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Prevalence of Fluorosis in 5-12 Year-old Children in the North-Western Villages of Makoo in 2004

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Abstract

Background and aims. Fluorosis is defined as a sort of enamel hypocalcification. Clinical features of fluorosis vary from thin white lines on the enamel to chalky and opaque enamel. The enamel may be destroyed after tooth eruption. Various prevalence rates have been reported in different populations. Major contributing factors are temperature, altitude and hygienic trends. The aim of this study was to evaluate the prevalence and severity of fluorosis in 5-12 year-old children in the North-Western villages of Makoo.

Materials and methods. A total of 58 children aged between 5 and 6, and 421 students aged between 7 and 12 from the North-Western villages of Makoo were selected. Dean Index was used to evaluate the prevalence of fluorosis in the primary and permanent dentition. To compare the severity of fluorosis in the maxilla and mandible and also to assess the coordination rate of fluorosis in the left and right sides of the jaw, TF Index was used. TSIF was used to compare fluorosis rate in different tooth surfaces. Discoloration prevalence and rate were compared between maxillary and mandibular incisors. Chi-square test and t-test were used to analyze the results.

Results. Fluorosis rate in the primary and permanent dentition was 100%. According to TF Index, the highest coordination rate was observed in mandibular incisors and the least was observed in maxillary second molars. The difference in the severity of fluorosis between maxilla and mandible was statistically significant ($p<0.05$). Discoloration rate increased in maxillary central incisors with age.

Conclusion. Very high prevalence rate of fluorosis in the primary and permanent teeth in the North-West of Makoo revealed a major regional problem; therefore, preventive strategies such as informing people of improper use of fluoride-containing supplements and reduction of the fluoride content of drinking water are suggested.

Key words: **Dean Index, Discoloration, Fluorosis, TF Index, TSIF.**

Introduction

Fluoride is found in water, soil, stone and even in air dust. Previous studies on the relationship between the fluoride content of water and tooth formation anomalies led to the discovery of the role of this element in caries prevention.[1] Fluourosis is defined as a sort of enamel hypocalcification. It occurs as a result of fluoride over-absorption during tooth calcification and maturation. Clinical features of flourosis vary from thin white lines on the enamel to chalky opaque enamel. The enamel may be destroyed immediately after tooth eruption.[1, 2]

The first epidemiological survey into fluorosis was carried out by Dean. The main indices for fluorosis evaluation are: Dean TF (Tooth Fluorosis) and TSIF (Tooth Surface Index of Fluorosis).[3] Dean revised his index in 1942 and this revised index is known as WHO Index. Dean also developed an index to compare the severity and type of flourosis in different populations. This Index is known as FCI (Community Index of Fluorosis).[4] FCI lower than 0.4 is not clinically important but 0.6 or more for FCI indicates the onset of a health problem.[3]

Thylstrop and Fejerskov developed another index to classify the manifestations of dental flourosis according to the histopathological changes of enamel. This index is known as TFI.[1] TSIF, the latest index of fluorosis, is based on the evaluation of different tooth surfaces.[5] TSIF provides differentiation between isolated pits, continuous pits and also discoloration and pit-related discolorations. TSIF increases sensitivity of diagnosis in populations with severe fluorosis.

Various prevalence rates have been reported in different populations. Major factors contributing to this varying prevalence rates are regional temperature, altitude and nutritional and hygienic trends. Reports on fluorosis prevalence in the United States, Tanzania and Senegal depict a prevalence rate up to 100% .[6] In Iran in some regions such as Larestan and Bandar Lengeh fluorosis prevalence is high (up to 67%).[7]

Due to limited cross-sectional studies on fluorosis in Iran, the present study was carried out to evaluate the prevalence of fluorosis and to determine the type of fluorosis in the North-Western villages of Makoo.

Materials and Methods

A questionnaire was designed in two pages and filled out by asking parents a number of questions and by examining the subjects. The subjects consisted of 58 children aged between 5 and 6 and 421 students aged between 7 and 12, selected randomly from school classes. In the first step a dentist and an examiner briefed the students on oral health and the research to be carried out, considering their young age. Then the parents answered the questions. Finally, examination was carried out in one of the classrooms under natural daylight. Tongue depressors and sterile gauze (to clean tooth surfaces), sterile examination sets and disposable gloves were used and a hand-held torch was also used to examine the posterior segments of the oral cavity. Fluorosis was detected by Dean Index and the highest Dean Index seen at least in two teeth was recorded. TF Index for central incisors, canines, second premolars and also for the first and second molars for both the left and right sides and TSIF for two posterior teeth were recorded.
Discoloration was classified and scored as follows:

0 Normal enamel
1 White chalky spots
2 Yellow spots
3 Brown sports
4 Dark brown spots

The fluoride content of drinking water in the region was 3 ppm. Prevalence and fluorosis type were determined in the subjects and the prevalence of fluorosis was estimated with a confidence interval of 95%. To compare dental fluorosis rates in different groups chi-square test was used and to compare the prevalence of fluorosis between boys and girls t-test was used.

Results

The results of the survey demonstrated 100% fluorosis prevalence in the primary dentition. Differences between boys and girls in fluorosis prevalence and also fluorosis

type in the primary dentition were not statistically significant according to t-test ($p>0.05$). The most prevalent form of fluorosis in the primary teeth was the mild form (63% for boys and 87.1% for girls) and the least prevalent form was the severe form (3.2% for boys and 0% for girls) (Figure 1). FCI was 1.88 for boys, 1.93 for girls and 1.9 for the primary dentition in this population.

Evaluation of fluorosis in the permanent dentition demonstrated 100% prevalence in both boys and girls. The most prevalent form in the permanent teeth was the moderate form (44% for total population). Boys had higher prevalence of moderate form in comparison with girls (44.8% versus 42.5%) and conversely, mild form was more prevalent in girls in comparison with boys (38.5% versus 33.9%). A small proportion of the population (5% - 9%) had a very mild degree of fluorosis. Chi-square test did not reveal any significant differences between boys and girls ($p>0.05$) (Figure 2). FCI was 2.6 for boys and 2.5 for girls and 2.55 for total population.

A total of 4308 teeth were evaluated by TF Index. Figure 3 shows TF Index scores for the teeth. A high proportion of teeth (28.8%) revealed a TF score of 3 and a low proportion of teeth (0.9%) had a TF score of 0. Surface enamel had been destroyed in 30.6% of the cases (TF score = 5-9). Almost none of the teeth had normal enamel and severe enamel destruction was observed in 0.2% of the cases (TF score = 9). Figures 4 and 5 depict the TF scores for the teeth in the maxilla and mandible (according to tooth type). Differences between maxilla and mandible were statistically significant based on chi-square test ($p<0.05$). Nearly none of the teeth had normal enamel. The most severely destroyed teeth were upper second molars. Nearly 77.7% of these teeth had TF scores between 5 and 9 and showed surface enamel destruction. The least fluorosis severity was seen in lower central incisors.

Figures 6 and 7 show fluorosis scores in homologous teeth. Central incisors were coordinate in 99.1% of the cases and second molars had the least coordination in 91% of the cases (TF Index).

To evaluate the fluorosis in different dental surfaces and also to determine the time-dependent changes, TSIF was recorded in every individual for two upper and lower first molars.

Figures 8 and 9 demonstrate the absolute and relative TSIF scores in different surfaces of upper and lower first molars. The highest score, and therefore the most affected surfaces in the upper jaw, were observed in palatal surfaces (31.7%, score 6-7), and the least affected were buccal surfaces (7.4%).

In the mandible the highest and lowest scores were seen in the buccal and lingual surfaces. Differences in the maxilla were significant ($p<0.05$). The same surfaces in the upper and lower jaws had different TSIF scores. Palatal surfaces were much more susceptible to destruction in comparison with lingual surfaces (6 times more).

Comparison of discoloration rates in the labial surfaces of central incisors revealed the least degree of discoloration in the lower central incisors (grade 1, 47%) and the highest discoloration rate in the upper central incisors (grade 2, 36.6%).

To evaluate the discoloration severity and changes in the central incisors a cross-sectional survey between two groups was carried out (7 to 9 year-olds and 10 to 12 year-olds). Figure 10 shows the results of this parallel survey. According to this figure, prevalence of grade 4 and grade 3 increases with age. In contrast, prevalence of mild grades decreases with age. Evaluation of these results by chi-square test demonstrated an increase in discoloration severity with age ($p<0.05$).

Discussion

Fluorosis rate in the primary dentition is lower than the permanent dentition.[1-3,8,9] Some contributing factors are:

1)placenta barrier for fluoride,
2)shorter period of maturation for the primary teeth,
3)differences in enamel thickness in the primary and permanent teeth.[3, 8]

In the current study fluorosis prevalence in the primary dentition of 5-6 year-old children in the North-West of Makoo was 100%. Fluorosis prevalence was 69% in the primary dentition in Karaj according to Esmailpour research.[10] Firouzpour reported 100% prevalence in Poldasht with 3 ppm fluoride.[11]

Mann[12] reported that boys are more susceptible to fluorosis, but in the current study no significant differences were found between boys and girls. It has not been proved that flourosis is sex-dependent but nutritional habits, especially breast feeding, play a major role in the prevalence and severity of fluorosis. Infant nutrition has a role in the fluoride content of early-calcifying teeth.[13] Powdered milk has much more fluoride content in comparison with maternal milk.[2,14] Osuji demonstrated that long-term use of powdered milk (13 months or more) increases fluorosis rate.[15]

Recent reports have demonstrated that fluorosis prevalence is on the rise in all societies.[14,17-19] Inappropriate use of fluoride mouthwashes and tooth pastes in children are some reasons for this increase.[16,18-20] Esmailpour reported a higher rate of fluorosis in children following the use of fluoride tablets.

One of the reasons for uncommon fluorosis rate in the tropics is temperature.[2] People in tropical regions drink more water, hence more fluoride intake.[1] In a population in Kenya with 2 ppm drinking water fluoride content, flourosis prevalence was 100% (92% of teeth and TF score of 4).

The same role has been considered for altitude. Fluorosis increases with altitude. The North-Western villages of Makoo are not tropical but have a high altitude, so temperature cannot be considered a contributing factor in this region.

Nutritional conditions and habits, too, affect fluorosis.[1,2] In some developing countries food intake is limited and children eat food just once a day, so fluoride is absorbed via an empty stomach.[2] Studies have reported that fluoride intake via an empty stomach is high[3], so fluoride intake in these children would be higher than children in the developed countries.

Dental fluorosis is a developmental process, so it is inevitable that different teeth will be affected by fluorosis in different stages of their development. Intra-oral pattern of fluorosis is pathognomonic for fluorosis.

The most affected teeth are the teeth which mineralize last (second molars and second premolars); maxillary incisors, canines, first molars and madibular incisors are affected in descending order.[3] This is consistent with the results in the current study.

Coordination pattern of fluorosis in homologous teeth has been demonstrated in various studies. This pattern may differ from one population to another[1], but the highest coordination rate has been reported in mandibular central incisors and the least has been reported in lower second molars and upper molars (50%).

In the present study 94.6% of the teeth had the same TF Index. Coordination between two sides of the dental arch was 4%. Central incisors erupt simultaneously in both sides of the dental arch, so the enamel defects would be the same, but different factors affect eruption of molars and premolars. Early or late loss of any primary tooth may affect the eruption in the corresponding permanent tooth. As a result of poor oral hygiene in the research region, most of the primary teeth are lost before normal exfoliation time. This phenomenon does not occur symmetrically; therefore, lower coordination in fluorosis rate of premolars and canines might be explained. Other important factors are oral and masticatory habits, which influence the clinical pattern of fluorosis after eruption.

Time-dependent changes affect mandibular occlusal surfaces. This might be explained by attritional forces in the mandible. Thylstrup and Fejerskov reported the same changes in occlusal surfaces.[1]

As stated in the "results section", discoloration of maxillary central incisors is more severe compared to mandibular incisors.

Discoloration occurs more severely in lip incompetence because maxillary central incisors dry out and dried surfaces absorb stains more easily and rapidly.[1] This is consistent with previous studies.[10, 11]

Comparison of two groups (7-9 year-olds and 10-12 year-olds) demonstrated an increase in discoloration with age. Fluorosis results in pitted enamel and this pitted enamel is susceptible to stain absorption over years.

Conclusion

Fluorosis prevalence was 100% in the North-Western villages of Makoo, so it is a major regional problem. Mental and physical

problems happen following this high prevalence. Therefore, caution should be exercised when different forms of fluoride are administered and the local residents should be instructed in this respect. Defluoridization of water using Alumina filters or Bonechar coal is also suggested.

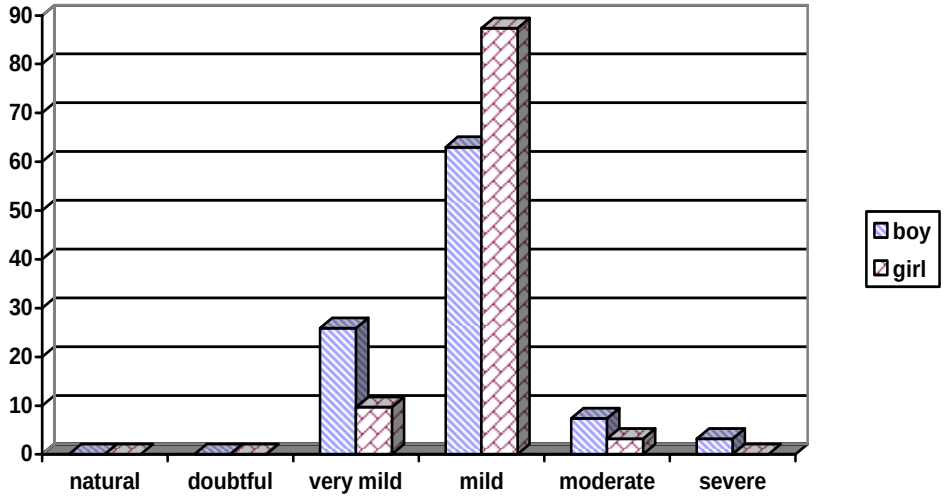

Figure 1. Relative frequency of Dean Index scores in primary dentition in boys and girls.

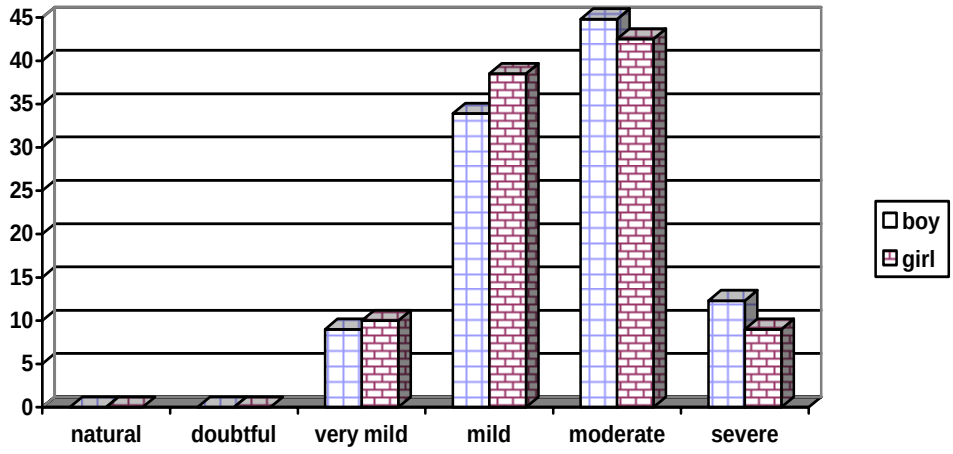

Figure 2. Relative frequency of Dean Index scores in the permanent dentition in boys and girls.

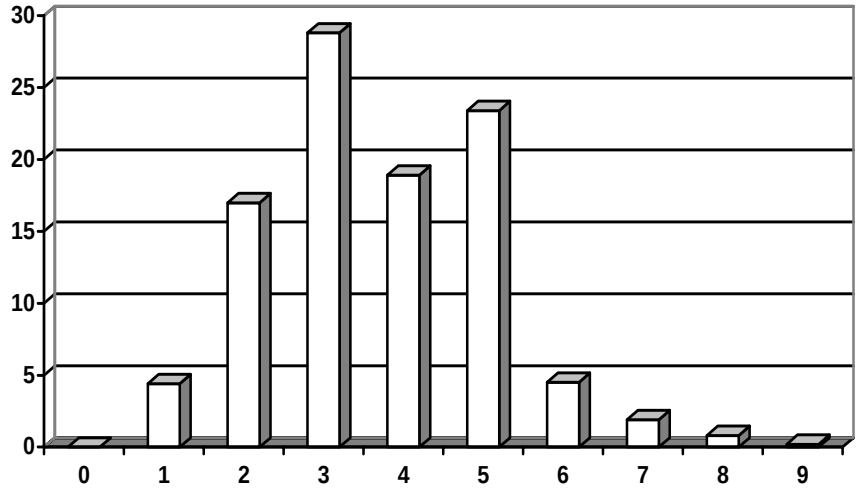

Figure 3. Relative frequency of TF Index scores in the subjects.

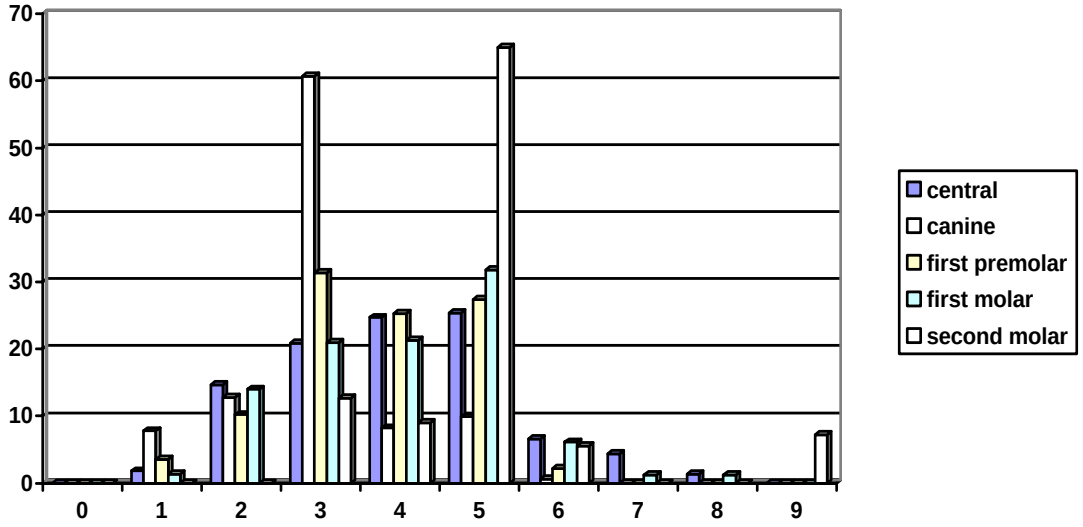

Figure 4. Relative frequency of TF Index scores in the maxilla.

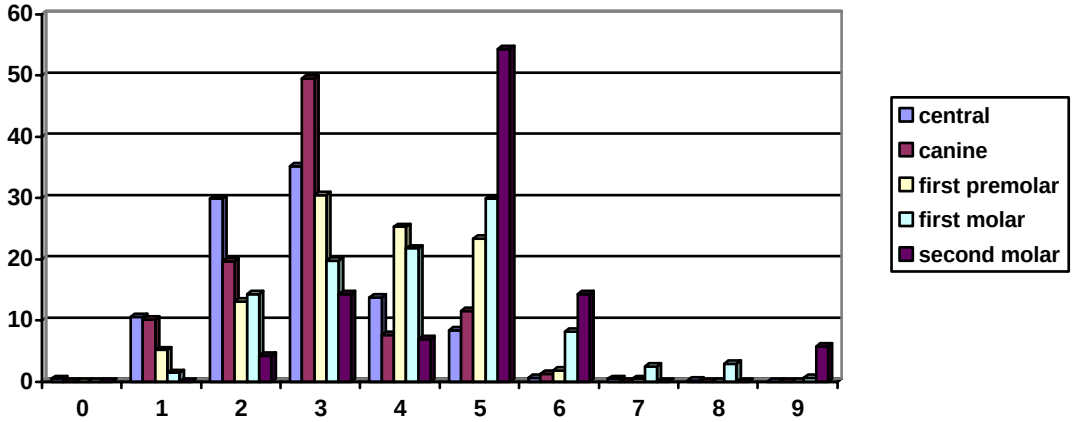

Figure 5. Relative frequency of TF Index scores in the mandible.

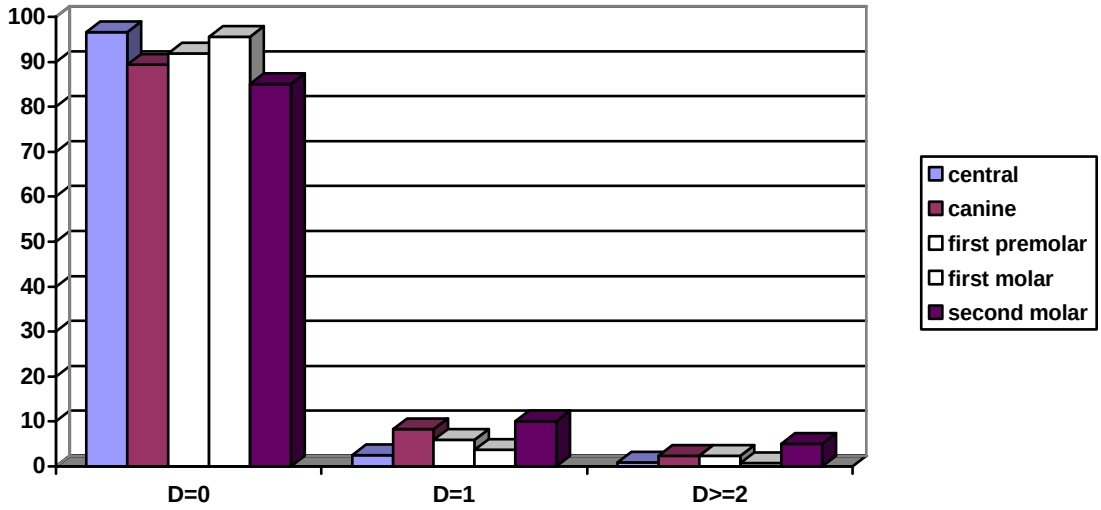

Figure 6. Fluorosis coordination scores of homologous teeth in the maxilla.

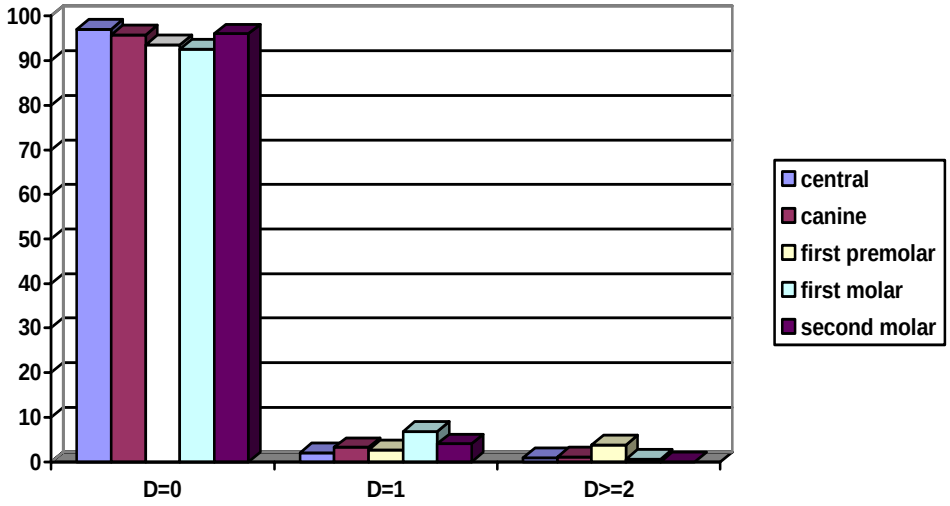

Figure 7. Fluorosis coordination scores of homologous teeth in the mandible.

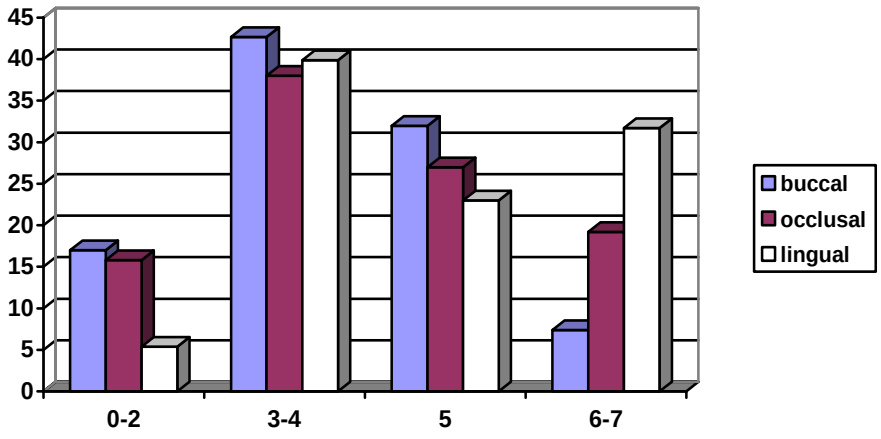

Figure 8. Distribution of TSIF scores in different surfaces of homologous teeth in the mandible.

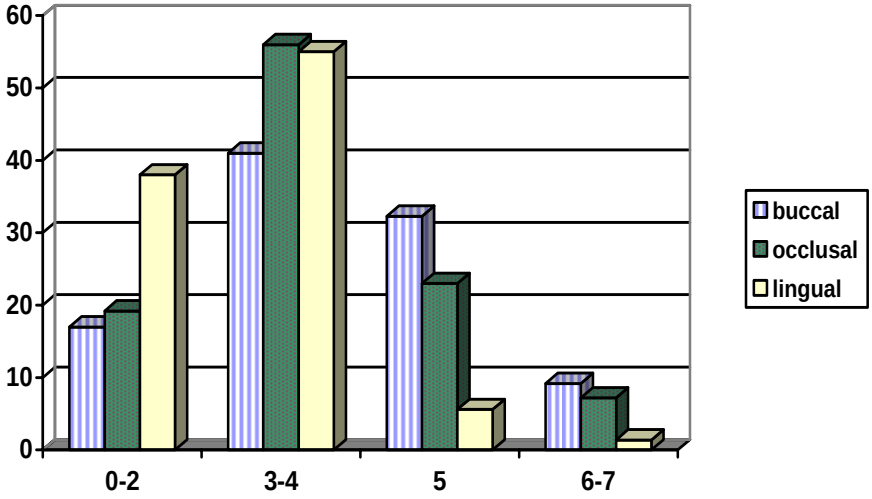

Figure 9. Distribution of TSIF scores in different surfaces of lower first molars.

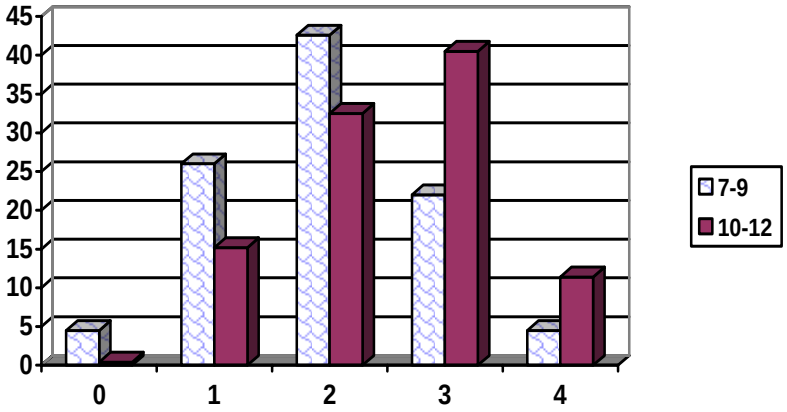

Figure 10. Relative frequency of staining in the upper central incisors in two groups (7-9 year-olds and 10-12 year-olds).

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