoride can be found in food, dental or home used products [2]. In daily dental practice, dentists use fluoride in various forms, for example: fluoride varnish (Fluor Protector [FP]), casein phosphopeptide-amorphous calcium phosphate (GC Tooth Mousse [TM]), calcium sodium phosphosilicate (SHY-NM), and casein phosphopeptide-amorphous calcium phosphate with fluoride (GC Tooth Mousse Plus [TMP]) [3]. However dentists also recommend the use of fluoride in much more well-known forms such as toothpaste and mouthwashes. In Europe, toothpastes contain more fluorine (maximum 1,500ppm), when in the US, the limit ends at 1,100ppm [4].

FLUORIDE – ABSORPTION, METABOLISM, FUNCTION

Fluoride is the thirteenth most common element and is spread widely throughout the earth [5]. Mainly in the lithosphere, as a fluorspar, fluorapatite and cryolite [6]. Fluoride is the chemical element with the symbol F, atomic number 9 and an atomic weight of 18.9984. At standard temperature and pressure, pure fluorine (F2) is a nonmetallic, corrosive, poisonous, pale, yellow gas that is a powerful oxidizing agent. Fluorine is classified as halogen and can react with almost any element of periodic table [7]. Although fluoride does not exists as the free form in the nature, but only in combination with other elements [6]. Fluoride can occur in numerous formulations: mainly sodium fluoride, acidulated fluorophosphates or stannous fluoride [2]. Fluorine has many unique and appropriable properties that are used widely in dentistry.

Fluoride is present in our everyday life and we consume it in various amounts. It can be found in small doses in fish, meat and cereals. In higher concentrations it can occur in canned anchovies, ground chicken meat, canned fruits, chocolate milk, some baby dietary supplements, even in black tea, chips and beer. A lot of fluoride is also found in products for oral hygiene [8]. A small amount of toothpaste, therefore a fluoride, can be also consumed during brushing, especially in children who tend to swallow most of it [6].

Most of the fluoride is absorbed in the gastrointestinal tract: 77% in proximal part of the small intestine and 25% in the stomach. Only small amount of the fluoride is excreted in feces [8]. Absorption of the fluoride is really high, for example for very soluble forms as sodium fluoride, nearly 100%. There are few things that can affect fluoride absorption as: stomach

pH, concentrations of calcium, magnesium and aluminum [9]. The peak concentration of fluoride plasma levels is achieved within 20-60 minutes after consumption [8]. After absorption fluoride is distributed widely in whole body.

In the children body, there is retained approximately 50% of fluoride, whereas adults retain around 36%. Most of fluoride (99%) is contained in bones, as for 1% that is left, it can be found in soft tissues. The kidneys engage in excretion of the remaining absorbed amount of fluoride. Other ways such as saliva or sweat are insignificant. Therefore, only the kidneys, are the only organ of the human body, that maintain concentration of the fluoride. However, there is a number of factors that can affect fluoride metabolism. The most significant are: altitude, circadian rhythm, hormones, kidney function, hematocrit, acid base disorders, genetic predispositions, physical activity and diet [10].

Interestingly, the uptake of fluoride in pregnant women depends on its concentration in the mother's blood. If the concentration is low, fluoride can be conducted into the placenta [11].

The profits of fluoride are accepted by practicing professionals and dental researchers. Fluorine has many valuable functions, besides as enamel strengthening, it has bacteriostatic effect. Thanks to blocking enzymes, important for the life of the bacterial cell, it inhibits the development of dental plaque. However, in comparison to positive effects, fluoride can be toxic to the patients. Presumable, the toxic dose is 5mg F/kg body weight, but just the intake of 1mg F/kg body weight may cause toxic effects in children. The lethal dose is 15mg F/kg body weight. Long term intake of even small amount of fluoride may cause fluorosis, but single overdose of fluoride may cause life threatening, acute fluoride poisoning. Symptoms of acute poisoning occur an hour after the intake exceeding a allowed dose of fluoride, are such as: headaches, diarrhea, nausea, abdominal pain, increased salivation, vomiting, tearing, sweating. In case of intoxication, it is vital to apply a large amounts of milk, induce vomiting and after that start hospitalization [12].

MECHANISM OF FLUROIDE

When using topical fluoride, it mainly forms calcium fluoride (CaF_2) or calcium fluoride-like material. Calcium fluoride called "loosely bound" in comparison to fluorapatite, known as "firmly bound" fluoride, has higher solubility and is probably inferior in slowly mineral diffusion within dental tissues. During remineralization, when fluoride collects on the new crystal surface, superficial fluorine attracts calcium and phosphate ions back to partially dematerialized crystals. The fluorapatite-like coating on crystals is made, and the final

product has significantly high amount of fluoride, which helps to reduce enamel solubility in future acid attack [13].

FLUOROSIS

Dental fluorosis, is a disease associated with excessive enamel development. Initially, the disease occurred in regions with increased amount of natural fluoride in drinking water, although more and more often appears individually due to increase consumption of fluoride from other sources [14]. The disease is the result of long-term intake of fluorides in doses exceeding the maximum daily amount of 1ppm [15]. Dental fluorosis mainly affects children up to 7 years of age and is associated with impaired biosynthesis of dental matrix. It is characterized by mottling, discolored, blackened or chalky white teeth. Depending on the degree of fluoride overdose, various changes in the structure of the enamel can be observed and their appearance is described by Dean's Fluorosis Index [16].

These effects do not appear in the secondary teeth that were already fully grown beyond the excessive exposure of the fluoride. Therefore, the absence of symptoms does not necessarily mean that the fluoride intake is within the normal range. Chronic intake of high doses of fluoride can cause severe and permanent bone and joint deformations, known as skeletal fluorosis. There is no existing treatment neither for dental nor skeletal fluorosis, and both of them cannot be reversed. The only cure is prevention. According to research, long-term intake and accumulation of fluorides have an impact not only on human skeletal and teeth, but also can make changes in the DNA-structure, paralysis of volition, cancer, etc. [17].

DENTAL CARIES

The main reason for the increase of dental caries is high consumption of sugars and insufficient fluoride supply (WHO 2010; 2015) [18].

Dental caries arises when three factors simultaneously work: increased supply of sugars, bacteria in dental plaque and tooth susceptibility [4]. However, dental caries is multifactorial disease and it combined: microbiological shifts in biofilm, salivary flow, carbohydrates supply, exposure to fluoride and mechanical cleaning of the teeth. Just a few seconds after brushing teeth, a thin biofilm is created. An uncontrolled biofilm promotes the formation of caries [19].

Tooth enamel is mainly built with hydroxyapatite (87%), which chemically constitutes crystalline calcium phosphate [16]. The solubility of hydroxyapatite depends on the pH in the oral cavity as well as on the ions of phosphate and calcium. In normal state the pH is 7. However, after eating food, the pH drops quickly, the concentration of ions decrease and the

acid is produced by bacteria from the supplied dietary carbohydrates. As a result, the enamel dissolves [4]. Dental caries typically start at and below the enamel surface. The initial stage of caries is called macula cariosa and it is a form of demineralization that can be reversed. Although, when not stopped, the disease process deep in the tissues of the teeth. It is not visual, but it can be found on RTG, when 30% of mineral compounds is lost.

REASERCH

The effect of fluoride on retention and prevention of caries is very significant, which has been proved in scientific studies [3,20].

In research, that was performed on 75 intact maxillary premolars extracted from patients during orthodontic treatment, the usefulness of fluorine was proven. Included teeth were divided into five groups. One group was left without treatment (a control group), and other were treated with fluorine in various forms. Objects were subjected to demineralization solution for 96 hours. After that they were examined under polarized light microscopy. The results show that using fluoride significantly reduced enamel demineralization in comparison to the control group [3].

A different research was conducted on 273 patients with fixed orthodontic appliances. The study was a double-blinded and objects were divided in two groups. One group of patients had application with fluoride varnish and the other, control group, got placebo varnish. After treatment period, it was found that using fluorine significantly decrease the incidence of WSL (white spot lesions) in comparison to control group [20].

CONCLUSION

Fluoride occurs naturally in our environment and we are exposed to it every day. In the right doses, it is very effective and helpful. However, in doses exceeding the recommended amount, according to WHO 14 mg fluoride per day, may be toxic [6]. There is clear evidence of the effective action of fluoride on children, adolescents and adults. However, the fluoride to make a change, must be used for a long time. Undeniably, the use of fluoride in the form of toothpaste or mouth rinses should take place every day. In dental office, the use of professional dental agents should be made after risk assessment, for example: previously or presently occurring dental caries [21].

REFERENCES

1. Pawka B., Dreher P., Herda J. i in. Próchnica zębów u dzieci problemem społecznym. Probl Hig Epidemiol 2010, 91(1): 5–7.

2. Pitts N, Zero D, Marsh P, Ekstrand K, Weintraub J et al. Dental Caries. Nature Reviews Disease Primers. 2017; 3.

3. Bichu YM, Kamat N, Chandra PK, Kapoor A, Razmus T et al. Prevention of enamel demineralization during orthodontic treatment: an in vitro comparative study. Orthodontics (Chic.). 2013;14(1): e22-9.

4. Cate J. Contemporary perspective on the use of fluoride products in caries prevention. British Dental Journal. 2013; 214: 161-167.

5. Review of fluoride. Benefits and risks. Department of health and human services. Public health service. 1991.

6. Lennon M, Whelton H, O'Mullane D, Ekstrand J. Rolling Revision of the WHO Guidelines for Drinking-Water Quality. World Health Organization. 2004.

7. Robert A. Lewis Dictionary of toxicology. Lewis Publishers. 1998.

8. Kanduti D, Sterbenk P, Artnik B. FLUORIDE: A REVIEW OF USE AND EFFECTS ON HEALTH. 2016; 28(2): 133-137.

9. Fluoride in Drinking Water: A Scientific Review of EPA's Standards. The National Academies Press. 2006(3).

10. Buzalaf MA, Whitford GM. Fluoride metabolism. Monogr Oral Sci. 2011; 22: 20-36.

11. M GS, Mohanty S, Rao P. Role of placenta to combat fluorosis (in fetus) in endemic fluorosis area. NJIRM. 2010; 1(4): 16-19.

12. Piątowska D. Kariologia współczesna. Postępowanie kliniczne. Med. Tour Press international. warszawa 2009, wyd 1.

13. Iida H. Center for fluoride research analysis. Mechanisms of anti-caries action of fluoride. 2015.

14. The use of fluoride in infants and Children. Paediatr Child Health. 2002(7).

15. Peneva M. TREATMENT OF DENTAL FLUOROSIS. 2008. 71-74.

16. Arlappa N , Qureshi A. , Srinivas R, Fluorosis in India: an overview.2013l 1(2): 97 – 102.

17. Roy S, Dass G. Fluoride Contamination in Drinking Water – A Review . Resources and Envrironmenr. 2013; 3(3): 53-58.

18. Petersen P, Ogawa H. Prevention of dental caries through the use of fluoride – the WHO approach. Community Dental Health. 2016; 33: 66-68.

19. Selwitz R, Ismail A., Pitts N, Dental caries. Lancet 2007; 369: 51-59.

20. Stecksén-Blicks C, Renfors G, Oscarson ND, Bergstrand F, Twetman S. Caries-preventive effectiveness of a fluoride varnish: a randomized controlled trial in adolescents with fixed orthodontic appliances. Caries Res. 2007; 41(6): 455-9.

21. Azarpazhooh A, Patricia A. Fluoride Varnish in the Prevention of Dental Caries in Children and Adolescents: A Systematic Review. Clinical Practice. 2008; 74(1): 73-79.