ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 3 Issue 7 July 2019

Review Article

Dental Fluorosis- A Clinicoepidemiological Review

Abhinav Bhargava[1]*, Bhavna Sabbarwal[1], Shourya Tandon[2], Sachin Chand[3] and Latika Bachani[4]

[1]*Senior Lecturer, Department of Public Health Dentistry Faculty of Dental Sciences SGT University, Gurugram, Haryana, India*

[2]*Professor and Head Department of Public Health Dentistry Faculty of Dental Sciences SGT University, Gurugram, Haryana, India*

[3]*Reader, Department of Public Health Dentistry Faculty of Dental Sciences SGT University, Gurugram, Haryana, India*

[4]*Assistant Professor Department of Oral Medicine and Radiology Faculty of Dental Sciences SGT University Gurugram, Haryana India*

***Corresponding Author:** Abhinav Bhargava, Senior lecturer Department of Public Health Dentistry Faculty of Dental Sciences SGT University, Gurugram, Haryana, India.

Received: May 28, 2019; **Published:** June 25, 2019

DOI: 10.31080/ASDS.2019.03.0573

Abstract

Fluoride is an essential element for life and is one of the trace elements normally present in the body. At low concentrations it is generally believed that fluoride deficiencies can arise but at high fluoride concentrations other deleterious effects can certainly transpire. In relation to drinking water it is generally believed that too little (< 0.5 mg/l) or too much (>1.5mg/l) can affect bone and teeth structure. The main source of fluoride in ground water is fluoride-bearing rocks such as fluorspar, fluorite, cryolite, fluorapatite and hydroxylapatite. Also the content in ground water is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, pH and temperature, concentrations of calcium and bicarbonate ions in water. Though fluoride enters the body through water, food, industrial exposure, drugs, cosmetics, drinking water is the major source of daily intake.

Keywords: Dental Fluorosis; Epidemiology; Fluorides; Risk Factor

Introduction

The key to man's health lies largely in his environment. The harmonious balance of the state of physical, mental and social well-being of the human individual integrated into his environment constitutes health. Fluoride in drinking water is one such problem [1]. Prolonged ingestion in excess of the daily requirement is associated with dental and skeletal fluorosis; and inadequate intake with dental caries. Dental fluorosis is a well known developmental enamel defect due to excessive fluoride ingestion during enamel formation, generally from chronic long term exposure to elevated levels of fluoride [2]. High fluoride concentration may be expected in ground water from calcium poor aquifers are in areas where fluoride bearing minerals are common [3]. About 5 billion people worldwide experience dental fluorosis presented in various forms at different stages of its clinical presentation [4]. Hydrofluorosis has been reported in India, China, Pakistan, Tanzania, Brazil, Kenya, Malawi, Taiwan and other countries like Mexico [5]. India and China are the worst affected countries among those that are endemic for dental fluorosis [4]. India lies in geographical fluoride belt which extends from Turkey to China and Japan through Iraq, Iran and Afghanistan [6]. Nearly 12 million of the 85 million tons of fluoride deposits in the earth's crust are found in India. It is therefore not surprising that dental fluorosis is endemic in 15 states of India [7]. The most common cause of fluorosis in India is fluoride laden water derived from bore wells dug deep into earth. Many of the states of the Indian union have alarmingly high concentration of fluoride in their water resources as reported in a large volume of literature [8]. Dental fluorosis is the most convenient biomarker of exposure to fluoride and the evaluation of prevalence and severity of dental diseases are required for planning and implementing oral health programs in a given population. This review is intended to provide clinicoepidemiological analysis of dental fluorosis.

Dental fluorosis

Dental fluorosis is a permanent hypomineralization of enamel that is characterized by greater surface and subsurface porosity than in normal enamel and results from exposure of the immature tooth to excess fluoride (F) during development stages. It is an aesthetic and social problem, besides being a health problem. Persons with discoloured teeth due to Dental Fluorosis develop an inferiority complex, presenting psychosocial problems to self and the family [9]. It is less common in primary than in the permanent dentition, although fluorosis of the primary teeth does occur such as in East Africa.

Epidemiological aspects

Worldwide around 200 million people are consuming water from a source contaminated with high fluoride. UNICEF reports that fluorosis is endemic in at least 25 countries across the globe. United States of America, Morocco, Algeria, Libya, Egypt, Jordan, Turkey, Kenya, Tanzania, South Africa, Australia, Japan, Thailand, Canada, Saudi Arabia, Persian Gulf, Srilanka, Syria are some of them [10]. In India an estimated 6 million children below the age of 14 years are affected from fluorosis. The adults affected by Fluorosis without any gender difference range from 2-30% of the rural population [9]. Rajasthan and Gujarat in North India and Andhra Pradesh in South India are worst affected. Punjab, Haryana, Madhya Pradesh and Maharashtra are moderately affected states in India, while the states Tamil Nadu, West Bengal, Uttar Pradesh, Bihar and Assam are mildly affected [11]. The drinking water fluoride so far detected in the country ranges from 0.2 to 48 mg/ litre. Whereas prevalence of dental fluorosis ranges from 8.2% in Himachal Pradesh [12]. to 96.52% in Uttar Pradesh [13-16]. with Andhra Pradesh (45 - 85.4%) [17-19], Telangana (30.6 - 74.8%) [20-23], Rajasthan (18.89 - 89.1%) [24-27], Karnataka (31.05 - 69.9%) [28-30], Punjab (46.15 - 91.12%) [16,31], Madhya Pradesh (69.6 - 85.96%) [32,33] and Haryana (54.4 - 79.5%) [16,34-36] affected most.

Etiology and risk factors

Fluorosis is associated with excessive fluoride intake during the period of tooth development [37]. It is thought to result from the unerupted tooth's constant exposure to elevated plasma F concentrations during enamel maturation which leads to disrupted mineralization. The major cause is the consumption of water, containing high levels of fluoride, by infants and children during the first 6 years of life.

Pathogenesis

There is some evidence in support of the hypothesis that excessive levels of fluoride can interfere with dental enamel formation and cause fluorosis [38]. The wellknown phenomenon of a strong affinity between fluoride and biological apatite is based on the ease of chemical substitution of the hydroxyl component of calcium hydroxyapatite by fluoride. Pure fluoroapatite contains approximately 3.7% fluoride; up to about one-third of the total hydroxyl ions in enamel can be replaced by fluoride ions [39].

Clinical features

Fluorotic lesions are usually bilaterally symmetrical, but the severity varies among the different types of teeth. Teeth that develop and mineralize later in life such as premolars have a higher prevalence of fluorosis, and are more severely affected. Rarely are the primary dentition and lower incisors affected [31,38]. The first signs of dental fluorosis are thin white striae across the enamel surface. The cusp tips, incisal edge or marginal ridges may appear opaque white, called the "snow cap phenomenon". With increasing severity, the entire tooth surface may exhibit distinct, irregular, opaque or cloudy white areas. The next degree of severity manifests as irregular opaque areas merging to give chalky white appearance. In more severe stages, the tooth surface is entirely opaque with focal loss of the outermost enamel. Such small defects are usually designated as "pits". Pits may vary in diameter and occur scattered over the surface, although most frequently they occur along the incisal/ occlusal half of the tooth. With increasing severity these pits merge to form horizontal bands. This confluence of the pitted areas produces larger "corroded" areas. Ultimately, the most severely fluorotic teeth exhibit an almost total loss of surface enamel whereby the normal tooth morphology is severely affected [41].

Histopathology of dental fluorosis

Fluoride affects the forming enamel by making it more porous. The degree and extent of the porosity depends on the concentration of fluoride in the tissue fluids during tooth development [37]. The porous areas are highly hypomineralized which is a result of increase in intercrystalline spaces both in rod and interrod enamel, particularly pronounced along the rod boundaries. These changes are reflected in an enhancement of the lines of von Ebner and are particularly evident in the pulpal part of the dentin [41].

Chemical and biochemical features

As compared to bone fluoride content of tooth enamel, once formed, remains constant. Post-eruptive change is reflected in the

outer layer of enamel (approximately 50 μm) owing to diffusion of fluoride from the oral environment (i.e. saliva, ingested materials, dental plaque and therapeutic applications) [38]. The characteristics of fluoride distribution in teeth are a relatively high concentration of 500-4000 mg/kg in surface enamel (approximately 50 μm) and a lower concentration (50-100 mg/kg) in deep enamel. Fluoride concentrations for the bulk of dentine are between those of surface and deep enamel – that is, 200-1500 mg/kg [39]. Fluorosed enamel have high proportion of immature matrix proteins. During maturation, relatively fewer amelogenins than enamelins are lost by the fluorosed enamel [41].

Management

There is no treatment for Fluorosis and therefore prevention and control through management of the patient through interventions is the only approach to mitigate Fluorosis [9].

Levels of prevention of dental fluorosis

Primary level

The only practical and effective public health measure for the prevention and control of dental fluorosis and caries is limitation of the fluoride content of drinking water to <0.5 ppm, using deep bore drinking water supplies and adequate calcium intake (dietary calcium >1 g/day)". [42] The WHO guideline is 1.5 mg/litre of fluoride is the "desirable upper limit in drinking water. The unsuitability of WHO guidelines for fluoride is being increasingly felt and new norms are formulated. Senegal is the first nation to reduce the upper permissible limit of fluoride in drinking water from 1.5 mg/litre to 0.6 mg/litre. The reason for such drastic change is due to the high prevalence of Dental Fluorosis in children with 1.5 mg/litre of fluoride in drinking water. India reduced the upper limit of fluoride in drinking water from 1.5 mg/l to 1.0 mg/l [9].

Secondary level

Improve the nutritional status, especially of expecting mothers, newborns and children up to the age of 12 years. Treat other causes of fluoride toxicity such as kidney and thyroid diseases, etc. People should consume adequate amount of calcium (Milk and milk products, Jaggery, Drum sticks, Kamal kakdi, Arbi, Green leafy vegetables), Vitamin E (Nuts, Vegetable oil, Whole gram cereals), Antioxidants (Garlic, Ginger, Onion, Carrot, Papya, Sweet potatoes). Food and other substances rich in Fluoride should be avoided e.g. Kala namak, Black tea, Tobacco, Supari, use of Fluoride tooth paste and Fluoride containing water [32].

Tertiary level

The teeth once affected by Dental Fluorosis cannot be reversed to normal. But the discoloured teeth can be masked by bleaching and/or by other methods. The various treatments available for Fluorosed teeth are:

- Bleaching of Teeth
- Filling with light cure material and laminated veneering
- Capping or crowning of teeth with metals like chrome, cobalt, gold, porcelain and acrylic.

Conclusion

Fluorosis is a major public health problem. Dental fluorosis affects the aesthetic, emotional, social, and even psychological aspects of an individual's life. With recent developments in the avenue of patient care and management, Fluorosis can be prevented through early diagnosis and prompt mitigation. Diet editing to avoid fluoride contaminated drinking water and food is an intervention that the patients are introduced to, for avoiding the damage. Fluoride because of its anti-caries action was considered pivot of preventive dentistry. Potential beneficial and harmful effects must be evaluated before decision making regarding use of fluorides.

Bibliography

1. Macdonald LH., *et al*. "An integrated approach to address endemic fluorosis in Jharkhand India". *Journal of Water Resource and Protection* 3.7 (2011): 457-472.

2. Naidu GM., *et al*. "prevalence and selfperception of dental fluorosis among 15yearold school children in Prakasam District of South India". *Journal of International Oral Health* 5.6 (2013): 67-71.

3. Yasmin S., *et al*. "Fluoride contamination and fluorosis in Gaya Region of Bihar, India". *Current Biotica* 5.2 (2011): 232-236.

4. Arya S., *et al*. "Prevalence and severity of dental fluorosis in some endemically afflicted villages of district Doda, Jammu and Kashmir, India". *Journal of Applied and Natural Science* 5.2 (2013): 406-410.

5. Joshi V and Joshi NK. "Fluorosis and its impact on public health in Jodhpur, Rajasthan". *International Journal of Basic and Applied Medical Sciences* 4.2 (2014): 87-92.

6. Marganwar R., *et al*. "Fluoride distribution in drinking water and dental fluorosis in children residing in Chandrapur District of Maharashtra". *International Journal of Life Sciences* 1.3 (2003): 202-206.

7. Baskaradoss JK., *et al*. "Prevalence of dental fluorosis and associated risk factors in 11-15 years old school children of Kanyakumari District, Tamilnadu, India: A Cross Sectional Survey". *Indian Journal of Dental Research* 19.4 (2008): 297-303.

8. Kotoky P., *et al*. "Fluoride and endemic fluorosis in the Karbionglong District, Assam, India". *Fluoride* 41.1 (2008): 42-45.

9. Fluorosis Research and Rural Development. Susheela AK. A Treatise on Fluorosis. 2nd Edition. Delhi, India (2003).

10. Annadurai ST., *et al*. "Incidence and effects of fluoride in Indian natural ecosystem: A Review". *Advances in Applied Science Research* 5.2 (2014): 173-185.

11. Arlappa N., *et al*. "Fluorosis in India: An Overview". *International Journal of Research and Developmentof Health* 1.2 (2013): 97-102.

12. Chauhan D., *et al*. "A study of prevalence and severity of dental fluorosis among school children in a northern hilly state of India". *SRM Journal of Research in Dental Sciences* 3.3 (2012):170-174.

13. Tuli A., *et al*. "Caries experience evidenced in children having dental fluorosis". *International Journal of Clinical Pediatric Dentistry* 2.2 (2009): 25-31.

14. Singh M., *et al*. "Prevalence of dental diseases in 5 to 14 years old school children in rural areas of the Barabanki District, Uttar Pradesh, India". *Indian Journal of Dental Research* 22.3 (2011): 396-399.

15. Jain A., *et al*. "Prevalence of dental caries and dental fluorosis amongst children of low, moderate and high fluoride areas in Lucknow District of Uttar Pradesh: A Clinical Survey". *Journal of Indian Association of Public Health Dentistry* 10.20 (2012): 66-71.

16. Saxena KL and Sewak R. "Fluoride consumption in endemic villages of india and its remedial measures". *International Journal of Engineering Science Invention* 4.1 (2015): 58-73.

17. Ranganath S and Naganandini S. "Prevalence of dental caries, dental fluorosis and its relation in water fluoride levels among school children in Makapur Mandal, Andhra Pradesh". *Journal of Indian Association of Public Health Dentistry* 9.18 (2011): 746-751.

18. Dandi KK., *et al*. "Prevalence and severity of dental caries and dental fluorosis among 12yearold school children in areas with varying levels of fluoride ion concentration in drinking water of Prakasam District in Andhra Pradesh, India". *Journal of Indian Association of Public Health Dentistry* 10.20 (2012): 72-80.

19. Rao NS. "Groundwater Quality: Focus on fluoride concentration in rural parts of Guntur District, Andhra Pradesh, India". *Hydrological Sciences* 48.5 (2003): 835-847.

20. Nirgude AS., *et al*. "An epidemiological study on fluorosis in an urban slum area of Nalgonda, Andhra Pradesh, India". *Indian Journal of Public Health* 54.4 (2010): 194-196.

21. Ravi Kiran E and Vijaya K. "A Study of Dental Fluorosis among High School Children in a rural area of Nalgonda District, Andhra Pradesh". *Indian Journal of Research and Reports in Medical Sciences* 2.4 (2012): 29-32.

22. Shanthi M., *et al*. "Relationship between drinking water fluoride levels, dental fluorosis, dental caries and associated risk factors in 9-12 years old school children of Nelakondapally Mandal of Khammam District, Andhra Pradesh, India: A Cross-Sectional Survey". *Journal of International Oral Health* 6.3 (2014):106-110.

23. Siddiqui AH. "Fluorosis in Nalgonda District, Hyderabad-Deccan". *British Medical Journal* 2.4953 (1955):1408-1413.

24. Solanki J., *et al*. "Prevalence of dental fluorosis in school children of Jodhpur City". *Indian Jouranl Dental Advancements.* 3.3 (2011): 563-567.

25. Sarvaiya BU., *et al*. "Prevalence of dental fluorosis in relation with different fluoride levels in drinking water among school going children in Sarada Tehsil of Udaipur District, Rajasthan". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 30.4 (2012): 317-322.

26. Agrawal M., *et al*. "Prevalence and severity of dental fluorosis among patients visiting a dental college in Jaipur, Rajasthan". *Indian Journal of Research in Pharmacy and Biotechnology* 2.4 (2014): 1339-1344.

27. Sharma P. "groundwater quality in some villages of Rajasthan (India): Focus on Fluoride". *Journal of Environmental Research and Development* 1.4 (2007): 383-391.

28. Acharya S. "Dental Caries, Its surface susceptibility and dental fluorosis in South India". *International Dental Journal* 55.6 (2005): 359-364.

29. Narayanamurthy S and Santhuram AN. "Prevalence of dental fluorosis in school children of Bangarpet Taluk, Kolar District". *Journal of orofacial sciences* 5.2 (2013): 105-108.

30. Vandana KL and Reddy SM. "Assessment of periodontal status in dental fluorosis subjects using Community Periodontal Index of Treatment Needs". *Indian Journal of Dental Research* 18.2 (2007): 67-71.

31. Shashi A and Bhardwaj M. "Prevalence of dental fluorosis in endemic fluoride areas of Punjab, India". *Bioscience Biotechnology Research Communications* 4.2 (2011): 155-163.

32. Shinde A and Shinde M. "Environmental fluorine and associated morbidities". *Journal of Environmental Research and Development* 1.1 (2006): 32-34.

33. Aziz M and Khan AA. "An attempt to study fluorosis and its impacts in parts of Jhabua District (MadhyaPradesh). (2014).

34. Shusheela AK., *et al*. "Prevalence of Endemic Fluorosis with gastrointestinal manifestations in people living in some North-Indian Villages". *Fluoride* 26.2 (1993): 97-104.

35. Marya CM., *et al*. "prevalence and severity of dental fluorosis in endemic fluoride areas of Haryana, India: An Epidemiological Study". *Acta Stomatologia Croatica* 44.3 (2010): 152-158.

36. Garg VK and Singh B. "Fluoride signatures in groundwater and dental fluorosis in permanent teeth of school children in rural areas of Haryana State, India". *International Journal of Occupational and Environmental Medicine* 4.2 (2013):107-108

37. Mascarenhas AK. "Risk factors for dental fluorosis: a review of the recent literature". *Pediatric Dentistry* 22.4 (2000): 269-277.

38. Wong MCM., *et al*. "Topical fluoride as a cause of dental fluorosis in children". *Evidence-Based Child Health* 6 (2011): 388-439.

39. WHO. Fluorides and Oral Health. Technical Report Series. 846. Geneva (1994).

40. Funmilayo AM and Mojidaro AD. "Dental fluorosis and its indices, What's New?". *IOSR Journal of Dental and Medical Sciences* 13.7 (2014): 55-60.

41. Fejerskov O., *et al*. "Fluoride in dentistry". 2nd Edition. Munksgaard.

42. Habbu N., *et al*. "Esthetic management of dental fluorosis". *International Journal of Dental Clinics* 3.2 (2011): 80-81.

Volume 3 Issue 7 July 2019