

DENTAL FLUOROSIS — AN ORTHODONTIC ADHESIVE CHALLENGE

¹HAMEED ULLAH JAN MARWAT, BDS, MCPS, FCPS (Pak), OJT (USA)

²MUHAMMAD SALIM KHAN, BDS, DHPM, MCPS

³WAQARUR REHMAN QURESHI, BDS, MSC (UK)

⁴MUHAMMAD ARIF MAHMOOD, BDS, MCPS

ABSTRACT

The purpose of this study, carried out in early 2010, was threefold: Firstly, to assess the frequency of mild to severe type of dental fluorosis in the school children of district Jhang, (Punjab), both males and females with an age range of 6-14 years. The ratio between girls (420) and boys (278) was 1.51:1. Out of a total sample size of 698, 76 girls and 90 boys suffered from dental fluorosis with a total frequency of 23.78%.

Secondly, to give a wake up call to those who are responsible for the prevention of this menace from that specific segment of poor and neglected society.

Lastly, to get an effective bonding clue for this pretty good quantum of patients who pose a great challenge in orthodontics, in terms of poor sheer bond strength of adhesives due to repeated bond failures while using “standard etching protocol”, resulting in a poor treatment outcome. Current orthodontic literature hints that among the various orthodontic adhesive materials, self etching primer has so far played a promising role in these cases, as is evident from various studies.¹

Key words: Fluorosis, DNA damage, District Jhang, MDC Lahore, Orthodontic material

INTRODUCTION

Fluorosis, a condition caused by an excessive intake of fluoride, manifests itself in the form of dental or skeletal fluorosis, when it attacks teeth or bone respectively. Dental fluorosis usually appears before the skeletal form, a bone crippling disease, which can alert the medical professionals to catch the problem right at the outset. The damage caused by fluorosis is permanent, making prevention very important in regions of the world where the problem is endemic, like Pakistan, India and China. Fluorosis appears to be especially common in the developing world, for a variety of reasons, but it has not spared even the West where its prevalence has increased over the past 50 years.² In Pakistan, the most effected sporadic areas are in Jhang, Chakwal, Khoshab, Chawinda, Mianwali and Lakki Marwat. However, in Lakki Marwat, a southern district of Khyber Pakhtoonkhwa province which was plagued in the past with severe form of dental fluorosis, is brought under full control.

Many among us believe that dental fluorosis is solely an “aesthetic” issue, and not a health problem at all. This statement is purely an assumption and not a reality. Certainly, dental fluorosis leaves a toxic and lethal impact on ameloblasts. The question is whether tooth cells are the exclusive cells in the body which are tar-

geted and the rest of the body cells are enjoying immunity?

To develop dental fluorosis, one has to intake 10 times the recommended daily consumption of fluoride for a protracted time period. In drinking water having excessive fluoride, greater than 1-2 ppm, can cause metabolic damage to the ameloblasts, forming a low quality matrix and resulting in improper calcification of teeth, whereby the porosity of the sub-surface enamel is increased.³ Excessive fluoride can come from fluoride pollution, inhalation of fluoride dust and fumes from aluminum industry, heavily fluoridated water, supplements, excessive consumption of tea so common in Pakistan, and consumption of unjustified use of fluoridated toothpastes.

Dental fluorosis some times called enamel fluorosis starts with small marks and spots on the teeth, sometimes accompanied with a mild transparency of the tooth enamel. If the condition is not checked in time, the teeth are bound to become pitted, cracked, and brittle. This situation poses a great challenge for orthodontic treatment. If dental fluorosis is envisioned on time, the patient is immediately alerted about sources of fluoride to be immediately avoided, and the teeth may be bleached, veneered or capped not only for an aesthetic reason, but also to protect them from further deterioration.

¹ HOD 28 MDC Lahore Cantt. Email: huj100@hotmail.com

² Asstt Prof, HoD Dental Materials, KCD Peshawar, Peshawar University

³ Asstt Prof of Oral & Maxillofacial Surgery, Ayub Medical College, Abbott Abad

⁴ Trainee, 28 MDC, Lahore Cantt.

Dental fluorosis can also influence shear bond strength (SBS) of the orthodontic brackets. A significant decrease in SBS was reported when orthodontic brackets were bonded on fluorosed teeth.⁴ Effects of self etching primers (SEP) on SBS of orthodontic brackets are well documented.⁵⁻⁷ Several authors reported that there was no difference between self etching and standard etching protocol on bond strengths.⁸⁻¹³ On the other hand, lower bond strengths with SEP have also been reported.^{14,15}

However, the situation is not much gloomy. Adanir N et al^{1,15} in their study has claimed that a satisfactory bond strengths were obtained when SEP was used for bonding brackets to the fluorosed teeth, as compared to the routine usage of “standard etching protocol”, where the bond strengths of orthodontic brackets were significantly compromised.

METHODOLOGY

This study was conducted in early 2010, exclusively on the children of various schools, located both in the urban and rural areas of district Jhang. To avoid bias, total of 40 schools of both genders were randomly selected. Girls primary schools were 20 while boys primary schools were 12. Girls high school was one while boys high schools were three. Elementary/Middle schools with co-education were four only. Informed verbal consent was taken both from the participants, their parents, teachers and concerned local chiefs. This study was purely conducted on voluntary and missionary basis with out seeking any financial support from any firm, Government or NGOs.

A screening proforma was designed and completed by the concerned professionals, who were well acquainted with the clinical diagnosis of dental fluorosis. Regarding cross infection control, a prudent and fool-proof approach was adapted and monitored by all professionals/workers, so as to abort all the risk factors, inflicting the children community at the time of dental and oral screening. All those children suffering from complete anodontia or rampant caries were excluded from the study. All other children, having mixed or permanent dentitions were included in the study. Children suffering from gingivitis, dental caries or other dental morphological anomalies were also included in the study. All participants were highly cooperative, compliant and no body declined the study.

Total of 698 school children were screened for the dental fluorosis. Gender distribution and age range of the patients were determined and data was compiled for the conclusive outcome.

RESULTS

Out of a total sample size of 698 school children, 420 girls and 278 boys, with a ratio of 1.51:1, screened from

the urban cum rural subset of population, only 166 suffered from mild to severe form of dental fluorosis, with a total frequency of 23.78%, which is a quite substantial figure. This comprised of 76 girls (46%) and 90 boys (54%). Boys outnumbered in suffering than the girls with no apparent reason. Table 1.

TABLE 1: FREQUENCY OF DENTAL FLUOROSIS IN BOYS AND GIRLS

Total frequency of Dental Fluorosis in school children	
Sample size: 698 (n)	Affected: 166(n) 23.78%
Girls	Boys
76 (46%)	90(54%)

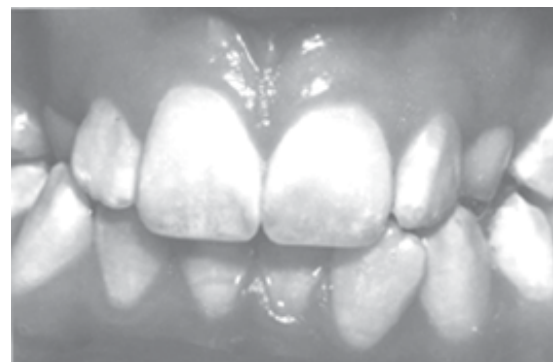


Fig 1: Mild to moderate dental fluorosis



Fig 2: Severe form of dental fluorosis

DISCUSSION

Dental fluorosis in our set up is not only a major esthetic concern, but also highly challenging and expensive condition to treat not only in Pakistan but also across the planet. Transglobally, we sporadically come across children or adults who are stained with the permanent stigma of dental fluorosis, particularly when frontal teeth are inflicted. If left untreated, it can cause embarrassment for the school-aged children, resulting in psychosocial distress, difficulties in societal adjustment and damage to the self-esteem of the patient.

They are teased by their peers, usually adapt avoidance behavior when meet others, puts hand before his mouth while smiling. They lack initiative due to compromised confidence level.

Children in all the endemic areas of dental fluorosis faced the same problems, what the rest of world is perplexed with, in terms of compromised esthetics, function and its associated problems.

Fluorosis impacts dentitions while they are in the developmental stage and are not yet erupted into the oral cavity. The same was the situation in this study. No child was spared whether male or female who used the same source/well for the drinking water.

It is well known that normal fluoride level is an important dietary supplement, which has been proven effective in the dental cariology. It is however, the excessive fluoride which damages ameloblasts as was evident from the present study sample. Crippling of these cells jeopardizes not only the mineralization process of the teeth, but also increases the porosity of the sub-surface of enamel. Thus dental fluorosis in its more advanced stages can leave teeth more susceptible to increased caries lesions because of pitting and loss of the outer enamel. Many of cases in this study also posed this advanced stage of dental fluorosis.

Like bones, a child's teeth are alive and growing. Fluorosis is the result of fluoride deranging the crystalline structure of a tooth's enamel as it is still growing. This potency and ability of excessive fluoride to cause changes within the body, raises concerns about similar damage that may be occurring in the bones.¹⁶ The safety of the use of fluorides ultimately rests on the assumption that the developing enamel organ is most sensitive to the toxic effects of fluoride. The results from this study suggest that the pinealocytes may be as susceptible to fluoride as the developing enamel organ.¹⁷

As stated earlier the long term over-intake of fluoride may cause skeletal as well as dental fluorosis. Many studies on other toxic effects of fluoride have been made, including whether it alters human genetic material and ultimately leads to more serious harm. In recent years, sister chromatid exchange (SCE) analysis has been considered to be a sensitive method for detecting DNA damage. There is a clear relationship between a substance's ability to induce DNA damage, mutate chromosomes, and cause cancers. The SCE frequency in the human body in peripheral blood lymphocytes is very steady, and does not vary with age or sex. Any increase of the SCE frequency is primarily due to chromosome damage. Thus using a method to detect SCE for exploring the toxicity and harm caused by fluoride is of great clinical importance.¹⁸

To detect toxicity of the fluoride, this novel technique of micronucleus (MN) and sister chromatid exchange (SCE) was applied in a study by some researchers, to detect mutagenicity and potential carcinogenicity from fluoride in fluorosis patients who drink elevated concentrations of fluoride in water. Results of the study revealed that the DNA of the patients with dental fluorosis was seriously damaged, and that the DNA of the healthy people in the endemic regions was also damaged in varying degree.¹⁹

The fact that the SCE frequency of the healthy people in the endemic regions was also higher than that of the controls in the non-endemic regions suggests that early harm by fluorine can be cytogenetically detected in the sub-clinical patients with fluorosis who could not be given an early diagnosis clinically.

After culturing human peripheral blood lymphocytes by using various concentrations of sodium fluoride (NaF), Lu Wenqing found that the increased micronucleus (MN) rate may cause a higher chromosome malformation frequency. The main types of chromosome malformation were breaks and crevices.²⁰

Keeping in mind the above illustrated risk factors, people with a naturally higher fluoride intake due to their diet or drinking water like what we are facing in some areas of Pakistan some of which are highlighted in this study, should watch out for fluorosis in the community, and consider some alternative or using filters which can help to eliminate fluorides in their water. It also comes under the jurisdiction of the concerned authorities to focus on the prevention of this highly resistant dental problem, which is so seriously plaguing the dental health of the poor and the neglected community.

Fluorosis leaps beyond borders. Over the past five decades, the prevalence of dental fluorosis has also dramatically increased in the United States and other fluoridated countries like Israel etc. Litigation cases in these countries are on the rise for dental professionals. In these countries excessive fluoride comes not only from the fluoridated water but also from the fluoride pollution, like inhalation of fluoride dust and fumes from aluminum industry, fluoride supplements, excessive consumption of tea, and consumption of fluoridated dentifrices. According to the Centre for Disease Control (CDC), dental fluorosis now impacts 32% of American children, the same was much low (10%) in 1940.

In the present study although confined to an endemic region, only 23.78 % children were affected, which represented only one district of Punjab province and not the whole country. This result (23.78 %) as compared to the US result (32%) is highly encouraging and reflects control and containment of fluorosis, as is observed in the district of Lakki Marwat. One more

interesting finding which emerged from the results of this study was that although girl students outnumbered the boy students as participants of this study, boys (54%) were more inflicted with dental fluorosis as compared to girls (46%). This needs a clue which may or may not be linked to the genetic make up of the two genders which in turn may manifest their predilection for the fluoride uptake.

Lastly, the effects of dental fluorosis and self etching primers (SEP) particularly 3M ESPE, on shear bond strengths (SBS) of brackets has shown promising results in orthodontics. This has substantially controlled the repeated bracket failures, so common in fluorosed cases, which in turn has dramatically reduced the total time period required for the accomplishment of orthodontic treatment.

CONCLUSION & RECOMMENDATIONS

Fluorosis which seriously adversely affects, not only the teeth and bones but also damages the DNA and chromosomes, resulting in the genetic mutations which may prove very damaging to the health of an individual.

Prevalence of fluorosis in our set up and its incidence should be properly monitored and brought under control. All sources of excessive fluorine, whether, water, industrial pollutions, tea or fluoridated tooth pastes, should be identified and eliminated.

Public awareness campaign both at School, Masjid and Community level is to be mobilized. Children and adults inflicted with fluorosis, should be given treatment priority, so as to minimize or disguise their staining stigma and pitting abnormalities of the teeth. Restoring their smiles through dental esthetics will help them in gaining self-esteem and confidence level.

Its prevalence in the sporadic regions of Pakistan, gives us an arousal that further broad based research is required across the country, so as to focus on its impact not only on the dentitions and skeletal system but also at “genetic complex” level.

ACKNOWLEDGEMENT

I sincerely acknowledge and will remain extremely indebted to Dr Muhammad Arif Mahmood, Senior Dental Surgeon, Jhang, now my trainee and his dynamic team who made day and night efforts to visit and collect data from the school children in collaboration with school heads/teachers and other honorable local elders in the district of Jhang, (Punjab, Pakistan).

My same feelings are for my loved ones, namely Khalid Hameed, Tariq Hameed, Umar Hameed, and Usama Hameed, for their technical help required for the completion of this manuscript.

REFERENCES

- Adanir N, Turkkahraman H, Yalcin Gungor A. Effects of adhesion promoters on the shear bond strengths of orthodontic brackets to fluorosed enamel. *Eur J Orthod.* 2009; 31: 276–80.
- Lawson J, Warren JJ, Levy SM, Broffitt B, Bishara SE. Relative esthetic importance of orthodontic and color abnormalities. *Angle Orthod.* 2008; 78:889–94.
- Fejerskov O, Larsen MJ, Richards A, Baelum V. Dental tissue effects of fluoride. *Adv Dent Res.* 1994; 8:15–31.
- Adanir N, Türkkahraman H, Güngör AY. Effects of fluorosis and bleaching on shear bond strengths of orthodontic brackets. *Eur J Dent.* 2007; 1:230–35.
- Iijima M, Ito S, Yuasa T, Muguruma T, Saito T, Mizoguchi I. Bond strength comparison and scanning electron microscopic evaluation of three orthodontic bonding systems. *Dent Mater J.* 2008; 27:392–99.
- Banks P, Thiruvenkatachari B. Long-term clinical evaluation of bracket failure with a self-etching primer: a randomized controlled trial. *J Orthod.* 2007; 34:243–51.
- Holzmeier M, Ernst CP, Willershausen B, Hirschfelder U. In-vitro shear bond strength of self-etching versus traditional adhesives for orthodontic luting. *J Orofac Orthop.* 2006;67: 244–59.
- Pandis N, Polychronopoulou A, Eliades T. Failure rate of self-ligating and edgewise brackets bonded with conventional acid etching and a self-etching primer: A prospective in vivo study. *Angle Orthod.* 2006; 76:119–22.
- Turk T, Elekdag-Turk S, Isci D. Effects of self-etching primer on shear bond strength of orthodontic brackets at different debond times. *Angle Orthod.* 2007; 77:108–12.
- Cal-Neto JP, Carvalho F, Almeida RC, Miguel JA. Evaluation of a new self-etching primer on bracket bond strength in vitro. *Angle Orthod.* 2006; 76:466–69.
- Chalgren R, Combe EC, Wahl AJ. Effects of etchants and primers on shear bond strength of a self-ligating esthetic orthodontic bracket. *Am J Orthod Dentofacial Orthop.* 2007; 132:577, 571–55.
- Faltermeier A, Behr M, Mussig D. A comparative evaluation of bracket bonding with 1-, 2-, and 3-component adhesive systems. *Am J Orthod Dentofacial Orthop.* 2007; 132:144, 141–45.
- Arnold RW, Combe EC, Warford JH., Jr. Bonding of stainless steel brackets to enamel with a new self-etching primer. *Am J Orthod Dentofacial Orthop.* 2002; 122:274–76.
- Bishara SE, Ajlouni R, Laffoon JF, Warren JJ. Comparison of shear bond strength of two self-etch primer/adhesive systems. *Angle Orthod.* 2006; 76:123–26.
- Cehreli ZC, Kecik D, Kocadereli I. Effect of self-etching primer and adhesive formulations on the shear bond strength of orthodontic brackets. *Am J Orthod Dentofacial Orthop.* 2005; 127:573–79.
- Environmental Working Group, “National Academy Calls for Lowering Fluoride Limits in Tap Water”, March 22, 2006.
- Luke J. (1997). *The Effect of Fluoride on the Physiology of the Pineal Gland.* Ph.D. Thesis. University of Surrey, Guildford. p. 176.
- Tsutsui T, Susuki N, Ohmori M. Sodium fluoride-induced morphological and neoplastic transformation, chromosome aberrations, sister chromatid exchanges, and unscheduled DNA synthesis in cultured Syrian hamster embryo cells. *Cancer Research* 1994; 44(3): 938-41.
- Tao Maoxuan, Gao Wenhua, Zao Zunliang. A cytogenetics study on farmers who drink contaminated well water. *Environment and Health* 1992; 9(1): 24-25.
- Lu Wenging, Zao Maiyin, Yan Hun, Shi Lei. Genetic toxicity of fluoride and antagonistic effect on fluoride toxicity. *Public Hygiene in China* 1991; 10(3): 157-59.