Enamel opacities removal using two different acids: an *in vivo* comparison

Ana Cristina Barreto Bezerra / Soraya Coelho Leal / Simone Auxiliadora Moraes Otero / Danuze Batista Lamas Gravina / Vanessa Resende Nogueira Cruvinel / Orlando Ayrton de Toledo

Computerized analysis assessed quantitatively the efficacy of microabrasion using 37% phosphoric and 18% hydrochloric acids with pumice on removal of enamel opacities. Baseline and after one month photos were taken and analyzed by Paint Shop Pro 7 software and Image Pro Express 4.0. Nonparametric tests were used. Results depicted significant differences immediately versus one month post treatment for both acids. It was concluded that both acids can be used, and as time passes enamel color improvement occurs.
J Clin Pediatr Dent 29(2): 147-150, 2005

INTRODUCTION

The opacities that involve the dental enamel can be consequence of changes that occurred during mineralization process affecting permanently the tooth structure.[1] It could also be pointed out that environmental chemicals, drugs or physical agents can adversely affect human teeth during embryonic and after eruption into the oral cavity.[2]

Fluorosis is considered one of the most important types of enamel opacities. It causes a subsurface hypomineralization or porosity, which extend toward the enamel thickness increasing in depth as severity also increases.[3] Fluorosis has been linked to the wide spread fluoride use, as well as many other different sources of this ion. Although dentifrice was not identified as a risk factor for dental fluorosis, many studies showed associations between dental fluorosis and the use of fluoridated toothpaste during early childhood.[4-6] The features of fluorosis include changes in dental enamel color varying from fine white lines until great opaque bilateral stains. The mottling surfaces can evolve to cavitations and or pigmentations with different shades of yellow and brown. The knowledge of the kind, nature and deepness of the discoloration is essential to make the diagnosis and choose the better treatment.[7]

The stains of dental enamel have been classified by different ways. According to Thylstrup and Fejerskov[8] the dental fluorosis received nine scores depending on the severity and characteristics of the enamel surfaces discolorations.

The use of chemical agents to remove enamel stain is not recent.[9] Several techniques were employed during the last decades. The more conservative one described is microabrasion, which removes only the most superficial dental enamel. The results of this technique are considered successfully and permanent. The hydrochloric acid has been employed for the technique. In 1984, McCloskey[10] described the use of the acid associated with pumice. Croll and Cavanaugh[11,12] assessed the technique using hydrochloric acid and pumice to remove fluorotic brown stains. The paste was manually rubbed with a wood stick over the enamel surface for 5 seconds and washed with water for 10 seconds. This procedure was repeated until an esthetical result was obtained, followed by 5 minutes fluoride application. This approach provided good results after six months showing a permanent improvement in enamel color and translucence.[12]

A more recent study[13] indicated the use of 37% phosphoric acid as substitute of hydrochloric acid. The author stated an advantage for the phosphoric acid is that it is a well known substance of the general practitioners.

The compounds used for enamel microabrasion should have an abrasive agent of great hardness that could remove few micrometers of the tissue, but not damage the deep enamel. The technique should also be fast, easy and safe.

This study aimed to compare through a computerized analysis, the clinical efficacy of the 18% hydrochloric and 37% phosphoric acid on the removal of suggestive fluorosis stains.

METHODS

Study population

Study subjects were recruited from Pediatric Dentistry Clinic of The Brazilian Dental Association – Brasilia DF, Brazil. Fifteen children aged 8 to 13 years with diffuse opacities on enamel surfaces of upper incisors suggestive of dental fluorosis were selected. A written informed consent was obtained of all parents or legal guardians, who agreed to answer a detailed question-

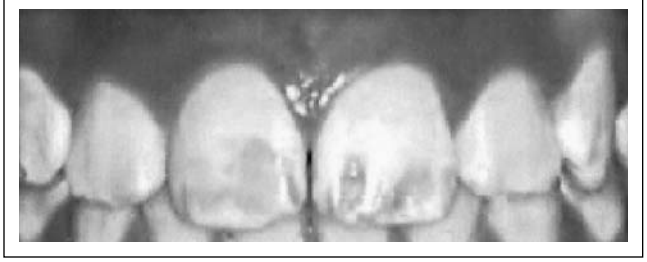

Figure 1. Opacities before treatment. Teeth 12/22 (TF-3) and 11/21(TF-4).

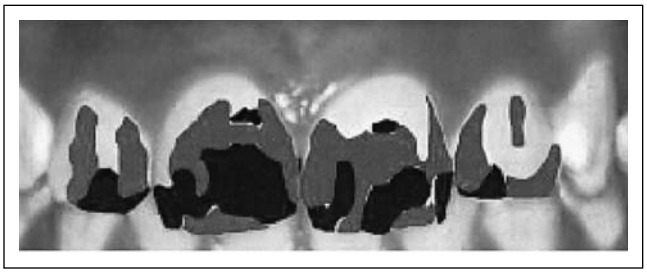

Figure 2. Opacities demarcation according to Paint Shop Pro 7. Dark blue corresponding to brown stains and light blue to white stains.

naire and allowed their children to undergo to dental examination and microabrasion treatment. The research project was approved by the Ethical Committee of the Medical School of the University of Brasilia, under the number 006/02.

Parental interview

A standardized questionnaire to collect information on education and income of the parents, oral health and hygiene, feeding practices and exposure to antibiotics and fluoridated compounds was designed. This questionnaire was applied by the main examiner with the objective of the diagnosis formulation.

Clinical examination

Following the interview and after a professional prophylaxis, one of the authors (VRNC) conducted a complete dental examination of each child in dental conventional operatory equipment. The teeth were examined in a relative humidity condition and under an undirected artificial light[14] in order to assess the opacities, which were classified according to Thylstrup and Fejerskov[8] (TF) index. This index has a variation in severity that ranges from 0 (sound enamel) to 9 (partial loss of external enamel and changes in the anatomy of the buccal surfaces). The children selected, showed opacities that ranged from 1 to 4 according to the TF index.

Micro-abrasion technique

Prophylaxis and protection of the mucosa with solid vaseline, as well as, isolation under rubber-dam and protection of the patients eyes were performed before start the microabrasion procedure. The teeth 11 and 12 of each child were chosen for the microabrasion technique using the paste with a 37% phosphoric acid with pumice (group 1 – G1) applied with rubber cup, in slow speed for 10 seconds, in a total of six applications rinsing with copious water spray during 20 seconds in between each application of the acid.[13] An 18% hydrochloric acid with pumice (group 2 – G2) was applied on the buccal surfaces of the 21 and 22 incisors. This paste was applied in the same way as the teeth 11 and 12, but during 5 seconds in a total of 4 applications, intercalated by 5 second water spray rinsing.[15]

Following the microabrasion a paste with sodium carbonated and water was applied to neutralize the effect of the acids over the enamel surfaces. A soflex disks (Pop-on – 3M Espe, Minneapolis, Minnesota, USA), in slow speed for polishing were used. At the end of the section a 1.1% neutral sodium fluoride gel was applied for 4 minutes.

Data analysis

Photos were taken before, immediately after and one months post treatment. The photos were scanned and analyzed in software Paint Shop Pro 7 for the opacities demarcations, followed by an analysis in Image Pro Express 4.0 software used for the calculus of the opacities total area (Figures 1 and 2).

Non parametric Mann Whitney and Wilcoxon tests were used to verify the hypothesis of the immediate and final equality of the effect of the two pastes. The significance level was $p<0.05$.

RESULTS

The Pro Express 4.0 image analysis showed that the baseline percentage of the opacities in G1 and G2 were 55.10% and 53.74% respectively. Results immediately after and one month pos-treatment are showed in Table 1.

Immediately after treatment the opacities reduction was 61.06% in G1 and 70.26% in G2. One month later the percentage of reduction raised to 86.18% and 89.72% for G1 and G2 respectively (Table 2). These figures did not show significant difference between groups (Table 3).

Table 4 depicts the comparison of both groups immediately after treatment and after one month showing statistical significance.

Figures 1, 3 and 5 show clinical aspects of the enamel discolorations before and after treatment, in one patient. Figures 2, 4 and 6 display the demarcations of enamel opacities in the observed periods (same patient of Figures 1, 3 and 5).

DISCUSSION

Enamel stains can often be removed by microabrasion technique when confined to superficial enamel layers. Since this technique does not remove extensive tooth structure it could be considered a conservative method. The main advantage of the enamel microabrasion is that the surface quality improves as time passes after

Table 1. Baseline, immediately and one month after treatment percentages of the opacities.

	Mean		Std. Deviation	
	G1 (N=30)	G2 (N=30)	G1 (N=30)	G2 (N=30)
Baseline	55.10	53.74	19.83	22.26
Immediately after treatment	20.56	14.87	11.02	8.87
After one month	8.14	5.68	8.28	6.17

Table 2. Opacities reduction immediately and after one month (percentage).

	Mean		Std. Deviation	
	G1 (N=30)	G2 (N=30)	G1 (N=30)	G2 (N=30)
Immediately after treatment	61.06	70.26	21.27	19.87
After one month	86.18	89.72	12.64	9.62

Table 3. Comparison between G1 and G2 immediately and one month after treatment.

Groups 1 and 2	Mann-Whitney U	P
Immediately after treatment	318.00	0.051*
After one month	391.00	0.383*

* Non significant

Table 4. Comparison immediately and one after one month.

	Wilcoxon Z	P
G1	-4.782	< 0.001*
G2	-4.782	< 0.001*

* Significant

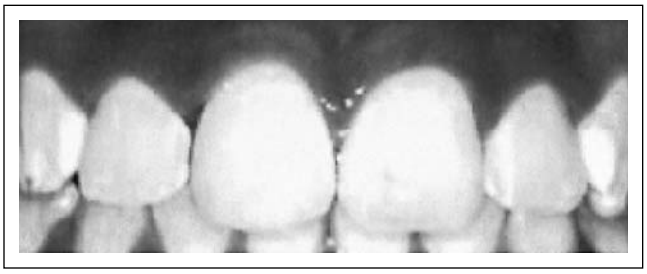

Figure 3. Clinical aspect of immediately microabrasion treatment.

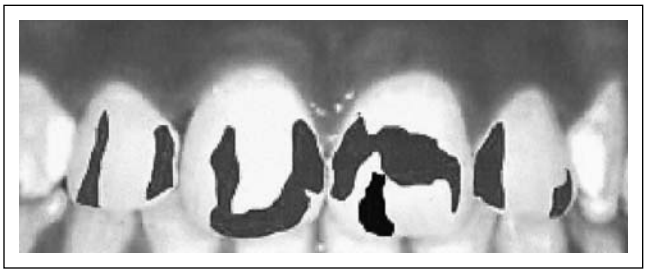

Figure 4. Stains demarcations of Figure 3.

treatment and in subsequent years. It has been stated that the treatment results in formation of a smooth enamel surface that develops a layer called "enamel glaze".[16]

During anamnesis and clinical examination, it was found that none of the children had caries experience in primary or permanent dentition, as well as, a very early initiation of dental cleaning using fluoridated toothpaste. Therefore it was suspected that the children could have swallowed an undesirable, amount of the dentifrice which could have caused a mild fluorosis level as suggest by Warren *et al*.[6,17] and Oliveira *et al*.[18]

Among the 15 treated patients, it was observed that the white stains when compared to brown stains, the latter had better results (Figures 1-6). It was also observed that the patients with mild degrees of fluorosis showed also better results. This data were confirmed by Train *et al*.[19]

Using rubber cup in slow speed for the acids application esthetical results were attained. According to Mondelli[14] and Soviero *et al*.[21] the use of rubber cup provides a more uniform and smooth enamel surface.

The results displayed in Table 1 show that the baseline opacity areas were similar in both groups. One month later the final area of the opacities comprised 8.4% in G1, using phosphoric acid while in G2 the reduction of the area was 5.68% (Table 1) when the hydrochloric acid was used. These results were statistically significant for both groups showing a marked reduction in the total area occupied by the opacities. Esthetic improvement of teeth undergoing microabrasion is the most important aspect of the treatment mainly to the patient, with the advantage that those unfluorosed appearances or enough reduction in fluorosis stains such that no further treatment is needed.[19] The patient and their parents were pleased with the results; therefore the parents complied with the follow up visits.

The total percentage of opacities reduction showed that in G1 it was obtained 61.06% and 70.26% in G2. After a month the percentage of reduction raised to 86.18% in G1 and 89.72% in G2 (Table 2). The difference between the two acids after a month was not statistically significant. What could be noticed is that appearance of the enamel surfaces have a tendency to

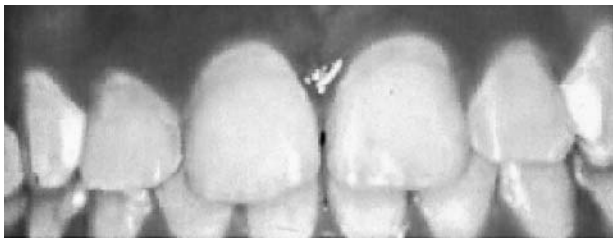

Figure 5. Clinical aspect of microabrasion treatment one month later.

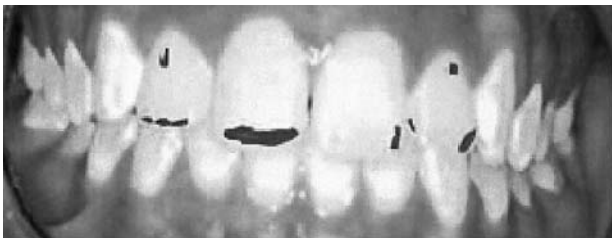

Figure 6. Stains demarcations of Figure 5.

improve as time goes by, clinically decreasing the area and size of the opacities. The microabrasion technique effects were also observed in the Croll studies.[9,11-12]

Concerning the two different acids, no clinical or statistically significant differences were found. The effects of phosphoric and hydrochloric acids are similar, suggesting that both can be used. The hydrochloric acid provides excellent results[10,11,20] in a small number of visits. Nevertheless is a very strong acid that demands careful techniques for its use to avoid damages on the soft tissues. On the other hand the phosphoric acid could be considered like a safe and efficient alternative,[13] furthermore it is an easily found substance at the dental office.

Sundfeld *et al*.[21] and Segura *et al*.[22] related the application of hydrochloric acid used in the microabrasion technique for enamel discoloration removal, was not capable to diffuse to the dentine-enamel junction. This could explain why none of the patients have reported post-operative sensitivity or any symptoms suggestive of pulpal damage. Although it could not be found any similar report concerning phosphoric acid, in the present study both acids clinically performed equally, since children did not complain of any discomfort.

Additionally, it could be said that the technique has also a positive psychological effects on patients. The children presenting esthetically compromised anterior teeth usually have a low self-steam and confidence. During the follow up controls the parents usually reported that their children had changed in behavior, after treatment by becoming outgoing and smiling without the fear of showing their teeth after treatment. The same observation was made by Powel and Craig.[23]

Even though the opacities were suggestive of fluorosis in the participants, Croll *et al*.[12] emphasized that the etiology is irrelevant when considering the success possibility in the correction of the enamel color, since the stains are confined to the more superficial enamel layer.

CONCLUSION

Based on the results it could be concluded that both acids can be used indistinctly and as time passes continue enamel color improvement occurs.

REFERENCES

1. Ten Cate AR. Oral histology- development, structure and function. 5th ed. St. Louis: Mosby, pp. 215-217, 1998.
2. Billings RJ, Berkowitz RJ, Watson G. Teeth. Pediatrics 113: 1120-7, 2004.
3. DenBesten PK. Biological mechanisms of dental fluorosis relevant to the use of fluoride supplements. Community Dent Oral Epidemiol 27: 41-47, 1999.
4. Houwink B, Wagg BJ. Effect of fluoride dentifrice usage during infance upon enamel mottling of the permanent teeth. Caries Res 13: 231-7, 1979.
5. Riordan PJ. Dental fluorosis, dental caries and fluoride exposure among 7-year-olds. Caries Res 27: 71-7, 1993.
6. Warren JJ, Levy SM. A review of fluoride dentifrice related to dental fluorosis. Pediatric Dentistry 21: 265-271, 1999.
7. Zbidi D, Zouiten S, Hajami H, Baccouche C. Treatment of dental fluorosis. Odontostomatol Trop 26: 28-32, 2003.
8. Thylstrup A, Ferjeskok O. Clinical appearance of dental fluorosis in permanent teeth in relation to histologic changes. Communit Dent Oral Epid 6: 315-328, 1978.
9. Croll TP. A case of enamel color modification: 60-year results. Quintessence Int 18:493-5, 1987.
10. McCloskey RJ. A technique for removal of fluorisis stains. J Am Dent Assoc 109: 63-4, 1984.
11. Croll TP, Cavanaugh RR. Enamel color modification by controlled hydrochloric pumice abrasion. I. technique and examples. Quintessence Int 17 : 81-87, 1986.
12. Croll TP, Cavanaugh RR. Hydrochloric acid pumice enamel surface abrasion for color modification: results after six months. Quintessence Int 17: 335-341,1986.
13. Mondelli J. Microabrasão com ácido fosfórico. Rev Bras Odont 52: 20-22, 1995.
14. FDI working group, Leader: Clarkson J. A review of the developmental defects of enamel index (DDE Index). Int Dent J 46: 411-426, 1992.
15. Croll TP. Enamel microabrasion: the technique. Quintessence Int 20: 395-400, 1989.
16. Croll TP, Segura A. Tooth color improvement for children and teens: enamel microabrasion and dental bleaching. J Dent Child 64: 17-22, 1996.
17. Warren JJ, Kangllis J, Levy SM. Fluorose na dentição decídua, o que isso significa para os dentes permanentes? JADA – Brasil 2: 7-17, 1999.
18. Oliveira ACB, Amaral, CRFL, Pereira CRS. Fluorose dentária: uma revisão bibliográfica. Rev. ABO Nac 8: 92-97, 2000.
19. TrainTE, McWhorter AG, Seale NS, Wilson CFG, Guo IY. Examination of esthetic improvement and surface alteration following microabrasion in fluorotic human incisors in vivo. Pediat Dent 18: 353-62, 1996.
20. Sovieiro VM, Modesto A, Monte-Alto LA, Massao JM, Ramos ME. Microabrasão do esmalte como tratamento estético da fluorose dentária. JBC – J Bras Odont Clini 1: 57-60, 1997.
21. Sundfeld RH, Croll TP, Mauro SJ, Komatsu J, Holland JC. Novas considerações clínicas sobre microabrasão do esmalte dental – efeitos da técnica e tempo de análise. Rev Bras Odont 52: 30-36, 1995.
22. Segura A, Donly KJ, Wefel JS. The effects of microabrasion on bacterial colonization and demineralization of enamel surfaces. Quintessence Int 28: 463-466, 1997.
23. Powel KR, Craig GG. A simple technique for the aesthetic improvement fluorotic-like lesions. J Dent Child 50: 112-117, 1982.