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Hydrochloric acid-pumice treatment for post-orthodontic localized decalcification

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Abstract: This article describes a method for the removal of decalcified white areas from tooth surfaces. This technique involves the application of 18% hydrochloric acid (HCl) and pumice mixture to the facial enamel of affected teeth. Improvement in color results by a process of chemical etching action of HCl and abrasive removal of the etched enamel. Increase in enamel permeability or pulpal effects have not been reported in experiments utilizing solutions with high concentrations of HCl. Other advantages of the technique include permanency of the results, requirement of a single office visit, minimal loss of enamel, good patient tolerance and ease of performance. Several case reports displaying the success of this technique are illustrated.

Key words: Decalcification; hydrochloric acid; orthodontics

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INTRODUCTION

An excellence in finishing is a desired objective of orthodontic treatment. However, occasionally due to poor oral hygiene or excessive consumption of sugar containing fluids and food during orthodontic treatment, white, opaque, decalcified areas become apparent on teeth during treatment and very obvious when the appliances are removed. To date, treatment of these white, opaque, decalcified areas has been limited to veneering with composite after etching the enamel surface with acid. This technique is associated with certain disadvantages such as staining of the veneer or loss of the restoration over time.

Other methods of treating intrinsic enamel stains involve the use of concentrated hydrogen peroxide with heat,[1,2] diethyl ether,[2-6] sodium hypochlorite,[2,5] phosphoric acid with superoxyl and heat,[2] sandpaper discing[6] or a combination of various chemicals.[3] These methods are associated with certain limitations which include predisposition to tooth hypersensitivity,[7,8] temporary results,[9] unnatural opaque appearance of teeth,[8] loss of mesiodistal tooth curvature[6] and the need for more than one office visit.[8] In addition, although these techniques have been relatively successful in treatment of intrinsic enamel stains due to conditions such as fluorosis, little is known about their applicability in the treatment of decalcification opacities.

An ideal technique for the treatment of decalcified white areas on teeth should provide permanent results, cause insignificant loss of tooth structure, not damage the pulp or periodontal tissues, be easy to perform and require the minimum amount of treatment time and office visits. The purpose of this article is to describe a technique which meets these criteria. The method involves the use of hydrochloric acid (HCl)-pumice mixture.

HISTORY OF TECHNIQUE

McCloskey[9] reported that the use of HCl and heat to remove intrinsic enamel stains due to fluorosis was first made by Dr. Walter Kane in 1916 in Colorado. Kane noted that the use of 18% HCl without heat produced the desirable color change. In a later modification of Kane's technique, McCloskey[9] advocated repeated applications of 18% HCl with a cotton pellet followed by a gentle rubber cup application of HCl-pumice mixture at 2,000 rpm to remove fluoride stains.

Recently, Croll & Cavanaugh[10,11] suggested further modifications of the HCl technique for the treatment of intrinsic enamel stains. The authors utilized a mixture of 18% HCl and fine flour of pumice to burnish away stains in the enamel and reported excellent results with this method. The technique described in this text for post-orthodontic treatment of decalcified opaque areas is adapted from the method described by Croll & Cavanaugh.[10,11]

DESCRIPTION OF TECHNIQUE

The use of 18% HCl requires extreme caution. Therefore, protective wear for the dentist, assistant and patient are essential. The protective materials required include dispos-

able eye protectors, protective patient drape, rubber gloves, rubber dam and frame, dental floss, cavity varnish and sodium bicarbonate. For the treatment, 18% HCl, fine flour of pumice and a plastic composite mixing spatula are necessary. The finishing procedures require topical acidulated phosphate fluoride, acidulated phosphate prophylaxis paste as well as a superfine aluminum oxide disc.

The treatment sequence is illustrated in Figures 1a-f:

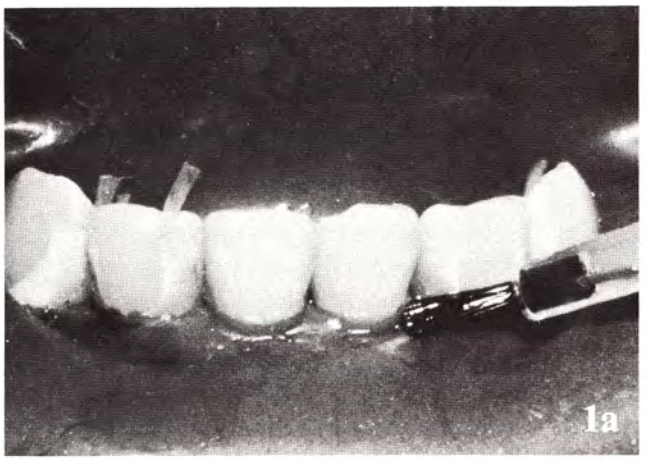

Fig. 1a. Isolation of affected teeth with rubber dam and cavity varnish.

Fig. 1b. Application of sodium bicarbonate paste on rubber dam as an additional protective measure.

Fig. 1c. HCl-pumice mixture burnished onto affected tooth surfaces for five seconds.

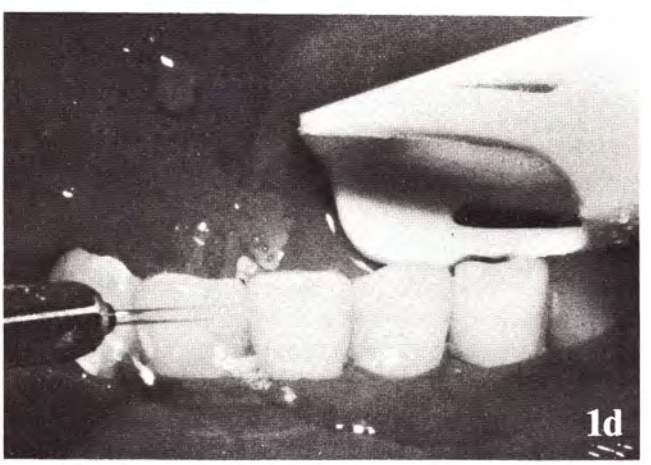

Fig. 1d. The HCl-pumice mixture is washed off with adequate amounts of water and high speed suction.

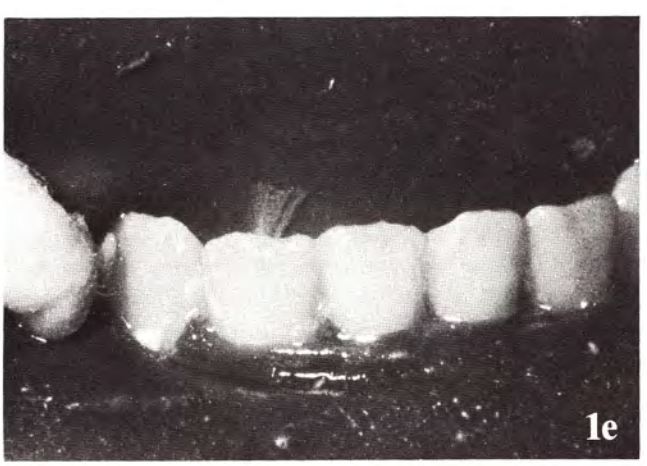

Fig. 1e. Application of topical fluoride gel for three minutes.

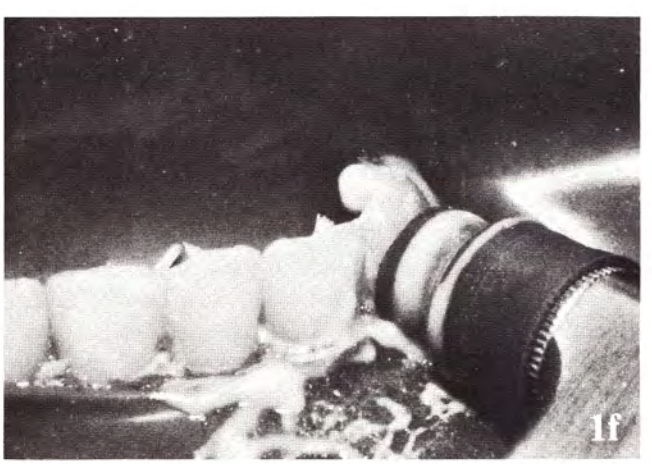

Fig. 1f. Smoothening of enamel surfaces with acidulated phosphate prophylaxis paste and rubber cup.

The treatment sequence is described as follows:

1. The operator and assistant should wear suitable eye protection and rubber gloves. The patient should be draped with a protective wrap and also wear eye protection.
2. Ensure that all composite or cement has been removed from the surfaces of the teeth.
3. Isolate the affected teeth with rubber dam. Ligate the teeth with dental floss and apply cavity varnish to the margins of the rubber dam and teeth (Fig. 1a). This helps to seal the oral cavity from the HCl. Accurate placement of the rubber dam around the cervical margins of the tooth crown is crucial as inadequate exposure of the crown will result in some decalcified opacities being retained on the tooth. On the other hand, over-retraction of the rubber dam with resultant exposure of the gingiva will cause acid burns on the soft tissue. Use of rubber dam clamps is contraindicated because of the corrosive action of HCl on the metal.
4. Mix a thick paste of sodium bicarbonate with water in a disposable mixing cup. Place this paste on the rubber dam around the teeth in order to protect the patient from any accidental spill of HCl (Fig. 1b).
5. The 18% HCl and pumice are mixed in a disposable cup to form a thick paste. Next the HCl-pumice mixture is burnished firmly into the areas of decalcified opacities with a plastic composite mixing spatula (Fig. 1C). A cotton swab is placed on the lingual surface of the teeth to absorb any excess acid. Some effervescent action between the acid and sodium bicarbonate may be observed at this stage.
6. The acid mixture is applied for five seconds after which it is washed with adequate amounts of water and high speed suction (Fig. 1d). This process is repeated until the desired color change is noted. However, more than 12-15 repeat applications are not recommended. At the end of this procedure the tooth usually appears uniformly etched.
7. When the final color change is achieved, the teeth are rinsed thoroughly with water for 30-60 seconds. A cotton swab is used to apply topical fluoride to the tooth surfaces (Fig. 1e).
8. Rough enamel surfaces are polished with an acidulated phosphate prophylaxis paste applied gently with a rubber cup (Fig. 1f).
9. The rubber dam is removed carefully. Normal enamel luster is restored with a superfine aluminum oxide disc.
10. The HCl-pumice mixture and sodium bicarbonate are mixed together before disposal.

Cases before and after treatment are shown in Figs. 2,3,4.

Fig. 2. (a) Mild decalcification on maxillary incisors in a 15 year-old male. (b) After seven repeated applications of HCl-pumice mixture.

Fig. 3. (a) Moderate to severe decalcification lesions on mandibular incisors and canines in a 15 year-old female. (b) After 10 repeated applications of HCl-pumice mixture.

Fig. 4. (a) Severe opaque areas on maxillary anterior teeth with Cl III cavities on lateral incisors in a 16 year-old female. The exposed dentin in these cavities was protected with calcium hydroxide lining. Fifteen repeat applications of the HCl-pumice mixture were required to remove the decalcification. (b) Post-treatment. Almost total removal of decalcification opacities and restoration of the cavities.

DISCUSSION

Due to the recent reintroduction and modifications in the technique described in this article, little experimental data is available on the effects of HCl-pumice mixture on enamel, dentin or pulp. However, Griffen *et al*[8] noted that neither 16% HCl nor McInnes solution containing 36% HCl and 30% hydrogen peroxide increased enamel permeability or penetrated into the pulp chamber. The authors postulated that the acid precipitates as calcium or phosphorous salts in the dentinal tubules which prevents further penetration of acid into the dentin. These investigators add that the salts also act as buffers and neutralize acid in the dentin. Similarly, Baumgartner *et al*[12] noted no significant effects of modified McInnes bleaching solution containing 36% HCl, 30% hydrogen peroxide and diethyl ether on pulp. None of the patients treated by the present author complained of any discomfort during the procedure and over the entire period of follow-up since the treatment.

Correction of decalcification opacities or intrinsic enamel stains by the HCl-pumice technique is probably achieved by a process of chemical etching action of the HCl and abrasive removal of the etched enamel by the pumice. This implies that removal of the enamel should be monitored carefully by the clinician as indicated previously by Griffen *et al*[8] and Baumgartner *el al*[12] in experiments using McInnes solution as well as HCl. However, Bailey & Christen[4] reported a loss of only 0.1 mm of enamel surface with a 20-minute treatment with modified McInnes solution followed by discing with a fine cuttle disc. Croll & Cavanaugh[11] also stated that the amount of loss of facial enamel in their patients treated with HCl-pumice mixture was clinically unrecognizable.

Advantages and limitations of the technique. The HCl-pumice technique is not recommended for treatment of deep decalcification opacities as it will result in removal of excessive amounts of enamel. If, however, the decalcification is deep in only small localized areas of the tooth with the majority of the remaining surface displaying superficial discoloration, the treatment may result in substantial improvement in appearance of the tooth. The residual opacities can be further improved with composite masking.

Often the depth of the lesion is difficult to determine. Croll & Cavanaugh[11] stated that in such cases it is fair to warn the patient and parents prior to treatment, that if the technique does not produce the desired results, restoration with a composite resin may be necessary. They also added that if improvement in color of the tooth is not noticed after 12-15 five-second applications of HCl-pumice mixture, further treatment by this method should be discontinued.

Danger of acid spill and the resultant tissue damage is a further consideration in this technique and extreme caution cannot be over-emphasized. This treatment approach is also not recommended for uncooperative patients or those with previous history of sensitivity to heat, cold and acidic fluids.

The HCl-pumice treatment can be applied for the treatment of decalcification opacities as well as intrinsic enamel stains due to other causes such as fluorosis. Mathewson *et al*[13] stated that this technique offers several advantages over other methods used for treatment of enamel stains. These advantages include minimal pulpal effects, insignificant increase in enamel permeability, requirement of a single office visit, minimal loss of enamel, permanency of results, good patient tolerance and ease of performance. The HCl-pumice technique is a viable option for the alleviation of decalcified white opacities on tooth surfaces due to poor oral hygiene maintenance during orthodontic treatment.

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The cases presented in this article were treated at the University of Oklahoma, while Dr. Kapila was a Clinical Instructor in Orthodontics. At present he is a doctoral student in the Department of Oral Biology at the University of California, San Francisco, California, USA. Dr. Currier is Associate Professor, Department of Orthodontics, University of Oklahoma, Oklahoma City, Oklahoma, USA.

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