A SIMPLE AND INEXPENSIVE METHOD OF TREATING FLUOROSED TEETH

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ABSTRACT

Unaesthetic staining due to increased fluorides called flourosis manifests as a yellow to dark brown stain on the front teeth. These stains can have a severe psychological impact on the patient concerned. This condition is quite common in Sri Lanka, specially in the North Central Province, where the prevalence rate is 55 - 77% in the 7 to 20 year old school going children.

Although treatment procedures such as constructing jacket crowns, veneering and composite restorations are carried out in the western world which are exorbitantly expensive, an average person in Sri Lanka, especially in the affected farmer families can hardly afford this kind of sophisticated expensive treatment. Therefore, the purpose of this study was to develop a simple and inexpensive method of treatment, for fluorosis, which could be ideal for the Sri Lankan situation.

Ten different treatment methods were tried out using a weaker and a relatively stronger acid with or without a bleaching agent. 18-36% hydrochloric acid with or without the bleaching agent gave satisfactory results. It was also noted that the concentration of the hydrochloric acid had to be increased when the mottling was severe in order to obtain satisfactory results.

This is a very simple and inexpensive method of treating dental fluorosis especially suitable for a developing country like Sri Lanka.

INTRODUCTION

Dental fluorosis occurs when water containing excessive amounts of fluoride is consumed during the developmental stage of teeth. (Dean, Arnold and Elove, 1942, Moller, 1982).

Dental fluorosis is manifested as an unsightly stain on the otherwise white and glossy enamel surface of the permanent tooth. Depending on the severity, this can take the form of a yellow or a brown or a black stain. The unaesthetic appearance thus caused can subject the persons affected with this condition to a severe psychological impact and a state of depression since this may equally harm the appearance, as with the other disfiguring conditions in the oro-facial region such as cleft lip, facial scars and other developmental facial deformities (Welbury and Shaw, 1990).

Black and Mckay (1916) reported endemic dental fluorosis for the first time. Later, Smith (1931) discovered the causative agent. Dean (1934) demonstrated an association between dental fluorosis and high levels of fluoride in drinking water. He also put forward an index, now referred to as the Dean's index, in order to

assess the severity of fluorosis in the dentition (Dean 1934). Subsequently, Dean and McKay (1939) and Dean, Arnold and Elove (1942), after conducting studies in the United States of America concluded that high levels of fluoride in the drinking water caused severe mottling of teeth.

Endemic dental fluorosis shows a global pattern of distribution (WHO Monograph 1970). It has been reported in India, China , Denmark , United Kingdom , United States of America and Canada among many other countries. In Sri Lanka too, endemic dental fluorosis has been reported specially in the north central province, where the prevalence rate reported is 55% to 77% in 7 to 20 year old school children (Seneviratne et al. 1973 and 1974). Galewela in the Matale district, Kekirawa in the Anuradhapura district, and Wariyapola in the Kurunegala district has also been reported as areas showing endemic dental fluorosis with a prevalence rate of over 50% (Warnakulasuriya, Balsuriya and Perera, 1990). In addition, Embilipitiya in the Ratnapura district has also been identified as an endemic area for dental fluorosis (Abayaratna 1989/90). All aforementioned areas have been shown to contain high levels of fluoride in the drinking water (Dissanayake 1982, Raghava Rao et al. 1987).

It has been shown that the minimum threshold value of fluoride in drinking water at which a change appeared was 1.0 to 1.1 ppm (parts per million). When this level exceeds 1.4 to 1.6 ppm, a serious aesthetic change may occur on the enamel of the teeth (Forrest,1956). Nevertheless, this so-called safe fluoride level is dependent upon the mean annual temperature of the area, which, in turn, reflects the amount of water consumption by the individual.

Although, fluoride has toxic effects when it is consumed in excess amounts, it is considered an important ingredient for the prevention and control of dental caries. Increased fluorides in the drinking water, and the mottling of teeth associated with this increase of fluoride, at the same time, has shown a low caries prevalence in the permanent teeth (Dean, Arnold and Elove, 1942, Moller, 1982). This is due to the fact that the fluoride ion by replacing the hydroxyl group of the hydroxyapatite crystal of the enamel, makes it harder and thereby less soluble to acids. (Issac et al. 1958, Fejerskov, Thylstrup and Lurson, 1981, Weatherall, Robinson and Strong, 1984). In addition, available evidence now suggests that the main action of fluorides in the prevention of dental caries is to promote remineralisation of the initial carious lesion (Mellberg, 1977, Fejerskov,Thylstrup and Lurson, 1981, Silverstone, 1984).

Since the prevalence of dental caries is reduced in areas where there is high fluoride in the drinking water(Dean,Arnold and Elove, 1942) and the optimum level of fluoride in drinking water to bring about a reduction of dental caries, is one part per million, without a manifestation of dental fluorosis (Dean, Arnold and Elove, 1942, Moller,1982), it was suggested to introduce community water fluoridation at 1ppm, for temperate countries and 0.7 ppm for tropical countries, as a measure for reducing dental caries. The first community water fluoridation scheme was implemented in Grand Rapids, USA in 1945 and was followed by other large-scale schemes in North America (Murray and RuggGun, 1982). There is no doubt at present that community water

technique causes a lot of pain and discomfort for the patient it has not gained any popularity. In addition, the results seem to be temporary. Chandra and Chawla (1975) reported a sand paper disc method for removing fluorosis stains from teeth. A bleaching solution consisting of 5 parts hydrogen peroxide (30%), 5 parts hydrochloric acid (36%) and one part of anaesthetic ether (5.25%) was applied on the stained teeth. Then a fine sand paper disc rotating at a speed of 1000-2000 rpm was used on the labial enamel surface. This method causes an appreciable loss of the mesiodistal curvature of the labial enamel and requires treatment more than once in some cases. Furthermore, McCloskey (1984) criticised the usage of the rotating sand paper disc and pointed out the disadvantage of cupping out of the enamel surface, of the treated teeth.

Therefore, the present study was designed and undertaken in order to explore a simple and inexpensive method of treatment for dental fluorosis that can be practised without much difficulty in Sri Lanka, in order to serve the patients living in rural areas, where easy access to sophisticated dental treatment is not readily available.

MATERIALS AND METHODS

This research project was formulated in order to find answers for the following .

1. To evaluate the effectiveness of a weaker acid which is freely available in Sri Lanka.
2. To evaluate the effectiveness of a relatively stronger acid which is freely available in Sri Lanka.
3. To evaluate the effectiveness of a bleaching agent, freely available in Sri Lanka
4. To evaluate the usage of non-toxic concentrations of reagents to make it easy to use in the Sri Lankan setting.

It was decided to use orthophosporic acid as the weaker acid , hydrochloric acid as the relatively stronger acid and hydrogen peroxide as the bleaching agent. Decision to use orthophosporic acid was based on the fact that 37% orthophosporic acid is used in dentistry extensively as an etching solution. In a study conducted by Smith and McInnes (1942), it was shown that the main ingredient present in most of the stain removing solutions available in the market at that time was hydrochloric acid. Hence, the decision to use hydrochloric acid as the relatively stronger acid. Apart from this, a laboratory study carried out by Wellbury and Shaw (1990) , clearly showed that the enamel loss when 18% hydrochloric acid was rubbed on sound enamel for over a period of 75 seconds was similar to a etching reaction, with phosphoric acid as reported by Silverstone et al. (1975). This justifies the usage of both hydrochloric acid and orthophosporic acid as the test reagents in the present study. In addition, 18% hydrochloric acid had been used by other workers with various other combinations as mentioned earlier (McClosky, 1984, Croll and Cavanaugh, 1986).

Therefore, in this study , ten treatment methods formulated on the above criteria were carried out and assessed.

DIFFERENT EXPERIMENTAL METHODS

Method 1

(a) Application of 37% orthophosporic acid on the labial surface of the experimental tooth and leave for two minutes for the acid to act
(b) Wash off with water for 30 seconds and polish with pumice, made into a slurry with water, using rubber cup and a slow rotating hand piece at 1000-2000 rpm
(c) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 2

(a) Application of 37% orthophosporic acid on the labial surface of the experimental tooth - leave for four minutes
(b) Wash off with water for 30 seconds and polish with pumice, made into a slurry with water, using rubber cup and a slow rotating hand piece at 1000-2000 rpm
(c) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 3

(a) Application of 37% orthophosporic acid on the labial surface of the experimental tooth - leave for two minutes
(b) Wash for 30 seconds with water
(c) Application of 10% hydrogen peroxide solution on to the labial surface of the experimental tooth - leave for five minutes
(d) Wash off with water for 30 seconds and polish with pumice, made into a slurry with water, using rubber cup and a slow rotating hand piece at 1000-2000 rpm
(e) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 4

(a) Application of 37% orthophosporic acid on the labial surface of the experimental tooth - leave for four minutes
(b) Wash for 30 seconds with water
(c) Application of 10% hydrogen peroxide solution on to the labial surface of the experimental tooth - leave for five minutes
(d) Wash off with water for 30 seconds and polish with pumice, made into a slurry with water, using rubber cup and a slow rotating hand piece at 1000-2000 rpm
(e) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 5

(a) A 9% solution of hydrochloric acid made into a slurry with pumice, rubbed on the labial surface of the experimental tooth. A serrated metal instrument with a little cotton wrapped at the end was used to rub the slurry on the tooth surface
(b) Continue rubbing for forty seconds
(c) Wash for 30 seconds with water
(d) Step (a), (b) and (c) repeated for a maximum number of five times until

an improvement is seen

(e) Polish with pumice ,made into a slurry with water, using rubber cup and a slow hand piece at 1000-2000 rpm. as previously done in Method 1

(f) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 6

(a) A 18% solution of hydrochloric acid made into a slurry with pumice, rubbed on the labial surface of the experimental tooth, using the same device used in Method 5, Step (a)

(b) Continue rubbing for forty seconds

(c) Wash for 30 seconds with water

(d) Step (a), (b) and (c) repeated for a maximum number of five times until an improvement is seen

(e) Polish with pumice, made into a slurry with water, using rubber cup and a slow hand piece at 1000-2000 rpm. as previously done in Method 1

(f) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 7

(a) A 36% solution of hydrochloric acid, made into a slurry with pumice, rubbed on the labial surface of the experimental tooth using the same device as stated in Method 5, Step (a)

(b) Continue rubbing for forty seconds

(c) Wash for 30 seconds with water

(d) Step (a), (b) and (c) repeated for a maximum number of five times until an improvement is seen

(e) Polish with pumice, made into a slurry with water, using rubber cup and a slow hand piece at 1000-2000 rpm. as previously done in Method 1

(f) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 8

(a) A 9% solution of hydrochloric acid made into a slurry with pumice, rubbed on the labial surface of the experimental tooth. A serrated metal instrument with a little cotton wrapped at the end was used to rub the slurry on the tooth surface

(b) Continue rubbing for forty seconds

(c) Wash for 30 seconds with water

(d) Application of 10% hydrogen peroxide solution on to the labial surface of the experimental tooth - leave for five minutes

(e) Wash off with water for 30 seconds

(f) Repeat steps a,b,c,d and e for a maximum number of 5 times until and improvement is seen

(g) Polish with pumice made into a slurry with water using rubber cup and a slow hand piece at 1000-2000 rpm, as previously done in Method 1, Step (b)

(h) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 9

(a) A 18% solution of hydrochloric acid made into a slurry with pumice, rubbed on the labial surface of the experimental tooth, using the same device used in Method 5, Step (a)
(b) Continue rubbing for forty seconds
(c) Wash for 30 seconds with water
(d) Application of 10% hydrogen peroxide solution on to the labial surface of the experimental tooth - leave for five minutes
(e) Wash off with water for 30 seconds
(f) Repeat steps a,b,c,d and e for a maximum number of 5 times until and improvement is seen
(g) Polish with pumice made into a slurry with water using rubber cup and a slow hand piece at 1000-2000 rpm, as previously done in Method 1, Step (b)
(h) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

Method 10

(a) A 36% solution of hydrochloric acid, made into a slurry with pumice, rubbed on the labial surface of the experimental tooth using the same device as stated in Method 5, Step (a)
(b) Continue rubbing for forty seconds
(c) Wash for 30 seconds with water
(d) Application of 10% hydrogen peroxide solution on to the labial surface of the experimental tooth - leave for five minutes
(e) Wash off with water for 30 seconds
(f) Repeat steps a,b,c,d and e for a maximum number of 5 times until and improvement is seen
(g) Polish with pumice made into a slurry with water using rubber cup and a slow hand piece at 1000-2000 rpm, as previously done in Method 1, Step (b)
(h) Application of non-acidulated fluoride gel on the labial surface of the tooth for three minutes.

SELECTION OF PATIENTS

Patients with mottled teeth were screened and classified according to the level of mottling. To make it convenient for this study a clinically oriented classification modified after Chandra and Chawla (1975) and McClosky (1984), was used. The classifications is as follows.

Grade I	**- Mild**	- presence of white spots; aesthetically acceptable.
Grade II	**- Moderate**	- yellow or light brown staining, no pitting on the surface enamel

Grade III - **Moderately Severe** - dark brown or black staining, no pitting on the surface enamel.

Grade IV - **Severe** - stains plus, pitting on the surface enamel.

In addition, a well prepared questionnaire was completed for each patient who participated in the study and a file which included other information such as, photographs both preoperative and postoperative for each patient. Before the commencement of the experimental procedure, oral hygiene instructions were delivered to the patient and to the parents in order to promote good oral hygiene habits. Immediately prior to the experimental procedure, prophylactic procedures were performed for all subjects, this was followed by polishing, with a rubber cup with pumice made into a slurry with water in a slow rotating hand piece with 1000-2000 rpm. Intra-oral colour photographs were taken using two cameras: one camera for colour prints and the other camera for colour slides. These same two cameras were used throughout the study. The same location, with the same light source and the same aperture setting specified in the camera was adhered to when taking all the photographs. After the treatment procedure was over, similar postoperative photographs were taken immediately. Similar photographs were repeated once again after three months and six months after treatment. Comparison of the first and second photographs will help to assess the validity of the success of a particular treatment procedure (treatment method). Comparing the second, third and the fourth photographs will help to assess the long-term follow up. The success of the technique, presence or absence of recurrence, degree of improvement and patients perception was scored.

The following were adhered to when carrying out the experimental procedures.

1. The experimental teeth were isolated with rubber dam
2. For methods 5 to 10, the patients , nurses and the operator used protective eye glasses (goggles) and gloves
3. Sodium bicarbonate made into a paste with water was available at hand in order to neutralise the effect of the acid in case the acid contaminated the skin or other soft tissues. This paste was also applied on the rubber dam in order to protect against inadvertent splashing of the hydrochloric acid
4. Each experimental tooth was subjected to a vitality test with the electric pulp tester, before , and immediately after the bleaching procedures
5. Vitality of the experimental teeth was carried out at 3 months and 6 months, during the follow up visits.

APPEARANCE BEFORE TREATMENT

Fig. 1. A 27 year old female from Kekirawa, who had lived there from birth. There is dental fluorosis, showing unaesthetic brown discolouration beginning from the upper right lateral incisor tooth to the upper left lateral incisor tooth. The maxillary central and lateral incisors show Grade III (moderately severe) fluorosis, while the maxillary canines show Grade I (mild) fluorosis.

APPEARANCE IMMEDIATELY AFTER TREATMENT

Fig. 2. The same patient shown in Fig. 1, immediately after the treatment of $\underline{21|12}$ using. Method 10, with 36% hydrochloric acid, followed by 10% hydrogen peroxide. Note: the brown discolouration on the treated central and the lateral incisors have been completely removed. There was no recurrence of the brown stain even after one year, and the treated teeth remained vital.

APPEARANCE BEFORE TREATMENT

Fig. 3. A 13 Year old female from Ampara, suffering from dental fluorosis. She had lived in Ampara throughout her life. Note: the unaesthetic brown discolouration on the maxillary central incisors that show grade III (moderately severe) fluorosis, while the maxillary lateral incisors show grade II (moderate) fluorosis. The lower front teeth fall into grade I (mild) category.

APPEARANCE IMMEDIATELY AFTER TREATMENT

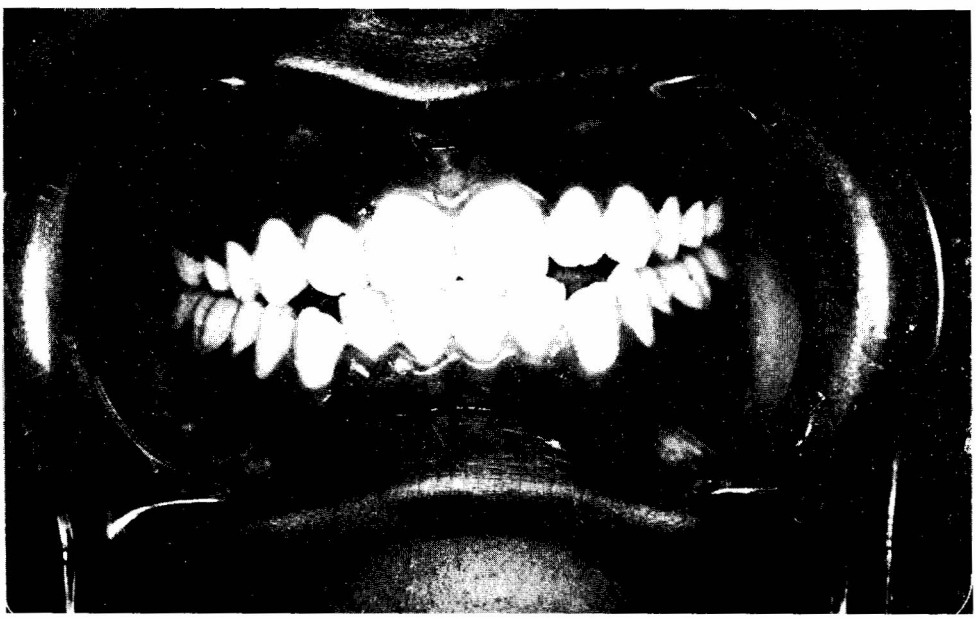

Fig. 4. The same patient shown in Fig. 3, immediately after treatment of $\underline{1|1}$ using. Method 7, with 36% hydrochloric acid. Note: the brown discolouration on the treated central incisors have been completely removed. There was no recurrence of the brown stain, even after one year, and the treated teeth remained vital.

RESULTS AND DISCUSSION

Usage of 37% orthophosporic acid did not give satisfactory results. Out of the ten different techniques tried, the technique that incorporated a relatively stronger acid with or without the hydrogen peroxide (method 10 and 7) gave satisfactory results. When the severity of the discoloration of dental flourishes was more, the concentration of the relatively stronger acid used, also had to be increased. 9% hydrochloric was not very effective except for very mild cases. Usage of 18% hydrochloric acid gave satisfactory results in moderately effected cases while moderately severe cases of mottling gave better results with a higher concentration of the hydrochloric acid , that ranged from 18 to 36% (Figures 1,2 ,3 and 4).

Figure 1. shows a 27 year old female from Kekirawa, who had lived there from birth, and suffering from dental fluorosis showing discoloration from the maxillary right lateral incisor tooth to the maxillary left lateral incisor tooth. The upper central and lateral incisors show Grade III (moderately severe) fluorosis, while the maxillary canines show Grade I (mild) fluorois. The same patient in Figure 1, is seen in Figure 2, immediately after treatment of $\underline{21|12}$ using method 10, with 36% hydrochloric acid, followed by 10% hydrogen peroxide. Note: that the brown discoloration on the central and the lateral incisors have been completely removed. There was no recurrence of the brown stain even after one year, and the treated teeth remained vital.

In Figure 3. a 13-year-old female patient from Ampara suffering from dental fluorosis is shown. She had lived in Ampara throughout her life. Note that the unaesthetic brown discoloration on the maxillary central incisors that show Grade III (moderately severe) fluorosis, while the maxillary lateral incisors show Grade II (moderate) fluorosis. The lower front teeth fall into Grade I (mild) category. The same patient in Figure 3. is seen in Figure 4. immediately after treatment of $\underline{1|1}$, using method 7, with 36% hydrochloric acid. Note: that the brown discoloration on the treated central incisor have been completely removed. There was no recurrence of the brown stain even after one year, and the treated teeth remained vital.

However, in some cases where the discoloration was very severe, the removal of the stain was not hundred percent, although some improvement from the original condition was seen. None of the teeth subjected to this technique lost their vitality immediately after the bleaching procedures or three to six months later. It is noteworthy to mention that none of the patients complained of any discomfort during or after the treatment procedure.

CONCLUSIONS

This study clearly shows that an application of a 18-36% hydrochloric acid on moderately discoloured teeth due to fluorosis is capable of removing the unsightly brown stain. The method described here is a much simpler and a less expensive method. This method could be carried out in any part of Sri Lanka by a dental surgeon. This method could bring immense relief to poor income groups, who cannot afford sophisticated and expensive treatment.

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