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Dentistry Section

Association of Temporomandibular Joint Signs & Symptoms with Dental Fluorosis & Skeletal Manifestations in Endemic Fluoride Areas of Dungarpur District, Rajasthan, India

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ABSTRACT

Introduction: Endemic fluorosis resulting from high fluoride concentration in groundwater is a major public health problem. India is among the numerous nations, where fluoride sullied groundwater is creating wellbeing issues. Safe drinking water in rural areas of India is predominantly rely on groundwater sources, which are exceptionally contaminated with fluoride.

Aim: To investigate the association of temporomandibular joint Signs & Symptoms with Dental Fluorosis & Skeletal Manifestations among people living in Dad, Bokersal & Deotalab villages of Dungarpur District, Rajasthan, India.

Materials and Methods: The study group consisted of 750 subjects who were born & brought up in Dad, Bokersal & Deotalab villages of Dungarpur District, Rajasthan. Temporomandibular joint & Dental fluorosis was assessed by performing type III clinical examination according to WHO guidelines (1997). For the assessment of skeletal manifestations, participants were asked to perform three diagnostic tests: (1) Touching the toes without bending the knees; (2) Touching the chest with the chin; (3) Stretching the arms sideways & folding the arms to touch the back of the head. Chi Square test & Multiple Logistic Regression were applied for statistical analysis.

Results: Among the 750 (462 males & 288 females) who participated in the study, 53% had moderate grade of dental fluorosis. The most prominent symptom suggesting Temporomandibular Joint Disorder was the clicking sound affecting 21.4% population.(p>0.001). TMJ Signs & Symptoms were prominent in the age group of 45-54 years & males were highly affected than females.

Conclusion: Clinical examination of TMJ in Dental Fluorosis & Skeletal Fluorosis subjects showed a significant association with Dental Fluorosis & Skeletal Fluorosis.

Keywords: TMJ, Dean's fluorosis index, Skeletal fluorosis

INTRODUCTION

Fluorosis is an imperative general well being issue in different nations, including India, which lies in the topographical fluoride belt that stretches out from Turkey to China and Japan through Iraq, Iran and Afghanistan. Of the 85 million tons of stores on the world's covering, 12 million are found in India. Henceforth, it is normal that fluoride sullying is across the board, escalated and disturbing in India. Since 1937, endemic fluorosis is predominant in India. It has been evaluated that the aggregate populace expending drinking water containing raised levels of fluoride is more than 66 million. The accessible information propose that 15 States in India are endemic for fluorosis (fluoride level in drinking water >1.5 mg/l), and around 62 million individuals in India experience the ill effects of dental, skeletal and non-skeletal fluorosis [1].

Tooth enamel is basically comprised of hydroxyapatite (87%) which is crystalline calcium phosphate. Fluoride which is more steady than hydroxyapatite uproots the hydroxide particles from hydroxyapatite to shape fluoroapatite. Fluorosis of dental enamel prevails when abundance Fluoride is ingested amid the years of tooth calcification-basically amid the initial 7 years of life. It is described by mottling of dental polish, which has been accounted for at levels above 1.5 mg/L consumption. On sustained continuation of this procedure the teeth turn out to be hard and fragile. This is called dental fluorosis. Dental fluorosis in the introductory stages results in the tooth getting to be shaded from yellow to brown to black. Contingent on the severity, it might be just discolouration of the teeth or arrangement of pits in the teeth. The colouration on the teeth may be as spots or as streaks [1]. As the level of the fluorosis increases in the body it affects many other body parts including the human skeleton. High fluoride concentration in drinking water can lead to the skeletal fluorosis [2]. Crippling skeletal fluorosis might occur in people who have ingested 10 to 20 mg of fluoride per day for over 10 to 20 years [1]. Since bone development and remodelling happen over a human's lifespan, skeletal fluorosis can continuously decline with overexposure to high fluoride levels [3]. Early stages of skeletal fluorosis start with pain in bones and joints, muscle weakness, sporadic pain, stiffness of joints and bones and joints, weakened muscles, sporadic agony, stiffness of joints and chronic fatigue [1]. During later stages, it causes aches and pains, limited joint movement, knock-knees, bowing of legs, and spinal curvature [2].

Fluorosis also poses non-skeletal threats such as loss of appetite, joint pain, stiffness of neck and back pain, gas formation, laziness in routine life, increased urination etc., as commonly reported in fluorotic regions [4].

Skeletal Fluorosis affects almost all joints of the body. Aseefa G et al., found clinical & radiographical prevalence of skeletal fluorosis among retired employees working in sugar estate. Results revealed that 46% had kyphosis, 70% had impaired squatting, 57% had impaired neck mobility & 72% had impaired lumbar mobility [3]. Teotia M et al., portrayed Endemic skeletal fluorosis in 6 youngsters matured 11 or above. Out of 6, restricted developments of spine, thoracic kyphosis, and flexion distortions at the hips and knees, crippling fluorosis, were found in 4 patients [5]. Bharati P et al., discovered Skeletal fluorotic manifestations in Gadag & Bagalkot area of Karnataka reporting twitching and desensitizing of extremities, pain in joints and knee, bowing, stiff limbs, stiff vertebral column and not able to complete the daily routine practices [6].

Temporomandibular Joint is the most important joint of human head & neck region. Temporomandibular joint aides in the essential capacity of biting food, speech and so forth. Patients with TMD ordinarily experience the ill effects of muscle and/or joint pain on palpation and on mandibular developments, joint sounds and the mandibular range of movement may be constrained [7].

Accumulation of fluoride in temporomandibular joint can also occur & lead to temporomandibular disorders. Animal studies indicate fluorosis may exert adverse effects in the temporomandibular joint (TMJ) structures [7]. Animal studies have been reported on TMJ but there are only few studies which have been done on human subjects.

In Rajasthan, 18 out of 32 districts are fluorotic and 11 million of the population are at risk. In the absence of perennial rivers, surface and canal system, groundwater remains the main source of drinking water. It contains 2 to 20 mg/L of fluoride [2]. The worst among these districts are: Nagaur, Jaipur, Sikar, Jodhpur, Barmer, Ajmer, Sirohi, Jhunjhunu, Churu, Bikaner & Ganganagar. It is therefore important & valuable to have epidemiological data to estimate the proportion & distribution of these disorder in the population [8].

In southern Rajasthan, there are three districts, namely Dungarpur, Banswara & Udaipur with very high fluoride content in water. In Dungarpur district, almost all the ground and surface water sources contain considerable Fluoride, whereas in Banswara and Udaipur districts only ground waters contain appreciable amounts of Fluoride. Therefore, chances of higher fluoride intake are greater in Dungarpur district, and a high prevalence of fluorosis in the villages of this district is more likely [9]. From the previous researchers it was found that Dad, Bokersal & Deotalab villages of Dungarpur are most endemic, with water fluoride content ranging from 5.0 to 13.8 ppm [9,10].

AIM

The objective of this cross-sectional epidemiological study was to investigate the association of temporomandibular joint Signs & Symptoms with Dental Fluorosis & Skeletal Manifestations among people living in Dad, Bokersal & Deotalab villages of Dungarpur District, Rajasthan, India.

MATERIALS AND METHODS

A cross-sectional descriptive survey was conducted among people residing in the Dad, Bokersal & Deotalab villages of Dungarpur District, Rajasthan, India during March – April 2014. The study protocol was reviewed by the ethical Committee of Pacific Dental College & Hospital & was granted ethical clearance. All the subjects who agreed to participate in the survey were requested to give written informed consent (either signature or thumb impression) prior to the clinical examination. People who were born & brought up in these villages & who were willing to participate were included in the study. Edentulous elderly people, People on medications that may influence bone metabolism, any metabolic and inflammatory bone disease, People with the habit of bruxism or parafunctional masticatory habits, acute infection or periodontitis, and a history of psychosomatic disorders, People with any systemic diseases, People with heavy stains of tobacco & smoking, Small children, sick individuals, individuals with debilitating diseases were excluded from the study.

Survey proforma was designed in English consisting of:

a. General information: demographic data, source of drinking water.

b. The three diagnostic tests to assess the clinical features of skeletal fluorosis.
    a. Touching the toes without bending the knees;
    b. Touching the chest with the chin;
    c. Stretching the arms sideways & folding the arms to touch the back of the head [11,12].

c. TMJ examination & Dean's Fluorosis index was recorded according to WHO Oral Health Assessment Form (1997) [13].

Subjects who could perform any one of the three tests were taken under 'mild' category, those who could perform two tests & the ones who were not able to perform any of the three tests were included in 'moderate' or 'severe' categories of skeletal fluorosis respectively. In the investigation of skeletal fluorosis considers, radiographic study is conventionally done; be that as it may, we didn't utilize radiographs as there were a substantial number of members and study area was situated in the outreach areas of Dungarpur District and was also far from the closest medicinal healing centre. So, it was not possible to take radiographs of all the study participants.

Before the start of the study, examiner was trained & calibrated in the Department of Public Health Dentistry for 1 week by an expert examiner to minimize the errors & doubts. The intra examiner reliability was assessed using Kappa Statistics, which was 92%, 90% & 89% respectively for assessment of skeletal fluorosis, temporomandibular joint assessment and dental fluorosis assessment. A pilot study was done on 50 subjects to know the appropriateness & feasibility of the survey.

Sample size (n) was determined by using the following formula:

$n = z^2pq/d^2$

The population of the three villages selected were obtained from the tehsil headquarters. Probability proportional sampling was done to select the study samples & a total sample of 750 subjects were selected. From each of the three villages, samples were randomly selected.

The examiner visited the villages on the predetermined dates according to the schedule. The people who were willing to participate in the study were first asked to sign the informed consent at the top of the proforma, after explaining the purpose of the study. Temporomandibular joint & Dental fluorosis was assessed by performing type III clinical examination according to WHO guidelines (1997) [14]. For the assessment of skeletal manifestations, participants were asked to perform three diagnostic tests.

STATISTICAL ANALYSIS

The statistical software namely SPSS version 17.0 was used for the analysis of the data. Chi-square test & Multinomial Logistic Regression were used for comparisons. Calculated values of the test criteria were compared with the tabular value at 95% confidence level to ascertain the significance of the test. The p-value of 0.05 or less was considered as statistically significant.

RESULTS

[Table/Fig-1] shows in a total of 750 subjects, there was increased severity of dental fluorosis (54.4%) & Skeletal Fluorosis (61.1%) in the age group of 55-64 years & was more commonly found in males than in females.

[Table/Fig-2] reveals with an increase in age TMJ Symptoms (74.4) & Clicking sound (50%) was found to be most prevalent in the eldest age group of 55-64 years. Females shows higher prevalence of TMJ Symptoms (46.1%) than males.

[Table/Fig-3] shows that among all the study subjects, Skeletal Fluorosis was significantly associated with TMJ Symptoms (33.0%). Severe Skeletal Fluorosis was most prevalent in subjects showing TMJ Symptoms (58.1%) & severe Grade of Dental Fluorosis was seen to be significantly associated with TMJ Symptoms (81.8%) & with Clicking Sound (49.0%).

[Table/Fig-4] shows a significant association with increased in age & TMJ Signs & Symptoms (0.14–0.45). Clicking was significantly associated with increased age (2.30–6.49), Dental Fluorosis (0.33–1.83) & Skeletal Fluorosis (0.54–2.71).

Variables	Age group (Years) n (%)					p value	Gender n (%)		Total n (%)	p value
	15-24	25-34	35-44	45-54	55-64		Male	Female		
Dental Fluorosis										
Mild	9 (50)	15 (62.5)	124 (34.9)	87 (33.0)	7 (7.7)	0.001*	168 (36.3)	74 (25.6)	242 (32.2)	0.001*
Moderate	7 (38.8)	5 (28.8)	207 (58.3)	145 (55.1)	34 (37.7)		212 (45.83)	186 (64.5)	398 (53.0)	
Severe	2 (11.1)	4 (16.6)	24 (6.7)	31 (11.7)	49 (54.4)		82 (17.7)	28 (9.7)	110 (14.6)	
Skeletal Fluorosis										
Mild	9 (50)	12 (50.5)	143 (40.2)	88 (33.4)	5 (5.5)	0.001*	184 (39.8)	73 (25.3)	257	0.001*
Moderate	6 (33.3)	4 (17.6)	173 (48.7)	94 (35.7)	30 (33.3)		151 (32.6)	156 (54.1)	307	
Severe	3 (16.6)	8 (33.3)	39 (10.9)	81 (30.7)	55 (61.1)		127 (27.4)	59 (20.4)	186	
Total	18 (2.4)	24 (3.2)	355 (47.0)	263 (35.0)	90 (12)		462 (61.6)	288 (38.4)	750	

[Table/Fig-1]: Distribution of study population according to various Independent Variables
Test applied: Chi square test
*Statistically significant

Variables	Frequency of TMJ Signs & Symptoms n (%)			
	TMJ Symptoms	Clicking	Tenderness	Reduced Mouth Opening
Age group (years)				
15-24 (n=18)	2 (11.1)	2 (11.1)	0	0
25-34 (n=24)	9 (37.5)	4 (16.6)	2 (8.3)	1 (4.1)
35-44 (n=355)	101 (28.5)	47 (13.2)	14 (3.9)	4 (1.1)
45-54 (n=263)	119 (45.2)	63 (23.9)	21 (7.9)	14 (5.3)
55-64 (n=90)	67 (74.4)	45 (50)	23 (25.5)	21 (23.3)
p value	0.001*	0.001*	0.001*	0.001*
Gender				
Male (n=462)	165 (35.7)	84 (18.1)	37 (8.0)	23 (4.9)
Female (n=288)	133 (46.1)	77 (26.7)	23 (7.9)	17 (5.9)
p value	0.028	0.065	0.89	0.09
Total (n=750)	298 (39.7)	161 (21.4)	60 (8.0)	40 (5.3)

[Table/Fig-2]: Assessment of TMJ Signs & Symptoms among study population by age & gender
Test applied: Chi square test
*Statistically significant

	TMJ Signs & Symptoms n (%)			
	TMJ Symptoms (n=298)	Clicking (n=161)	Tenderness (n=60)	Reduced Mouth Opening (n=40)
Dental Fluorosis				
Mild (n=242)	74 (30.5)	35 (14.4)	10 (4.1)	8 (3.3)
Moderate (n=398)	134 (33.6)	72 (18.0)	28 (7.0)	19 (4.7)
Severe (n=110)	90 (81.8)	54 (49.0)	22 (20.0)	13 (11.8)
p value	0.001*	0.001*	0.001*	0.001*
Clinical Features of Skeletal Fluorosis				
Mild (n=242)	63 (26.0)	79 (32.6)	11 (4.5)	3 (1.2)
Moderate (n=398)	121 (30.4)	52 (13.0)	23 (5.7)	11 (2.7)
Severe (n=110)	64 (58.1)	41 (37.2)	17 (15.4)	9 (8.1)
p value	0.001*	0.001*	0.001*	0.001*
Total	248 (33.0)	172 (22.9)	51 (6.8)	23 (3.0)

[Table/Fig-3]: Association of Dental fluorosis & Clinical Features of Skeletal Fluorosis with TMJ Signs & Symptoms
Test applied: Chi square test
*Statistically significant

Variable	TMJ Symptoms	Clicking	Tenderness	Reduced Mouth Opening
Age				
15-24	.025 (0.003-0.206)*	4.94 (0.74 – 32.88)	30.73 (0.00)	26.17 (0.00)
25-34	.088 (0.031 – 0.254)*	9.92 (2.61 – 37.64)*	1.80 (0.35 – 9.10)	36.22 (0.00)
35-44	.088 (0.049 – 0.158)*	8.75 (5.00 – 15.31)*	7.03 (3.38 – 14.61)*	31.88 (9.11 – 111.56)*
45-54	.259 (0.147 – 0.457)*	3.86 (2.30 – 6.49)*	4.43 (2.28 – 8.63)*	6.25 (2.98 – 13.09)*
55-64				
Gender				
Male	.784 (0.566 – 1.087)	0.95 (0.64 – 1.40)	0.86 (0.47 – 1.58)	1.74 (0.80 – 3.17)
Female				
Dental fluorosis				
Mild	3.327 (0.165 – 10.47)	0.45 (0.41 – 5.15)	3.90 (1.66 – 9.14)*	0.33 (0.87 – 1.27)
Moderate	.905 (1.74 – 6.35)	0.78 (0.33 – 1.83)*	23.55(0.00)	0.46 (0.37 – 5.88)
Severe				
Clinical Features of Skeletal Fluorosis				
Mild	.784 (0.122 – 6.69)	1.74 (0.17 – 17.56)	0.41 (0.41 – 0.41)	1.95 (1.95 – 1.95)
Moderate	1.316 (0.147 – 0.461)	1.25 (0.54 – 2.71)*	4.00 (0.00)	1.21 (0.11 – 12.27)
Severe				

[Table/Fig-4]: Multinomial Logistic Regression Odd ratios (95% CI) for TMJ Signs & Symptoms Score as dependent variable among study population
Italicized category is taken as reference group
* Statistically signidicant

DISCUSSION

The chronic toxic effects of fluoride on the skeletal system have been described from certain geographical regions of the world where drinking water contains excessive quantities of natural fluoride [15]. This form of chronic intoxication was first described in India from the state of Madras as early at 1937 [16]. Skeletal fluorosis may emerge by an increased thickness of bone and exhibited in grown-ups radiographically. The study showed that the limit of total fluoride which may be ingested day by day without unsafe body storage is of the order of 4-5mg daily [15].

Nirgude et al., in his study showed that the prevalence of skeletal fluorosis & dental fluorosis in Nalgonda is 24.9% & 30.6% respectively [11]. Susheela AK et al., found out that skeletal fluorosis & its associated manifestations can develop due to ingestion of fluorides along with other factors such as low calcium, high water alkalinity, & dietary deficiency of calcium & Vitamin C [17].

Dental fluorosis is a developmental disorder of dental tissues provoked by progressive exposures to high concentrations of Fluoride development of tooth, inducing low mineral content in enamel with increased porosity [18]. Choubisa et al., concluded that in southern Rajasthan the overall prevalence of dental fluorosis is 45.7% [9]. In an another study by Choubisa et al., showed that Among subjects with poor nutrition, the prevalence of dental fluorosis rose to 61.6% and skeletal fluorosis to 23.9% [19]. Kotecha et al., reported that dental fluorosis prevalence in high fluoride territory was

reported to be 59.31% while in typical fluoride range it was 39.21%, highly affecting the age group of 12-24 years [20]. Karthikeyan G et al., revealed a direct correlation between the high fluoride level in drinking water and the increased incidence of dental fluorosis in five endemic Fluorotic areas of Tamilnadu [21]. Dental fluorosis has a high prevalence among children in these brick-tea endemic areas, but skeletal fluorosis does not normally become apparent until adulthood. An 86.5% were found by radiological examination to have developmental skeletal abnormalities in the wrist [22].

Moimaz SA et al., diagnosed fluorosis in 292 (58.9%) children; from these, 220 (44.4%) children were diagnosed with very mild fluorosis, 59 (11.9%) with mild fluorosis, 12 (2.4%) with moderate fluorosis, and 1 (0.2%) child with severe fluorosis [23]. Vilasrao GS et al., reported that Dental and skeletal fluorosis is endemic among children in the surveyed districts of Chhattisgarh State, and is related to drinking water with fluoride content of =1.5 ppm [24].

Temporomandibular disorders (TMD) including abnormal, incomplete, or impaired function of the TMJ, along with a collection of symptoms frequently observed in various combinations were first described by Costen in the 1930s [18] which he guaranteed to be reflexes because of aggravation of the auriculotemporal and/or chorda tympanic nerves as they rise up out of the tympanic plate brought on by adjusted anatomic relations and disorders of the TMJ can lead to loss of occlusal vertical measurement, loss of back tooth support, and/or different malocclusions. The manifestations can likewise incorporate headache about the vertex and occiput, tinnitus, pain around the ear, impaired hearing, and painful tongue. Buyukkaplan et al., inferred that clinical and radiological examination of TMJ in DF patients in his study demonstrated no huge difference from the control subjects without DF [18].

CONCLUSION

Based on the results, it was concluded that dental fluorosis & clinical features of skeletal manifestations showed association with TMJ signs & symptoms. The findings of this study are alarming and entailing further investigations with advanced diagnostic procedures for skeletal fluorosis to establish measures for prevention and treatment. General skeletal fluorosis directly affects the economy of villagers in the areas studied, by causing illness and debilitation in humans. Hence, provision of defluoridated drinking water and health education aimed at abating fluorosis are highly desirable in these districts of Rajasthan. High fluoride content in the sources of drinking water is the main reason for dental fluorosis, suggesting an urgent need for defluoridation of water sources.

LIMITATIONS

Skeletal fluorosis was assessed only by examining clinical features and radiographic examinations of the study participants was not performed due to large sample size & lack of feasibility to the nearby hospital.

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