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Microabrasion and Bleaching In Treatment of Dental Fluorosis among Sudanese Children

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FDSRCs (Ed) FDSRCPS (Glasg)
Dedication

To all members of my family (father, mother, brothers, sister, husband and my brother in law) for their encouragement and support and for coping with me during difficult times particularly the long hours this work required both in and out door.
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Abstract

Dental fluorosis is a fairly common condition in the Sudan, with a high prevalence in certain geographical areas. Dental fluorosis induces discoloration and changes the appearance of teeth. It has great psychological impact on affected individuals. Different techniques have been advocated for improvement of the appearance of fluoritic teeth, the most common techniques are bleaching and microabrasion. Although both bleaching and microabrasion were reported to be effective in removal of fluorosis stain, studies comparing their efficiency are lacking. This study was conducted to compare the efficiency of bleaching and microabrasion techniques on teeth with moderate dental fluorosis of 44 school children aged 9-11 years in Abou-grown area in Khartoum state. The children were divided into two treatment groups, in one group microabrasion was performed while the other group received bleaching with 30% hydrogen peroxide. The results of the study showed that both bleaching and microabrasion are effective in decreasing stain on teeth affected by fluorosis, but microabrasion is better compared to bleaching in removing the stain P= 0.001.
ملخص البحث

مرض حالات تبقي الأسنان الناتجة عن زيادة تركيز مادة الفلور
ينتشر في السودان، وفي بعض المناطق الجغرافية هنالك زيادة في عدد
حالات الإصابة بهذه الحالة. منطقة أبو قرون حيث أجريت هذه الدراسة
تعتبر واحدة من هذه المناطق. هنالك طرق مختلفة تستعمل لعلاج هذه
الحالة (تبييض الأسنان) طريقة التبييض بالبرد والتبييض بالمواد الكيميائية
من أكثر الطرق التحفظية التي تستعمل في العلاج.

ليست هناك دراسات مقارنة لهاتين الطريقتين أو أي طرق علاجية
أخرى عند مراجعة البحوث المتاحة. هذه الدراسة التي قمنا بها تعتبر
الأولى من نوعها في السودان.

ومن أهدافها الأخرى محاولة معرفة مدى فعالية هاتين الطريقتين
العلاجيتين.

أجريت هذه الدراسة على مجموعة مكونة من (44) طالب تتراوح
أعمارهم بين التاسعة والثانية عشر قسمت لمجموعتين متساويين في العدد.
22 في كل مجموعة، وكل منها تحتوي على أربعة عشر من أناث وثمانية
ذكور كلهم يسعون من درجة تبقي متوسطة، وتم اختيار القاطعين
الأمامي العلويين للمعالجة.

أحد المجموعتين عولجت بطريقة برد سطح الأسنان الكيميائي
(حامض الهيدرو كلوروك) 18% والأخرى بطريقة التبييض الكيميائي
باستعمال ماء الأكسجين 30%).

التحليل الإحصائي لنتائج البحث أوضح أن الطريقتين العلاجيتين
فعالتين، بدون وجود اكتراث في الاحتمالية قبل وبعد المعالجات.
من النتائج المفاجئة وجدنا أن معظم التحسين الذي ظرّا في طريقة
استعمال ماء الأكسجين حدد بعد الزيارة الأولى ولم يطرأ أي تحسن يذكر
بعد الزيارات التالية (عادة تتم المعالجة بماء الأكسجين في ثلاث زيارات
متتالية). وجدنا التبضّب عن طريق البرد أفضل من طريقة التبضّب بإضافة
ماء الأكسجين، كل المرضى الذين عولجوا بالبرد استجابوا بدرجات
متفاوتة وفي حوالي 59.1% منهم اختفت آثار التلوين تماماً، وهذا
الاختلاف استمر طوال مدة الدراسة أما بطريقة التبضّب بالماء النقي فقد
حدث الاختفاء الكلي للون في حوالي 9.1% من الحالات والعدد الكلي للذين
استجابوا للعلاج بهذه الطريقة لم يتعد الـ 45.5%.

نوصي بعمل دراسات أخرى لمحاولة معرفة وجود علاقة إيجابية
بين عدد الزيارات والنتيجة النهائية عند استعمال طريقة التبضّب بماء
الأكسجين يمكن أن تكون مفيدة جداً.

نوصي أيضا بعمل دراسات مشابهة باستعمال طريقة البرد عند
البالغين لمعرفة إمكانية حدوث نتائج إيجابية مشابهة لما وجدناه في استعمال
هذه الطريقة مع الأطفال.
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Chapter One

Introduction

&

Literature Review
INTRODUCTION

Dental fluorosis is a condition in which defective enamel formation occurs as a result of excessive fluoride intake during tooth formation.

Its clinical appearance reflects a spectrum of changes on the crown ranging from perceptible white striae or diffuse opacities to generalize opaque and chalky appearance with confluent pitting and staining of hypomineralized fissures.

There is a wide accepted evidence suggesting that the prevalence of dental fluorosis has increased considerably over the past few decades (1). This increase in prevalence has been reported in populations whose water supply is fluoridated and in those who are not (1). In Sudan a high prevalence of dental fluorosis has been reported especially in Western statues, and in Khartoum in areas of Gubal Awalia, Alsrorap, Trait Elbigia and Abou grown (1)

The defective enamel formation and subsequent discoloration seen in dental fluorosis has great psychological impact on affected individuals. Over the years many techniques have been advocated for treatment of dental fluorosis. This ranges from conservative bleaching procedures to the extensive crown preparations.

A relatively new simple conservative technique had started to gain popularity in the treatment of fluorosis. This technique is microabrasion, which was first advocated by (2) and later modified
by (3). When compared to bleaching microabrasion is simple, time saving, and a safe procedure, however no evidence was found in the literature for a direct comparison of their efficiency in removing fluorosis stain. This study was conducted to compare the efficiency of bleaching and microabrasion techniques in removing fluorosis stain.
LITERATURE REVIEW

1.1. Dental Fluorosis:

The term dental fluorosis is applied to pathological conditions affecting teeth and related to excessive exposure to fluoride. Many definitions have been proposed by different authors (4). Dental fluorosis is defined as specific disturbances of tooth formation caused by excessive intake of fluoride during the formative period of dentition. (5) suggested the following comprehensive definition, that dental fluorosis refer to a defect in the formation of enamel, induced by excessive fluoride intake in the proximity of developing tooth during secretary and or maturation phase of the enamel. The severity and distribution of fluorosis depend on the concentration and duration of exposure to fluoride, stage of ameloblast activity and individual susceptibility. (6) suggested that disturbance of tooth enamel formation caused by fluoride present in tissue fluid over prolonged period during tooth development.

1.2. Historical background:

Kuhns in Mexico first reported mottling of teeth in 1888. When professor Stefano Chiaie observed the condition and related it to the geological condition (7) documented the first case of mottled enamel in a public health reports. (8) recognize the condition, which was, then named Colorado Brown Stain. Later black & McKay gave, the name mottled enamel. They described the condition as
endemic and related to certain geographic areas, in 1920s McKay reached a conclusion that the causative elements must be unknown constituent in the water supply of the same community. 

(9) experimentally reported the relation between fluoride in drinking water and something-analogous to mottling of teeth in rats. (9) and (8) and Black published the relation between caries reduction and fluoride concentration. In the year 1930 experimental animals and epidemiological studies established for the first time the causal association between the level of fluorides in drinking water and mottled enamel (which was referred to as dental fluorosis).

These findings eventually led to the discovery of correlation between fluoride content of drinking water and the presence of dental fluorosis (10,11), (12) developed a classification for mottled enamel; he also used a community index for fluorosis.

In the years 1934, 1938a, &1938b& 1942 (12,13,14) who was considered father of fluoridation referred to mottled enamel as fluorosis and considered fluoride in amount above I.P.Pm (1mgfluoride/Liter water) to be the cause of the condition.

In these epidemiological studies Dean also proved the inverse relationship between the prevalence of dental caries and the fluoride contents of drinking water. During the period 1944-1947 fluoride was introduced as a caries preventive agent into the water supply in the USA cites of Grand-Rapids. Newsburg, Schenboyg and Evanston (15).
The equation for calculating the optimal fluoride level in drinking water had been devised by (16,17,18) in the early 1970s, the introduction and wide spread uses of fluoridated dentifrices and dietary fluoride supplement in communities with deficient fluoride contributed to caries prevention (19) suggested that dental fluorosis has become more prevalent among children in both fluoridated and non-fluoridated areas as result of ingestion of fluoride from sources other than drinking water.

1.3. Clinical Features of fluorosis:

In its mild forms dental fluorosis is characterized by a pattern of white opacities affecting homologous teeth. The opacities can vary from minor white striation to small extensive area of (lusterless) opaque enamel; in moderate and severe cases of dental fluorosis post eruptive staining or pitting of enamel may occur (20). From their observation on mottled (8) stated that, all teeth of the same individual did not exhibit the same degree of changes (4) stated that lusterless, opaque white patches on the enamel that may become striated, mottled and/or pitted characterize dental fluorosis. The opaque area may become stained from yellow to dark brown. The affected teeth may show pronounced accentuation of perikymata and in more severe cases multiple pits and large areas of hypoplasia of enamel may severely alter the morphology of the tooth. (6) reported that, long term intake of fluoride during enamel formation lead to a continuum of varying clinical changes of enamel from fine, white lines to severely, chalky opaque which may break apart soon after eruption. These severities of changes
depend on the amount of fluoride intake during period of tooth formation.

Also at the same year Fejerskov established that the first sign of dental fluorosis could be seen as thin white line (straie) running across the enamel surface. Often they are most easily seen in the incisal edge area. These fine opaque lines follow the perikymata stage distinguished after cleaning and drying the tooth surface, fluorosis at this stage is totally opaque white designated as (snow cap phenomena). In slightly more affected teeth the fine white lines become broader and more pronounced. Occasionally the emergence of several lines occurs to produce smaller irregular, cloudy, or paper-white areas scattered over the surface. These changes may be realized without drying the teeth, but they become clearer after wiping and drying the tooth surface. With increasing severity, the whole tooth surface exhibit, irregular opaque or cloudy, white areas. Between these irregular opacities accentuated perikymata lines are often visible. Specific variations may occur at this stage of severity. Frequently the cervical enamel appear more homogeneously opaque, and the incisal part, of the upper incisors may exhibit different degrees of a brownish discolouration, which is the result of post eruption staining. In rare cases the patch, cloudy areas may also have minute pits, (focal loss of surface enamel) because of extensive subsurface porosity of the tissue. The next degree of severity is manifested as irregular opaque areas which merge until the entire tooth surface appear chalky white. At the
time of eruption, this stage may vary clinically from a white opaque tooth which feels relatively hard on probing, to a totally chalky tooth which immediately after eruption exhibits surface damage. When such surfaces are probed firmly part of the surface enamel may become detached. In more severe stages of dental fluorosis the tooth surface, which is entirely opaque, may exhibit focal loss of the outer most enamel, i.e. pits. These pits may vary in diameter and size and are 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 and in more severely affected teeth confluence of the pitting surfaces may produce large corroded areas. Very severely affected fluoritic teeth may exhibit total loss of surface enamel and the shape of the tooth may show severe damage. The loss of surface enamel may be so extensive that only a cervical intact rim of markedly opaque but otherwise intact enamel remains. The remaining part of the tooth often manifests a dark brownish discolouration. The discolouration is entirely dependent on such post eruptive and environmental conditions as dietary habits, and the degree of discolouration should, therefore, not be used as a part of any scoring system.

Dental fluorosis has a high degree of bilateral symmetry in severity between homologous teeth\(^{21}\) Teeth that are more affected are those, which are last to mineralize namely premolars, second molars, upper canines, maxillary central and lateral incisors. First molars, and lower incisors are least
affected. This variation in severity among individual teeth is thought to be due to low fluoride exposure during infancy and due to limited intake of water and increase intake of milk. Another explanation for this variation is that fluoride being absorbed primary by bone during early infancy\(^{(22)}\). Difference in mottling among upper and lower central incisors is mainly attributed to difference in enamel thickness\(^{(23)}\).

Symmetry or bilateral correspondence of dental fluorosis was then studied by\(^{(24)}\) where they found it to be 50%. \(^{(25)}\) reported it as one third of affected people. Dental fluorosis in deciduous teeth may be less noticeable because of their natural opaque colour, which makes their diagnosis difficult specially the mildest form of fluorosis. Dental fluorosis in deciduous teeth has been reported in second a primary molar suggests the postnatal effect of fluoride. Other reasons could the fact that there is a placental barrier to fluoride, in addition the formation and maturation of enamel is shorter in duration in deciduous teeth \(^{(20)}\). Enamel is also thin in deciduous teeth compared to permanents ones.

1.4. Indices for Measuring Dental Fluorosis:

An index is defined as a numerical value describing the relative status of a population on a graduated scale with definite upper and lower limits designed to permit and facilitate comparisons with other populations classified by the same criteria and methods.
It can describe prevalence, severity or intensity of a condition \(^{(26)}\).

However many indices were used to classify dental fluorosis. Most of the early studies were conducted by Dean and co-workers in high fluoride areas using \(^{(12,15)}\). In 1939 Dean et al modified his original classification made up of seven categories ranging from normal to severe by dropping the moderately severe category \(^{(14)}\). By 1942 \(^{(14)}\) proposed a method for measuring the severity of mottled enamel within the community. In his method the grades of mottled enamel was assigned a statistical weight and the index named Dean's community Index for Dental Fluorosis (FCI), which depend on number and distribution of the individual scores.

The index is calculated using the following equation:

\[
FCI = \frac{\text{sum of } (F \times W)}{N}
\]

F = Number of individuals with fluorosis.
W = Statistical weight
N = Total number of individuals examined.

An index of 0.4 or less is of no concern from the standpoint of mottled enamel; if above 0.6 a public health problem rises (objectionable fluorosis). The value between 0.4 and 0.6 was assigned to the border line objectionable fluorosis. This method was criticized by several authors \(^{(27,5)}\).

**Dean Categories are:**

\[x\]
Normal: The enamel represent the usual translucent, semi vetriform type of structure the surface is smooth glossy and usually of pale creamy white color score (0)

Questionable: in highly endemic areas cases having slight aberrations in the translucency of normal enamel ranging from white flecks to occasional white spots score (0.5)

Very mild: small opaque white areas scattered irregularly labially or buccally affecting less than 25% of tooth, no brown stain included in these teeth showing no more than about 1-2 mm of white opacity at the tip of the cusps of bicuspid or second molars scores (1).

Mild: White opaque flecks involve at least half of the teeth surface (50%) score (2).

Moderate: All enamel surfaces of the teeth are affected. Brown stains may appear, score (3).

Severe: All enamel surfaces are affected, discrete or confluent pitting, brown stairs are widely spreaded, and teeth often present corroded like appearance. Hypoplasia is common in these categories and general form of the tooth may be affected score (4).

2. Treatment of Dental fluorosis:
The discolouration and impaired appearance of teeth affected by dental fluorosis are the main measures for patients to seek dental treatment.
Various methods were advocated for improvement of appearance of affected teeth. Depending on the degree of severity of fluorosis treatment ranging from simple conservative technique like micro/macroabrasion and bleaching to the more extensive crown preparation, treatment of fluorosis can also be done by grinding and polishing, a technique, which is not usually recommended. While demineralization of enamel with sodium fluoride and calcium sucrose phosphate solution is a technique for treatment of dental fluorosis which need to be confirmed\(^{(28)}\).

2.1 Microabrasion:

These techniques involve application of 18% HCL acid to soften the enamel and then abrading it with controlled abrasive technique. Pumice is used to remove superficial stain defect. However, even silicon carbide may be used with 11% HCL\(^{(29)}\) defined microabrasion as a procedure in which a microscopic layer of enamel is simultaneously eroded and abraded with special compound, leaving perfectly intact enamel surface behind and called it enamel demineralization.

2.1.1. History of microabrasion:

The dental profession has removed superficial discoloration of enamel with various abrasives/acid dissolution techniques for years.\(^{(30)}\) tried hydrochloric acid, oxalic acid in all types of tooth discoloration.

In 1916 Kaine applied muriatic acid to teeth and heated the solution with an alcohol torch to remove surface stains while
Mclnns in 1966 reported the use of 30% H₂O₂ (suproxol), 36% HCL, and ether in 5: 5: 1 solution for the same purpose.\textsuperscript{(2)} suggested direct application of 18% HCL made by diluting 36% hydrochloric acid with equal parts of distilled water. Most of the patients in the study had moderate grade of mottling, the least number of patient had mild grades. The result was, the fluorosis stain can be removed by hydrochloric acid immediately and permanently, and there was no patient discomfort\textsuperscript{(2)}.

In 1988 Croll Cavanaugh described a technique of enamel microabrasion using a mixture of 18% HCL and pumice rubbed on stains. They obtained good results and described it as Croll technique. Later in 1989 the same investigator described a microabrasion technique with 10% hydrochloric acid and pumice in a paste.

In 1990 the premier company working in conjugation with doctor Croll marketed a commercial enamel microabrasion product called prema which contains the reduced concentration of HCL (approx.10%) in an abrasive prophylaxis in a form of paste. The mechanism of action of this product was found to be superior to the original formula. It works by physical removal of stained outer enamel layer by stripping action of acid and abrasive action of pumice. Normally less than 200um in total of enamel is removed, but it may be much less \textsuperscript{(31)}. Using the correct concentration procedure and application carefully controlled the degree of enamel loss \textsuperscript{(32)}. 

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In addition to these changes action of acid removes inter prismatic substances and change light refraction characteristics. There is also an oxidation of some pigments.

2.1.2. Materials for microabrasion:

Hydrochloric acid is colourless fuming aqueous solution of hydrogen chloride with the pungent odour. Stored below 30° in airtight containers of glass or other inert materials. Hydrochloric acid is highly irritant and corrosive (33). Hydrochloric acid 18% and pumice is the main ingredient in the microabrasion procedure. The technique may be enhanced by adding an abrasive materials e.g. silicon carbide pumice advocated by (3,31).

2.1.3 Indications and Contraindication of microabrasion:

Enamel microabrasion is suitable for superficial stains located in the outer layer of enamel (29) but not deep enamel hypocalcified lesion. Microabrasion also used in treatments of white hypocalcified spots not extended to the dentine or stains from tetracycline. It is also used for cream yellow and brown fluorosis, particularly speckled stains, multicoloured stains (brown, grey and yellow), decalcification lesions from stasis of plaque and from orthodontic bands and some irregular surface textures, but is contraindicated for using in cases of amelogenesis and dentinogenesis imperfecta, caries lesions underlying decalcification and age related staining (31).
2.1.4 Advantages of microabrasion:

Improved method of superficial stains removal, is safer than heat activated bleaching and easily performed\(^{(34)}\) and fast acting technique\(^{(35)}\) moreover the results are permanent\(^{(2)}\).

2.1.5 Disadvantages of microabrasion:

One of the disadvantages of microabrasion is sensitivity, which develops when cement is exposed to the acid paste. This will result in wearing of tooth structure. (Croll technique removes 36-62 microns in (5seconds application in comparison; normal prophylaxis removes 8micrones in 30 seconds). The second disadvantage is that patient might not allow cutting of tooth structure and thirdly defect may persist after finishing the technique for which a restorative alternative may be needed .

\(^{(36)}\) described a simple quick technique using a paste of hydrochloric acid and pumice and on the bases of their clinical experience suggested that their method is the treatment of choice for removal of mottling, opacities and pigmentation from enamel.\(^{(37)}\) discussed the management of dark staining of the teeth caused by dental fluorosis. The results of 20 patients treated with hydrochloric acid pumice technique showed considerable improvement in colour which was maintained for up to two years.
2.2 Bleaching:

Bleaching was defined by Clifford as lightening of discoloured teeth through the application of a chemical agent to oxidize the organic pigmentation\(^{(20)}\).

2.2.1 History of bleaching:

Bleaching of non-vital teeth was first reported in 1848, whereas bleaching of vital teeth in office was first reported in 1868. By the early 1900s, in office vital bleaching had evolved the use of heat and light for activation of the process. The bleaching of vital teeth outside the office began a round 1968 using guard vital bleaching.

Most bleaching techniques use some hydrogen peroxide derivatives in different concentrations and application techniques. Bleaching generally has an approximate life span of 1-3 years, change may be permanent in some situations\(^{(38)}\).

2.2.2 Materials of Bleaching:

Since bleaching was practiced numerous materials have been introduced, the first generation materials were in a liquid form. These materials didn't remain in the trays for long and needed more time than the other generations. The second generation is more viscous and in a gel form which stop the materials leaking out of the tray causing soft tissue irritation. This generation contains different concentrations of active ingredients.
The third generation differ in their vehicle and colour that controlled by manufacturers and dental companies\(^{(39)}\). Historically sodium peroxyborate monohydrate, a powder in sealed sachets was used as main bleaching agent, it contains sodium perborate monohydrate (69.72%), buffer with anhydrous sodium hydrogen tartrate (29.88%) and flavored with peppermint oil and menthol was used \(^{(31)}\). Sodium peroxyborate monohydrate releases more oxygen than sodium perborate does, gradually decomposing into sodium metaporate and hydrogen peroxide with evolution of oxygen which evolves more rapidly if the solution is warmed.

Sodium perborate is odorless or almost colourless, prismatic crystals or white powder, stable in crystalline form\(^{(33)}\). It is mild disinfectant and deodorant; it releases oxygen in contact with oxidisable matter and has been used in aqueous solution for purposes similar to hydrogen peroxide.

Sodium hypochlorite is a common root canal irrigant that is available commercially in a 3 to 5.25% household bleaching. Used as bleaching agent; it does not release enough oxygen to be effective and is not recommended for routine bleaching \(^{(38)}\). Its strength decreases rapidly and should be used immediately after preparation otherwise it should be stored in a cool place in well-defined airtight bottle, closed with a glass stopper or suitable plastic cap, protected from light.

Nowadays the commonly used bleaching agent is suproxol which is 30-35% hydrogen peroxide, it may contain a suitable
stabilizing agent (up to 0.05 preservative agents). It is a clear colourless liquid, decomposes vigorously in contact with oxidable organic matter and with certain metals. It gives best result if used at neutral pH\(^{(40)}\). Hydrogen peroxide should be kept refrigerated in tightly capped, amber colored bottle or a suitable opaque container, under these conditions, the shelf life should be approximately one year, stored solutions produce irritation (burns) on the skin and mucous membrane with a white scar, but the pain disappears in about an hour. Continuous use of hydrogen peroxide as a mouthwash may cause reversible hypertrophy of the papillae of the tongue.

There are restrictions in a number of countries on the concentration of hydrogen peroxide allowed in cosmetics \(^{(33)}\). Carbmaide peroxide (CH\(_6\)N\(_2\)O\(_3\)) in a 10% concentration is the most common used bleaching agent. It is a solution of urea hydrogen peroxide in anhydrous glycerol. It works best at an acidic pH of 4.0-7.5; it is usually stored at a temperature not exceeding 40° in air tight containers to be protected from light. Carbmaide peroxide is formulated with glycerin base which enhances the viscosity of the preparation and ease of manipulation. However this may dehydrate the tooth. The dehydrating effect and swallowing of the glycerin in solution may be responsible for the sore throat, which has reported sometimes\(^{(41)}\). Gel with surfactant or pigment dispersants may be more effective than those without \(^{(42,40)}\). The function of surfactant is surface wetting which allow hydrogen peroxide to
diffuse across the gel-tooth boundary and the pigment dispersant keeps pigments in suspension.

All solutions contain a preservative such as phosphoric acids or citric acid. These preservatives sequestrate transitional metals such as iron, copper, and magnesium, which accelerate the breakdown of hydrogen peroxide\(^{(31)}\).

In general a bleaching material contains carbopol (water soluble resin which is carboxypolymethelene polymer) is recommended because it thickens the bleaching solution, extends the oxidation process, improves the adherence to the tooth surface and keeps the gel contained within the tray better and slows the chemical reaction.\(^{(31)}\) Polyx is a thickener used in Colgate platinum system, its composition is a trade secret.\(^{(43)}\)

A 35% solution of carbmaide peroxide is available in the trade name (Quickstar) of (Opalescence Quick). This was marketed to be used by the dentist as an in office initial procedure, prior to the patient using the home kit. This 35% carbmaide peroxide solution is actually 10% hydrogen peroxide; it can cause soft tissue damage and should be applied using a rubber dam.

Differences in bleaching efficacy between treatments with different concentration are not fully known \(^{(42)}\). (Opalescence ®FTM) is available in 15% carbmaide peroxide (5%H\(_2\)O\(_2\)), or 20% carbmaide peroxide (7%H\(_2\)O\(_2\)) it is a potent, sticky, and highly viscous bleaching formula stays on teeth & in tray, its water quantity minimizes tooth dehydration. Opalescence is applied for 30 minutes per day and stays active for 8-10 hours.
for night time bleaching, it is available in regular, mint, melon and banana flavours. (Materials and Procedure Manual-Ultraden products 1999). On the other hand ethyl ether was used for bleaching. It is a colourless transparent, very volatile, inflammable, very mobile liquid with characteristic odour. It should be stored in a well-closed container at temperatures not exceeding 15°C and protected from light. Ingestion of 30 to 60 ml of ethylether may be fatal\(^{(33)}\). Ethylether was mixed with superoxol in 1:5 ratio and the mixture used for bleaching, the addition of ether lowers the surface tension of the liquid for better wetting and enhances the penetration of superoxol into the tooth structure.

Another bleaching agent is 37% phosphoric acid, which is used for etching the enamel surface prior to bleaching for increasing the porosity of the enamel and allow greater penetration of the bleach. It is odourless, colourless, corrosive liquid, miscible with water or alcohol. When stored at a low temperatures it may solidify, forming a mass of colourless crystals, which don't melt until the temperature reaches 28°C. It is usually stored in airtight glass containers \(^{(33)}\).

The use of phosphoric acid in combination with hydrogen peroxide in bleaching technique is not mandatory\(^{(31)}\). In a case reported by \(^{(44)}\) describing the treatment for dental fluorosis, six maxillary anterior teeth were treated. Three with an acid bleach combination and three with acid technique, no clinical differences were noted in treatment time or aesthetic results.

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Bleaching agents need activation by application of heat to accelerate the reaction and shorten the treatment time. Effective temperatures that do not produce undue pulpal reactions are in the range of 125-140; F (52-60°C)

Heat can be applied with a metal instrument heated over a flame, but it is preferable to use a regulated heat source. There are three heating instruments currently marketed by Union Broach Company they include:- Union Broach heating paddle, heating instruments with interchangeable metal tips offer good heat regulation, new Image bleaching unit, a heat lamp with built-in timer and a temperature regulator and the illuminator, a combination unit with both heat lamp and heating paddle.

2.2.3 Mechanisms of bleaching:

Hydrogen peroxide acts as an oxygenator and oxidant, and bleaching effect has been attributed to both these qualities. Although the exact mechanism of bleaching tooth structure has not been fully explained yet. In general, the hydrogen peroxides oxidize the pigments in the tooth, the yellow pigments are oxidized to white pigments the oxidant react with the chromophores that are the colour radicals to cleave double bonds\(^{(31)}\) Peroxide solution flow freely through enamel and dentine due to porosity and permeability of these structures\(^{(35)}\). This free movement is due to the low molecular weight of the peroxide molecules and penetrating nature of the oxygen and superoxide radicals. This procedure is different from the action
of hydrochloric acid that decalcified the superficial layer of the tooth.

The carbmaide peroxide breaks down to water, oxygen, urea, carbon dioxide and ammonia. These breakdown byproducts are of some concerns as their effects are still relatively unknown\(^\text{(31)}\). The hydrogen peroxide systems may be faster than solution systems \(^\text{(45)}\). The concentration of hydrogen peroxide is determined by tooth not by soft tissue, as the contains mucous membrane protectant, they are aqueous carbmaide peroxide system is anhydrous based. Dehydration of the hard tissue is less likely to occur with hydrogen peroxide treatment, which have shorter treatment and shorter exposure times. The carbmaide peroxide systems bleach more slowly and need longer exposure time. They do not contain soft tissue protectant, thus they may be more soft tissue irritants, possibly due to the higher concentration of hydroxyl ion, acid, urea and ammonia of carbonic acid\(^\text{(40)}\). The carbmaide peroxide solution move freely through the tooth and can laterally diffuses through the tooth or to distant sites\(^\text{(46)}\). This action means that it can be applied palatally to the tooth surface in order to bleach the colour beneath a labially placed veneer. The transient pulp sensitivity that some patients experience may be due to the rapid movements of urea and oxygen through the teeth\(^\text{(46)}\). Due to the greater variations in colour of the teeth being bleached, the bleaching time has to vary according to the shade of the tooth and the desired shade. Some manufacturers suggest that the
solution should be changed after one hour as it may lose its efficacy. As safety concerns them still debatable, it would seem appropriate to use the solution for the shortest period of time and to replenish frequently.

2.2.4 Effect of Bleaching on Teeth:

Bleaching affects enamel, dentine, cement and pulp. On the level of the enamel it is sought that the enamel surface remains intact and not affected by carbmaide peroxide solution, and the bleaching process \(^{(46)}\). However \(^{(41)}\) showed that under scanning electron microscope (SEM), focal area of shallow erosion developed on the tooth exposed to carbmaide peroxide solution. There may be loss of carbon, hydrocarbon and tertiary amine groups from treated surfaces which gain oxygen, calcium and phosphorous. Enamel surface hardness is apparently unaffected by the bleaching \(^{(31)}\). On the other hand there seem to be effects on the surface morphology of the tooth. In a relatively recent study by \(^{(47)}\) teeth exposed to carbmaide peroxide for six hours lost average of 1.06 mcg/mm\(^2\) of calcium. This amount is small and may not be clinically significant. Some of the over counters bleaching agents have a very low pH 5.6 and this may cause erosion of the enamel. The tooth pastes provided with the kits may be abrasive to the tooth surface \(^{(48)}\). There is a potential side effect on the teeth other they are etched bleached \(^{(31)}\). Dentine bonding may be altered after bleaching \(^{(49)}\) and smear layer may be removed \(^{(39)}\). The bonding between glass ionomer
and dentine may also be affected \(^{(39)}\). This investigation thus suggested that adhesive dentistry should be delayed two weeks post bleaching this was also confirmed by other studies\(^{(50)}\). The pulp may be penetrated during initial bleaching. A 3% solution of hydrogen peroxide is able to cause a transient reduction in pulpal blood circulation and occluding pulpal blood vessels\(^{(51)}\). The most common side effect is transient mild temperature sensitivity during the first postoperative hour \(^{(52)}\). This sensitivity appears to be does related rather than pH related. In their studies \(^{(53,54)}\) recommended careful treatment when a patient has large restoration, cervical erosion and/or enamel cracks. The studies appear to support the clinical observation that controlled home bleaching is safe to the pulp.\(^{(31)}\) In study on human pulpal reactions to modified Mclnnes bleaching technique, concluded that no severe pulpal reactions were observed but there was a significant clinical loss of enamel. It appears from recent studies that cementum is not affected by bleaching\(^{(55,56)}\). However studies by\(^{(53)}\) showed that the surface morphology of cementum was unaffected when using an ad-mix type of home bleaching system\(^{(53)}\).

Other studies mentioned the occurrence of cervical resorption \(^{(57,58)}\) and extreme root resorption \(^{(59)}\) using internal bleaching techniques. In a latter study, where most of the teeth treated were associated with previous trauma it was not known whether the trauma predisposed to resorption or it was caused by the
effect of the bleaching.\(^{(58)}\) have demonstrated cervical resorption occurring in those teeth that were not previously traumatized. Bleaching may be done as internal, external or internal/external techniques, which depend on the vitality of the tooth. Vital teeth can be bleached by dentist applied bleaching (office bleaching), or the patient applied bleaching (home bleaching)\(^{(40)}\).

**2.2.5 Evaluating the efficacy of bleaching:**

*Longevity.* Treatment is seldom permanent and reliable prediction of the exact duration of colour change is impossible. It is difficult to fully evaluate the efficacy of any method of tooth bleaching partially due to the difficulty in correctly measuring colour changes in teeth. Each system of evaluation has its flaws.

Clinical observation is especially reliable when comparing treated and untreated arches, but there are no quantitative measures or baseline references for recording gradual change overtime. Photographs provide a more permanent baseline record, but are subject to film variation, lighting conditions and processing errors. They have no qualitative basis and should be taken with a colour standard for comparison and calibration. Shade tabs seldom match the extremes of discolouration, and the increments provide quantitative data, but do not lend themselves, well to intraoral measurements. The sensitivity of the instrument and the difficulty in accurate placement and infections control limit the reliability of this instrument.
Computer digitization from slides is less labour intensive, but relies on the camera/slide image. Desktop publishing software enables some alteration of two images to match a single colour standard in both slides, but the measurement features are still incomplete.

Generally the colour lightening last from 1-4 years, with the teeth gradually returning to their original colour, partly due to age darkening\(^{(20)}\). The effect seems to last longer in young patients and yellow stains recur more slowly than blue/gray/black discoloration does.

**Safety:**

Over the years bleaching has been a relatively safe procedure. Following the technique properly can adequately control certain risks, associated with it.

Bleaching agent and heat application can produce pulpal changes as well as altering enamel and dentine structure. Reduction in the microhardness of both enamel and dentine has been reported\(^{(20)}\).

Baumgartner in 1983 reported that, the modified bleaching technique has been recommended for removing stains of endemic dental fluorosis\(^{(31)}\). Weitzman 1986 stated that hydrogen peroxide can by itself, induce pathologic changes frequently associated with neoplastic lesions; it may also augment carcinogenesis associated with 9.1-dimethyl1,2 benzantrhacene (DMBA). DMBA is a known carcinogenic
analogous to the polycyclic aromatic hydrocarbons (bund in tobacco)\(^{(31)}\).

Two treated teeth and two controlled were extracted for other dental reasons at 1,3,5,7,9,11,13,17,19 days following bleaching technique, from nine patients, ages 11 to 17 years. Microscopic examination revealed no significant pulpal reaction even when a substantial amount of enamel was removed from the facial surface of the crown.

Peroxide has mutagenic potential and boosts the effects of known carcinogen. Long term use can alter the oral flora, with potentials for chemical burns of the soft tissue\(^{(31)}\).

2.2.6 External (Vital) Bleaching:

The first published report on external or vital bleaching was by\(^{(30)}\) and it involves the use of oxalic acid.

**Indications:**

External bleaching is indicated in cases of mild uniform, yellow, discoloration (age darkening, fluorosis). Yellow to brown extrinsic/intrinsic staining. (Age darkening, fluorosis, xxvii
tetracycline). Discolorations in the gray blue gray or black range do not respond well to bleaching and tend to darken more rapidly. Teeth that exhibit colour banding from tetracycline require special procedure to minimize the band effect (38).

2.2.6.1 Dentist Applied (Office) Bleaching:

Due to the technical nature of the procedure and the caustic nature of the material involved, bleaching should be performed by the dentist. However, in today’s practice bleaching can be done either as an office procedure or the patient may apply special bleaching materials at home under the instructions and recall monitoring of a dentist.

Laser bleaching: New laser bleaching can be an option for some patients who want a quick dramatic whitening effect quickly. In a recent report by Dr stimulated the reaction when hydrogen peroxide come in contact with laser - beam. This procedure begins with application of gel to the teeth. When energizing by special laser the gel act as a catalyst to whiten the enamel. Two different lasers are usually used. The argon laser which emits a visible blue light which is absorbed by the dark stains and becomes less effective as the tooth whitens because the blue light will be reflected rather than absorbed by the white tooth surface and the Co2 laser, which emits visible blue infrared energy, used to achieve deeper penetration of the energized oxygen leaking to deeper, more
efficient tooth whitening. Laser bleaching also can be combined with bleaching at home combined bleaching.

The American Dental Association Council in scientific affairs has not approved the carbon dioxide laser since a number of unanswered questions still exist regarding its safety and efficacy. The argon laser is approved for use only as a heat source\(^{(31)}\).

2.2.6.2 Patient applied (home) Bleaching:

In the late 1960s a dentist was using gly-oxide as an oral antiseptic gel with 10% carbmaide peroxide for a patient with having orthodontic appliance to reduce tissue irritation. He noticed a lightening effect on the tetracycline stain teeth, which were in contact with gel. In 1986 John Manure presented his observations to manufacturers. (Omminio International). They introduce the first commercial bleaching agent (White and Brite), indicated for home bleaching, similar to those for office bleaching\(^{(31)}\).

**Advantages of home bleaching:**

Home bleaching produces a substantial reduction in chair side time.

**Potential risks:**

Possible risks arising from home bleaching include, adverse soft tissue response due to long term contact with chemicals while
excessive ingestion to the chemical causing possible systemic effects. Etching of enamel and dentine can cause hypersensitivity, and possible surface alteration of resin, ceramic, glass ionomer and metal restoration may occurs. Also bite alteration and TMJ problems from extensive use of trays are ones of the potential risks of home bleaching.

**Over-The-Counter (OTC) - kits:** One of the controversies about bleaching is availability of over-the-counter bleaching kits. Such products sold as cosmetics have escaped rigorous legislation in America, UK, and Europe. They are freely available through pharmacies, stores, mail orders and the internet. This has caused many problems for patients and dentists who should be monitoring bleaching procedures carefully(31).

These kits contain ingredients to be used at three different stages. Acid rinse, the potential for misuse may be considerable (48).

The pH of this rinse is between 1 and 2. The second stage is application bleaching gel for two minutes, it has acidic pH also and the third stage is post bleaching polishing cream (toothpaste), that containing titanium dioxide which may give a temporary painted-white appearance.

The hydrogen peroxide strips system is a thin strips precoated with an adhesive 3.5% hydrogen peroxide gel(53). The manufacturers claim that the strip hold the gel in place to whiten the teeth both extrinsically and intrinsically and provides a uniform controlled application of the gel. The material will initially be supplied to dentists and will then be available over the counter(31).
Problems with over the counter kits are over-uses, misuses and abuses. Cubbon and Ore in 1999 reported that the over use of these agents caused erosion of the labial surfaces of the teeth, dissolution of enamel and loss of surface anatomy. The exposed dentine appears darker than the remaining enamel.

**Bleaching/Whitening Tooth pastes:** These can be used in combination with other bleaching techniques to reduce surface staining or they may be used in an ad-mixture bleaching (53) where equal amount of bleaching and tooth paste were used in combination, however there have been few studies on the admix technique. In a study by (53) the use of bleaching gel and tooth paste in 1:1 ratio did cause colour change but compared with night guard it was not significant.

### 2.2.7 Bleaching of non-Vital Teeth (internal Bleaching):

When the discolouration is from the pulp chamber, from necrotic pulp tissue or from staining agents that are present in the pulp chamber, the bleaching treatment need to take place within the pulp chamber.

Non vital bleaching can be done by techniques such as, heat and light technique, bleaching with Sho-fue Hi Lite, (Thermocatalytic technique), walking bleaching technique and internal external technique. The bleaching agent is usually 30% hydrogen peroxide, sodium perborate, or sodium hypochlorite(31). There is slight potential (<1%) for most deleterious side effect termed cervical resorption which has been observed when
thermocatalytic technique is used. Therefore the walking bleaching and in office bleaching which does not require heat are preferable. To reduce the possibility of cervical resorption, a paste of calcium hydroxide and sterile water is placed within the operated pulp chamber, also sodium perborate alone rather than in conjugation with hydrogen peroxide is used as a primary bleaching agent, although it is slow but, it is safer and less offensive to the tooth. Periodic radiographs should be made post-bleaching to screen for cervical resorption, which has its onset in 1-7 years\(^{(20)}\).

**Contraindications of non-Vital Bleaching:**

Contraindications of non-vital or internal bleaching include extensive restored teeth, in which bleaching cannot be done in and outside the crown at the same time and crack of enamel or hypoplastic or severely undermined enamel are also considered contraindication to internal bleaching. As the formation of discolouration from metallic salt, particularly silver amalgam and the dentine tubules of the tooth become virtually saturated with alloys so no amount of bleaching with a valuable products with significantly improve the shade.

**Walking Bleaching:**

Walking bleaching is an effective and safe procedure, which can be utilized in all situations requiring internal bleaching. Recent
studies showed that 30% hydrogen peroxide reduce microhardness of enamel and dentin, while treatment with sodium perborate mixed with hydrogen peroxide or with distilled water or a local anesthetic solution prevents alteration of the microhardness of either enamel or dentine (20). The maximum bleaching effect is attained within 24 hours. However the prolonged chairside time for this procedure is considered as its main disadvantage.

2.2.8 Internal/External Technique:

Bleach treatment may be combined in numerous ways to treat specific discoloration problem such as a single discoloured tooth (60). In internal technique can be applied by sealing 35% carbamide peroxide into the access cavity, and is used with home bleaching agent applied externally (61).

(62) in 1989 stated that bleaching discoloured teeth must be considered a viable treatment modality although it does not offer the predictability of many cosmetic options; its simplicity and economics demand attention. Combining bleaching with selected bonding and contouring can retain smile to the not so affluent, conservative or apprehensive patient who does not wish to face tooth reduction and full coverage. (31) in a comparison between microabrasion and bleaching stated that microabrasion improves tooth colour by eliminating the superficial discolouration permanently. Microabrasion is preferred when general tooth colour changes are not needed but
a defined isolated surface is present. Bleaching improves tooth colour by lightening, whitening and brightening the teeth and preserves the intact fluoride rich layer of enamel and the tooth shape. In order to obtain the best results the shade of the teeth over many years may darken slightly, but teeth never retain to their original dark colour. The two techniques can be used in conjunction with each other depending on specific case. In study about effect of etching, microabrasion and bleaching on surface enamel of extracted teeth concluded that hydrogen peroxide and hydrochloric acid are two chemical agents that have been recommended for use alone and in combination with other agents for the removal of variety of intrinsic stains from tooth surfaces. The results of the study revealed a significant large difference in the depth of the enamel loss between the groups. The enamel loss found in microabrasion treatment range from (100 ± 47 to 360 ±130 microns)depending on the time, pumice and rotary cup used. In bleaching by hydrogen peroxide, very small amount is lost in treatment with phosphoric acid alone (5.7 ± 1.8micron) and about the same amount in treatment with a combination of phosphoric acid and hydrogen peroxide (5.3 ± 1.6micron).
Chapter Two
Objectives
Materials & Methods
General Objectives

1. To evaluate the effect of treatment of dental fluorosis on Sudanese children teeth.

Special Objectives

1. To evaluate the effect of hydrogen peroxide as treatment of dental fluorosis on Sudanese children teeth.

2. To evaluate the effect of microabrasion as treatment of dental fluorosis on Sudanese children teeth.

3. To compare between two treatments of dental fluorosis on Sudanese children teeth.
MATERIALS AND METHODS

This study was partially conducted in Abou-grown area in Khartoum north province and completed in the conservative dentistry department at Khartoum dental college. Abu-grown was selected to be the study area because it is one of the areas of endemic fluorosis, according to previous prevalence studies (1).

The study was approved by the faculty of dentistry research committee, the head of the village, two headmasters of the schools and the parents. All ethical considerations were discussed. The data was collected from pre and postoperative clinical examination and evaluation carried by the researcher. The appointments were decided according to schools timetables so as to meet the pupil's free time.

A total number of 50 school children, aged 9-12 years were randomly selected from the schools to participate in the study. The maxillary central incisors of each subject with moderate dental fluorosis according to the modified Dean's index were selected for the treatment. The teeth were examined in daylight using plane mouth mirror (Ash-German).

The subjects with moderate dental fluorosis were divided into three groups according to the degree of enamel discolouration. Tetraceramic® vivadent shade (USA) was used to classify the subjects into those with slight, moderate or severe discolouration (see table 1). Six of the subjects were later excluded either because...
of apprehension or failure to continue the treatment and follow up plan.

Of the 44 subject 22 were treated with bleaching and the other 22 with microabrasion, the allocation to either of the two group was random.

Of the 22 subjects treated with microabrasion (44 teeth), five has slight discolouration, nine moderate and eight has severe discolouration.

The teeth were cleaned by prophylaxis polishing paste (phosphate fluoride). The shade was taken using Tetraceramic® vivadent shade (USA) Vaseline was applied to the soft tissue. Followed by application of rubber dam (The hygienic corporation "Akron USA") to isolate the teeth. Thin long diamond bur in high speed handpiece was used to remove very thin layer from the tooth surface, this was followed by application of prima (distilled water, hydrochloric acid, fumed silica, silicon carbide) using a plastic spatula on the teeth and distributed on the teeth surfaces by special rubber cup in low speed handpiece rotated by an angle for 30 seconds. The teeth were then washed and a topical fluoride was applied, immediately after treatment shade recording was taken using the same procedure that was used at the beginning.

Of the 22 subjects treated by bleaching four have slight discolouration, eleven have moderate and seven have severe discolouration.

The bleaching was done on three visits. 30 % hydrogen peroxide was used as bleaching agent, teeth were first polished using a
prophylaxis polishing paste containing phosphate fluoride. Vaseline was applied to the soft tissues and the teeth isolated by rubber dam. A piece of cotton soaked in 30% hydrogen peroxide was applied to the labial surfaces of the teeth and activation was done by a visible light (Hilux "Ankara -Turkey") applied for three minutes. This process was repeated three times each visit (9 minutes for each case). The time interval between the visits is one week. Shade was taken and recorded after completion of each visit and photographs were taken. The data was analyzed using the computer program EP6. The differences between groups were tested by Chi-square test and the results were considered significant at value P< 0.05.
Chapter Three

Results
RESULTS

50 school children, age 9-12 years were originally selected for the study. Six of them were excluded from the study because of failure to continue. The remaining 44 subjects were divided into two equal groups, 14 (64%) were females and 8 (36%) were males in each group. The mean and standard deviation of the age were 10.909, 1.158. One group was treated with microabrasion and the other group with bleaching.

All subjects in both groups had moderate dental fluorosis which was further subdivided according to severity of enamel discolouration into four groups absent slight, moderate and severe discolouration according to a predetermined shade reading (Table 1) it was also noted that the degree of severity of discolouration of both incisors in the same subject was almost symmetrical in all subjects seen during the study.

Of the 22 teeth treated with microabrasion, five had slight, nine moderate and eight severe discolouration while of the 22 treated with bleaching, four had slight, 11 moderate and seven severe discolouration before the treatment. (Table 2, 3)

Of the 22 treated with microabrasion, 13 subjects (59.1%) showed complete absence of discolouration, five of these 13 had previously slight and 8 had moderate discolouration (Table 2)

Three subjects (13.6%) one had moderate and two had severe discolouration had improved to slight discolouration after the treatment, while the remaining six of severe discolouration
showed improvement to moderate discolouration. All subjects showed some degree of positive response to the treatment.
The other group of 22 was treated with bleaching, in three-treatment session with a week interval between visits. (Total period of treatment and observation of three weeks).
Four patients who had slight discolouration at the beginning of the treatment, only one of them had complete disappearance of the discolouration after the first treatment and remained so through the period of treatment and observation. The rest of this subgroup showed no change in their original discolouration, (table 4,5).
Eleven subjects had moderate discolouration at the start. Seven of them improved to slight discolouration after the first treatment and remained through the three weeks period and no change observed with the other four (Table 4,5).
Of the seven who started with severe discolouration, one improved to moderate after week one of the treatment and the discolouration disappeared completely after week two and remained so after week three. Another patient in this subgroup improved to moderate discolouration after the first treatment but no further improvement was shown with treatment though. This mild improvement was also remained through the period of observation. The rest of this sub group showed no change with treatment throughout the study period (Table 4,5).
Despite the fact that small numbers of patients entered in each group of the study, a clear difference in response was noted between the two different types of treatment.

All patients treated with microabrasion showed variable response to treatment Total responders 100% of patients The difference between all patients treated was statistically significant, P=0.0006. While only two patients from the group treated with bleaching had complete disappearance of discolouration, one from slight and the other from severe discolouration subgroups. Seven patients showed improvement to slight discolouration all of them from moderate discolouration subgroup. One patient from the severe discolouration improved to moderate discolouration. Total responders 10 out of 22= about 45.5% of patient.

The difference between bleaching before and after the first visit was statistically significant P=0.002. This difference remained the same when compared with second and third visits, indicating that this significant change occur only after the first visit.

When the result obtained from microabrasion group compared to the result of weak one, two three bleaching group, a significant difference was noted between them P.0.03 (table 6,7,8).
Table 1:
Teeth classification according to the discolouration

<table>
<thead>
<tr>
<th>Shade</th>
<th>Degree of discolouration</th>
</tr>
</thead>
<tbody>
<tr>
<td>110-140</td>
<td>Absent</td>
</tr>
<tr>
<td>210-230</td>
<td>Slight</td>
</tr>
<tr>
<td>340</td>
<td>Moderate</td>
</tr>
<tr>
<td>540</td>
<td>Severe</td>
</tr>
</tbody>
</table>

Table 2:
Degree of discolouration before and after microabrasion

<table>
<thead>
<tr>
<th>Degree of discolouration</th>
<th>Before Microabrasion</th>
<th>After Microabrasion</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0*</td>
<td>1**</td>
</tr>
<tr>
<td>**1</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>***2</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>****3</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

Chi square = 19.48 P value = 0.0006

* No discolouration
** Slight discolouration
*** Moderated discolouration
**** Severe discolouration
Table 3:
Degree of discolouration before and after week one bleaching

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discolouration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td>*1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>***2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>****3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

Chi square = 21.39
P value = 0.002

Table 4:
Degree of discolouration before bleaching and after week two bleaching

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discolouration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td>*1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>***2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>****3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Chi square = 19.18
P value = 0.003
### Table 5:

**Degree of discolouration before the treatment and after week three bleaching.**

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discoloration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>***2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>****3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Chi square = 19.81

P value = 0.003

### Table 6:

**Comparison of the results of microabrasion and week one bleaching.**

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discolouration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td>*0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>**1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>***2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
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<td>10</td>
</tr>
</tbody>
</table>

Chi square = 13.61

P value = 0.03
Table 7:
Comparison of the results of microabrasion and week two bleaching

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discolouration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td>*0</td>
<td>1</td>
<td>8</td>
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<tr>
<td>**1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>***2</td>
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</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Chi square = 13.79
P value = 0.03

Table 8:
Comparison of the results of microabrasion and week three bleaching

<table>
<thead>
<tr>
<th>Before Bleaching Degree of discolouration</th>
<th>After Bleaching</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>*0</td>
<td>**1</td>
</tr>
<tr>
<td>*0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>**1</td>
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<tr>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Chi square = 13.79
P value = 0.03
Chapter Four

- Discussion
- Conclusion & Recommendation.
- References.
DISCUSSION

Mottling of teeth can have significant psychological impact particularly on children and adolescents. A number of procedures have been suggested for removal of mottling and stains. The most conservative procedures so far for removal of fluorosis stain are bleaching and microabrasion. Both techniques have been reported to produce variable degrees of improvement of enamel fluorosis stain \(^{(31)}\).

In this study, a comparison was made between bleaching and microabrasion technique for removal of moderate fluorosis staining. For bleaching 30% hydrogen peroxide activated by light was used, whereas a microabrasion technique using prima (18% HCL, silicon carbide, distilled water) was performed.

The study population was 9-12 years old school children who were diagnosed according to Dean Index. The reasons behind taking this age group for the study are the ease and feasibility of doing both treatment and follow up. In addition it has been reported that teeth of young individuals would be easier to bleach compared to older ones. (Scale and Thrash 1985).
There are different methods used for evaluating changes in
discoloration following treatment. Those include clinical
observation, photographs, and shade tabs and
colorimeters\(^{(64)}\). In this study a combination of clinical
observation, shade tabs and photographs were used to assess
colour changes after treatment with both bleaching and
microabrasion. As shade tabs selection seldom match the
extremes of discolouration, the discolouration of affected
teeth on our subjects was put into range. The colorimeter is
the only available method that can give quantitative data in
colour change and it would be more informative if used.

Microabrasion is a simple one-stage procedure used to treat
discolouration, which may be the result of
hypermineralization and/or hypomineralization or
staining\(^{(29)}\). The study showed that enamel fluorosis stains
can be removed using this technique.

59.1% of the treated subject who has previously slight
and moderate discolouration had complete disappearance,
13.6% had changed to slight discolouration, and only 27.3 %
changed to moderate. The difference before and after
treatment was found to be statistically significant \(P=0.0006\),
this result is with agreement with results of previous
studies\(^{(37)}\) in treatment of 20 patients with the same
technique, reported that all their patients have shown considerable improvement of colour, which was maintained for review periods of up to two years. McCloskey 1984 also reported considerable improvement of fluorosis stain using 18% hydrochloric acid; also his technique has the principles as the technique adopted. In this study different pumice was used instead of aqueous hydrochloric acid used by McCloskey. McCloskey's study also had included subjects with severe dental fluorosis, where as in the present study subjects with severe dental fluorosis where not treated. Another study was done by Wellbury and Shaw 1990 where it was found that excellent results can be obtained when treating dental fluorosis stains with microabrasion and they conclude that microabrasion is the treatment for such problem.

Bleaching using 30% hydrogen peroxide to bleach vital teeth has been available for nearly 100 years (31). Many clinical studies were conducted to evaluate its effects on removal of fluorosis stain (Bailey and Christian 1968, Musin and Barkameier 1982). The degree to which bleaching is effective in the treatment depends on a number of inter related variables such as severity (Bailey and Christian 1968, Colon 1971, Jordan and Boksman 1984), location (Arend et al 1972,
Jordan and Boksman 1984), colour, degree of discolouration, and number and duration of bleaching sessions. (Bailey and Christian 1968, Seale and Thrash 1985).

In agreement with other studies bleaching was found to be effective in removal of fluorosis stain. Statistically significant difference was found between groups before and after treatment (P=0.002), however an unexpected finding was that the significant part of the improvement in bleaching was after the first visit (P=0.001). No significant differences were found between first and second and third visits. This was in contrast to Seale and Thrash, (1985) findings, who found that the number of bleaching session was contributing to the degree of change in fluorosis stain. The data available for evaluating the effect of number of bleaching session is limited and further studies are needed to clarify this point.

When comparing bleaching results with microabrasion results, microabrasion was found to be superior to bleaching (P=0.03). Although there were no available studies comparing microabrasion to bleaching, the literature includes a number of studies combining bleaching and microabrasion in treatment of dental fluorosis. Mclnnes (1966) developed a formula consisting of suproxol (30% H2O2) and concentrated HCL for removal of fluorosis stain. Later this technique was adopted
and slightly modified by Chandra and Chawla (1975). The main problem of this technique is the use of different materials that need immediate mixing prior to application. This is obviously a disadvantage in today's dental practice where time and speed of operation are very important. The results of the present study showed clearly that microabrasion is a valuable treatment modality in the treatment of dental fluorosis in children. Whether this treatment has the same effect in fluorosis in adult subjects, needs further investigation any previous results?

From the results obtained there seem to be individual variation in response to treatment by both bleaching and microabrasion, e.g. some cases of severe discolouration respond better to treatment than those of slight and moderate discolouration, the reasons behind those variability need to be further investigated, as there is no available previous result.
CONCLUSIONS AND RECOMMENDATIONS

1. Microabrasion is an effective treatment for dental fluorosis. All patients in the study show some degree of response and complete disappearance of discolouration was seen in 59.1%.

2. Though bleaching is a cheap form (material wise) of treatment it is not as effective as microabrasion. Only 9.1% had complete disappearance of discolouration and the total number of the responders didn't exceed 45.5%.

3. As far as bleaching is concerned, this study showed that those who responded did so after the first visit. Only one patient had further improvement after the second visit and the third visit seems to have no effect on the final outcome of treatment.

4. Further studies are needed to verify the importance of multiple bleaching sessions.

5. Further follow up studies are also required to evaluate the longevity of the positive responses for the treatment and to find out whether there are any long term complications.

6. The findings of this study inspite of there limitation can be adopted to change our practice in treating moderate enamel fluorosis stains.

7. Microabrasion technique can be taught to under graduate and graduate dentists in dental educational programs to improve their skills and increase their awareness of the problem.


60. Swift EJ. Restorative consideration with vital tooth bleaching. ADA 1997; 128:60-4.

