



An investigation of the transverse technique of dentifrice application to reduce the amount of fluoride dentifrice for young children

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Abstract

Purpose: Recent studies have shown an increase in the prevalence of fluorosis. Consequently, recommendations for the use of a small quantity of fluoride dentifrice, 0.25 to 0.5g or the equivalent of a "pea size" amount for children, have been made. This study evaluated a method of placing dentifrice in a transverse relation to the bristles (TT) and compares it to the standard technique used (ST) and to the "pea size" recommendation (PS).

Methods: The study was conducted in three phases: the first was in a laboratory setting using 22 commercial brands of children's toothbrushes; the second evaluated various recommendations with 240 mothers (Brazilian and Peruvian); and the third evaluated these recommendations in 135 Peruvian children (ages 4 to 6).

Results: The results showed that the mean quantity of dentifrice used with ST, PS, and TT was 0.58g, 0.34g, and 0.27g for the mothers and 0.46g, 0.29g, and 0.24g for the children, respectively. The average TT obtained through multiple weighing of 22 children's toothbrushes was 0.22g. Both recommendations (PS and TT) reduced the amount of dentifrice used. However, TT also yielded a smaller variation range. Mothers and children learn easily and prefer TT.

Conclusion: This technique could be recommended for young children in order to decrease the amount of fluoride dentifrice used, hence minimizing the potential inadvertent ingestion of fluoride dentifrice. (*Pediatr Dent* 22:312-317, 2000)

In recent years, along with a generalized decline in dental caries prevalence among children in the United States and other developed countries, there is evidence of an increase in the prevalence of dental fluorosis, in cities with fluoridated water as well as in cities which lack this preventive measure.¹⁻⁴ In Sao Paulo, Brazil, as light increase in the prevalence of fluorosis in the infant population is also evident.⁵

Dietary fluoride supplements^{6,7} and water fluoride¹⁻⁴ have been considered as risk factors for dental fluorosis. However, more recently, a number of studies have identified fluoride dentifrices as an important additional risk factor for dental fluorosis.^{6,8-11} In Brazil¹²⁻¹⁴ and Peru,¹⁵ nearly 100% of dentifrices contain fluoride. Children's dentifrices contain 1000-1100 ppm F, and the use of dentifrices with "high" fluoride concentrations (1450-1500 ppm F) has increased during recent years. Until 1993, only one dentifrice with high fluo-

ride concentration was available in Peru, however, currently nine brands can be found with this fluoride concentration.

Some studies in South America have shown that the use of dentifrice with fluoride is also used at early ages, especially in the infant population of big cities. In Sao Paulo, Brazil, it has been found that 52% of 12 month old and 100% of 36 month old children use dentifrices¹⁶ and in Lima, Peru, 72% of children from 1-3 years old use dentifrices on a regular basis (once or more a day).¹⁷ With a desire to educate the population in regard to the appropriate use of fluoride, practitioners are recommending that children under 7 years of age use smaller quantities of dentifrice with fluoride. Recommendations such as using 0.3g, 0.5g, a small quantity, or a "pea size" amount have appeared in scientific studies,¹⁸⁻²⁴ however, due to cultural factors, nutrition, and translation, there has been difficulty in transmitting these recommendations to sectors of the South American population (Brazil and Peru). The translations from English to Spanish or Portuguese recommend a "pea size" or a "bean size" or a "little bean size," yet this recommendation many times creates confusion due to the great variety of peas and beans found in food markets (Fig 1).



Fig 1. A pea size amount of dentifrice applied to a toothbrush compared with different sizes of peas and beans available in a typical food market.

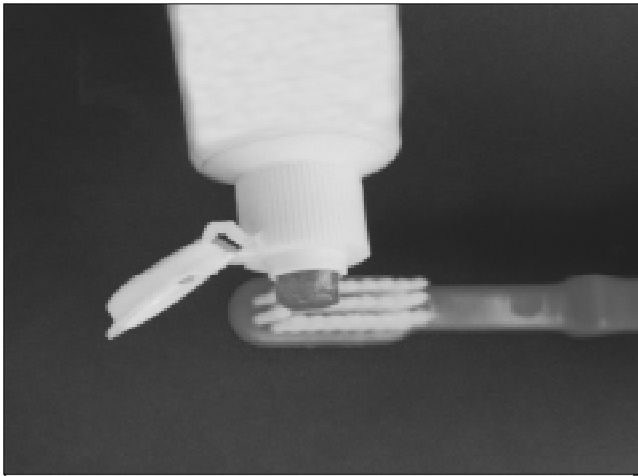


Fig 2. Transverse technique to apply dentifrice to toothbrush.

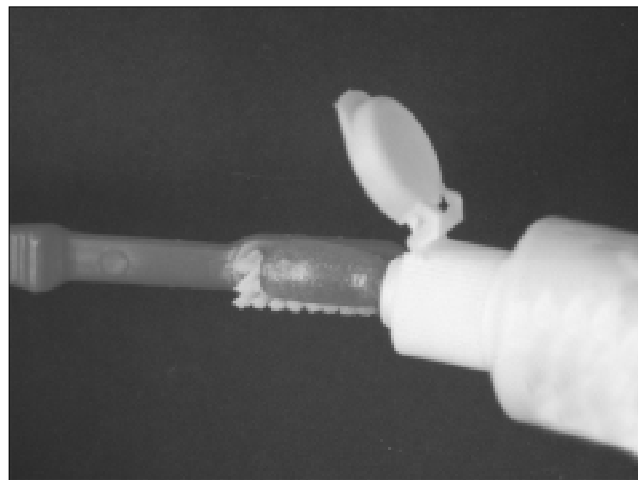


Fig 3. Conventional or standard application of dentifrice to toothbrush.

A preliminary study performed in 1995²⁵ found that dentifrice placed in a transverse direction to the bristles of the toothbrush (Fig 2) and not in a longitudinal direction as is commonly recommended (Fig 3), results in a smaller quantity of dentifrice used.

The purpose of this study was to evaluate this method called “transverse technique” compared with other previous recommendations for dentifrice use in mothers and children, as well as to verify the feasibility of its use in different commercial brands of children’s toothbrushes.

Methods

The study was divided into three phases:

Phase I: Laboratory phase

This phase was designed to evaluate the amount of dentifrice used with the transverse technique (TT) in a laboratory setting using 22 commercial brands of children’s toothbrushes found in South American stores. One operator weighed the amount of dentifrice placed on the following brands of toothbrushes.

The orifices of the toothpaste tubes (regular and for children) were also measured to verify the amount of dentifrice

<i>Toothbrush</i>	<i>Brand - manufacturer</i>	<i>Made in</i>
Periodica	Oral Care	USA
Kolynos Doctor	Kolynos	Brasil
Crest complete	Crest	USA
Tandy	Kolynos	Brasil
Alcance	Johnson & Johnson	Brasil
Reach	Johnson & Johnson	Brasil
Colgate Jr	Colgate	Mexico
Colgate Child	Colgate	USA
Condor Jr	Condor	Brasil
Johnsons Jr	Johnson & Johnson	Brasil
PRO 415	PRO	Colombia
Milch Zahn	Dr. Best	Germany
TEK infantil	TEK	Brasil
Junior 112	Butler GUM	USA
Child 111	Butler GUM	USA
P - 20	Oral B	USA
Aquafresh kids	Aquafresh	Germany
* Chicco	Artsana	Italy
* My first Colgate	Colgate	USA
* P - 5	Oral B	USA
* Todler 100	Butler GUM	USA
* Periodica	Oral Care	USA

*Recommended for infants and pre-school children

dispensed. The only difference found in the diameter or form of the orifices were in the Colgate Junior Super Star - Colgate, dentifrice, which presented a star shaped exit. Because of this difference each toothbrush was measured 10 times in the amount of dentifrice delivered using TT, 5 times with the standard round orifice (A) and 5 times with Colgate Junior, star shaped orifice (B).

Phase II: Clinical phase with parents or guardians

The second phase of the study compared the amount of dentifrice used with different methods of application of dentifrice to the toothbrush. Recruited were 100 Brazilian (from 1994 to 1996) and 140 Peruvian (during 1998) parents or guardians from the University Hospital, University of Sao Paulo, SP, Brazil (city with fluoridated water), and from the Rimac Hospital in Lima, Peru, during the national vaccination campaigns, a time of year when a great number of children under the age of 7 are in attendance.

The mothers were interviewed and those with children from 1-5 years old who usually applied the dentifrice to the toothbrushes of their children were selected. Appropriate informed consent procedures were used before participation in the study.

Initially parents were given a toothbrush and asked to apply the quantity of dentifrice which they usually used (ST). Later, they were instructed to apply a small “pea size” amount (PS). Finally mothers were instructed and used the transverse technique (TT). Three toothbrushes were used by each participant, the same that were weighed before and after each measurement. The same brand of toothbrush and of dentifrice

(Tandy® Kolynos, Brazil) was used for phases II and III of the study.

Phase III: Clinical phase with children

Children who usually dispense the dentifrice themselves (4-6 years old) were selected by interview to verify and compare the amount of dentifrice used with the different recommendations. The methods were similar to Phase II, but were limited to 135 Peruvian children who were recruited from the Rimac Hospital in Lima, Peru, with appropriate informed consent from their parents or guardians. All the participants received orientation about mouth hygiene and the appropriate use of fluoride when they completed the study.

Data analyses were conducted using the Statistical Package for Social Sciences (SPSS). Non-parametric techniques were used (2 related samples: Wilcoxon; 3 related samples: Friedman and 2 independents groups: Mann Whitney). The level of statistical significance was set at $P < 0.05$.

Results

The average amount of dentifrice delivered with TT obtained from multiple testing of 22 children's toothbrushes was 0.22g (Infant toothbrushes \bar{x} = 0.14g, and Children's toothbrushes, \bar{x} = 0.26g). A statistically smaller amount of dentifrice ($P < 0.001$) was obtained when using TT in toothbrushes designed for children between 1 and 3 years old. Although less toothpaste was applied using the star (B) rather than the round nozzle (A), this difference was not statistically significant (Table 1).

Table 2 summarizes the results concerning the amount of dentifrice used by Brazilian and Peruvian mothers (M) and children (CH), using ST, PS and TT. When the three techniques were evaluated, it was observed that $ST > PS > TT$.

The results showed that in all the techniques used the mothers always used more dentifrice than the children. The measures obtained using ST, PS and TT were 0.58g, 0.34g, 0.27g, and 0.46g, 0.29g, 0.24g respectively for mothers and children. The range of variation for mothers and children were 0.08-0.91g and 0.07-0.74g, respectively. It is important to note that a smaller range was obtained with TT in both groups, showing a better pattern or dosage with this technique (Fig 4).

Discussion

It is a frequent practice in pediatric dentistry to recommend the use of a small quantity or a pea size amount of dentifrice for young children.^{7,10,11,18-24} This is due to a concern for the development dental fluorosis associated with ingestion of dentifrice in small children, caused by inadequate expectoration of the dentifrice.²⁶ The critical period for esthetic changes that would affect the permanent maxillary incisors is an interval that varies from 22-26 months,²⁷ or even from 15-30 months.²⁸ This age group may require greater attention, without meaning that children between 4 and 6 years old should not be considered.^{8,23} Reducing the concentration of fluoride in dentifrices (250-500 ppm F) is in effect in some European countries, New Zealand, and Australia.^{19,29} Nevertheless, unlike in the USA,³⁰ these reduced fluoride concentration dentifrices are not available in Brazil or Peru,¹²⁻¹⁵ and this factor increases the importance of methods to reduce the amount of dentifrice used for children.

In this study, the placement of dentifrice in a transverse direction on the bristles of the toothbrush was found to be a method to reduce the amount of dentifrice used. The feasibility of its use was evaluated in the first phase of the study, and it was found that, despite the variety of designs and sizes of the toothbrushes available for children under the age of 7, the quantity of dentifrice used was always below the amount considered

Table 1. Amount of Dentifrice (Grams) Used With the Transverse Technique (TT) in Different Brands of Children's Toothbrushes Using Dentifrice Tubes With Different Shapes of Nozzles (A: Round and B: Star Shaped).

Dentifrice shapes of nozzle	Toothbrushes	Mean	Median	Range	Standard Deviation	$P <^*$
A	Children** (N=17)	0.26	0.25	0.18 - 0.32	0.05	0.001
	Infant /toddler† (N=5)	0.14	0.14	0.11 - 0.21	0.03	
B	Children** (N=17)	0.25	0.25	0.17 - 0.30	0.04	0.001
	Infant/toddler† (N=5)	0.13	0.13	0.10 - 0.19	0.02	

* Mann Whitney test for the comparison of groups

** No significant difference when dentifrice A and B are compared on children's toothbrushes ($P > 0.05$) with the Wilcoxon test

† No significant difference when dentifrice A and B are compared on infant toothbrushes ($P > 0.05$) with the Wilcoxon test

Significant statistical differences ($P < 0.001$) were found when the three groups of subjects were compared: Brazilian mothers > Peruvian mothers > children. In Table 3 the results are summarized and distributions of estimated average quantity of fluoride dentifrice used for all mothers (N=240) and children (N=135), in that way comparing only two groups of popula-

to be a "small size" (0.25-0.5g), and it should be noted that when infant toothbrushes were used the measure was 0.14 g. This amount is similar to the use of a "smear" described by Rock²³ and evaluated by Bertley et al.,²⁴ where it was shown that the average weight of a "pea size" was equivalent to 0.3g, and 0.22g when a "smear" was recommended.

Table 2. Amount of Dentifrice (Grams) Dispensed by Brazilian/Peruvian Mothers and Peruvian Children Using the Standard Technique (ST), a Pea-Size Amount (PS) and the Transverse Technique (TT)

Group	Technique	Mean	Standard Deviation	Median	Range	P<†
Brazilian mothers (N=100)	ST	0.58**	0.16	0.59	0.24 – 0.91	0.001
	PS	0.37*	0.13	0.34	0.12 – 0.78	
	TT	0.29	0.07	0.30	0.10 – 0.41	
Peruvian mothers (N=140)	ST	0.56**	0.18	0.58	0.15 – 0.88	0.001
	PS	0.32*	0.13	0.32	0.08 – 0.65	
	TT	0.26	0.07	0.26	0.11 – 0.39	
Peruvian Children (N=135)	ST	0.46**	0.16	0.48	0.12 – 0.74	0.001
	PS	0.29*	0.12	0.28	0.07 – 0.62	
	TT	0.24	0.07	0.22	0.07 – 0.39	

* Statistically significant (P<0.001) when PS – ST and PS – TT were compared (Wilcoxon)

** Statistically significant (P<0.001) when ST – TT were compared (Wilcoxon)

† Friedman statistical test to compare the three techniques

When a “pea size” (0.30 g) amount of a dentifrice with 1000 ppm fluoride is used, a child would be exposed to 0.30 mg F. If a “pea size” amount of a dentifrice of 500 ppm was used, the exposure would be cut by half, or to 0.15 mg F. However, when TT was used with infant toothbrushes, the amount was 0.14 g. In other words, even though a dentifrice of 1000 ppm F was used, the exposure would be 0.14 mg F, which is practically the same as that found when using a “pea size” amount with a dentifrice of 500 ppm F. This finding shows that besides reducing the fluoride concentration of the dentifrice, another strategy would be to reduce the quantity of dentifrice used, especially in small children.

Pendry³⁰ observed that using more than a “pea size” amount of toothpaste throughout the first eight years of life contributed to more than 70% of fluorosis in children who grew up in optimally fluoridated communities. It supports the belief that it is the amount of toothpaste during the early years and not the frequency of brushing itself that is an important underlying fluorosis risk factor. Another aspect that is important to emphasize, apart from the amount of toothpaste used, is the risk from other sources of fluoride to which the child may be exposed.^{7,21,30,31} Additional studies should be performed to examine if the efficiency of the dentifrice, in terms of preventing dental caries, is affected when the quantity used is reduced.³⁴⁻³⁹

When the results of the second and third phases were evaluated, it was observed that when PS was compared with ST and TT was compared with ST, reductions of 41% (M), 37% (CH), and 53% (M), 48% (CH) were reached, respectively. When TT (0.27 g (M) and 0.24g (CH)) was compared with PS (0.34 (M) and 0.29 (CH)), significant statistical differences (P<0.001) of 0.07g (M) and 0.05g (CH) were found, but these were not clinically meaningful. The most important finding is that TT in comparison with PS showed a smaller range of variation indicating that TT was easy to be standardized; TT was always below 0.5 g, in comparison with PS where values of 0.78g (M) and 0.62g (CH) could be found. This indicates that the PS recommendation can create confusion with a lot of individual variability. The Brazilian mothers, when compared with the Peruvian ones, used more dentifrice and started hygiene of their children’s teeth at much younger ages. This aspect in terms of

fluorosis risk should be considered, since Sao Paulo in comparison to Lima has fluoridated water.

When the results of the mothers and the children were compared, it was observed that mothers used more dentifrice. This result may be associated with a greater pressure used on the tube, better motor coordination, or the frequently held belief related by the mothers: “I thought that the more dentifrice I used, the better it would be”.

An additional aspect that deserves comment is that, with the exception of three children, all participants placed the dentifrice in a longitudinal direction on the bristles of the toothbrushes as in the Standard Technique (ST). This is probably related to marketing campaigns of the manufacturers and could probably explain the quantity of dentifrice usually placed (ST) that on average proved to be high.

The TT was found to be a feasible method to use, easy to standardize, and easy to be understood by the mothers and children from 4-6 years of age, which during the study showed that they preferred this method. For this reason, it could be considered as an alternative educational message in relation to the appropriate use of fluoride dentifrice. It is important to note that other precautions such as: parental responsibility for the placement of the dentifrice and the supervision of the brush-

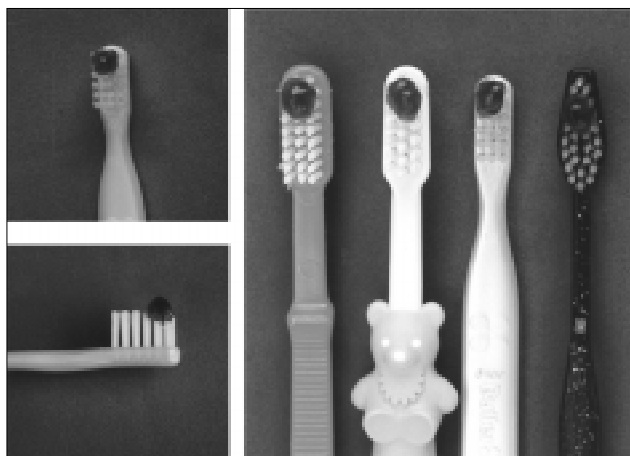


Fig 4. Toothpaste applied to different brands of infants and children’s toothbrushes with the transverse technique.

Table 3. Amount of Dentifrice (Grams) Dispensed by Mothers (n=240) and Children (N=135) Using the Standard Technique (ST), a Pea-Size Amount (PS) and Transverse Technique (TT)

<i>Technique</i>	<i>Group</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Median</i>	<i>Range</i>	<i>P<*</i>
ST	Mothers (N=240)	0.58	0.17	0.56	0.15 - 0.91	0.001
	Children (N=135)	0.46	0.16	0.48	0.12 - 0.74	
PS	Mothers (N=240)	0.34	0.13	0.33	0.08 - 0.78	0.001
	Children (N=135)	0.29	0.12	0.28	0.07 - 0.62	
TT	Mothers (N=240)	0.27	0.07	0.27	0.10 - 0.41	0.001
	Children (N=135)	0.24	0.07	0.22	0.07 - 0.39	

* Mann Whitney statistical test to compare both groups.

ing; special attention to flavored dentifrice for children that may result in encouraging its ingestion; not leaving dentifrice within the reach of the children; use of small toothbrushes, especially in children under 3 years of age; and not recommending dentifrices with a high concentration of fluoride, especially in cities with fluoridated water.^{10,11,21,30,37-39} Eliminating the manufacturer's promotion of use of a full strip of dentifrice and avoiding the use of phrases on the boxes of products for children such as "soft and delicious flavor that children adore" are additional measures that could contribute to a reduction in dentifrice amount. Additional studies that would evaluate the efficacy and the necessity of introducing dentifrices with lower concentrations of fluoride than the conventional ones found in the actual market are also necessary. The prevention of ingestion of large quantities of fluoridated dentifrice by young children continues to be an important problem that should be recognized not only by health professionals (dental team and pediatricians), but also by professional organizations and manufacturers.

Conclusions

1. The transverse technique for dispensing dentifrice is easier to use and to dispense consistently small amounts of dentifrice. It is well accepted by parents and young children.
2. This technique could be recommended for young children to decrease the amount of fluoride dentifrice dispensed, minimizing inadvertent dentifrice ingestion and the risk of developing dental fluorosis.

Partial results of this research were presented at the 1999 annual meeting of the International Association for Dental Research, Vancouver, Canada.

The author thanks the facilities given by University of Sao Paulo, School of Dentistry, during her postgraduate studies and Lic. Jorge Medina for the statistical analysis.

References

1. Clark DC: Trends in prevalence of dental fluorosis in North America. *Community Dent Oral Epidemiol* 22:148-52, 1994.
2. Szpunar SM, Burt BA: Trends in the prevalence of dental fluoride in the United States: a review. *J Public Health Dent* 47:71-79, 1986.
3. Leverett D: Prevalence of dental fluorosis en fluoridated and nonfluoridated communities: a preliminary investigation. *J Public Health Dent* 46:184-87, 1986.
4. Pendrys DG, Stamm JW: Relationship of total fluoride intake to beneficial effects and enamel fluorosis. *J Dent Res* 69:529-38,1990.
5. Tomita NE, Panighel CPMA, Narvai PC, Lopes ES, Palma RG: Implicacoes da vigilancia a saude sobre ocorrencia de fluorose dentaria. *Anais da Sociedade Brasileira de Pesquisa Odontologica. IADR – Brazilian Section* 66: 1994 [Abst. 127].
6. Lalumandier JA, Rozier RG: The prevalence and risk factors of fluorosis among patients in pediatric dental practice. *Pediatr Dent* 17: 19-25, 1995.
7. Pendrys DG, Katz RV: Risk of enamel fluorosis associated with fluoride supplementation, infant formula, and fluoride dentifrice use. *Am J Epidemiol* 130:1199-1208, 1989.
8. Osuji O, Leake JL, Chipman ML, Nikiforuk G, Levine N : Risk factors for dental fluorosis in a fluoridated community. *J Dent Res* 67:1488-92, 1988.

9. Skotowski MC, Hunt RJ, Levy SM: Risk factors for dental fluorosis in pediatric dental patients. *J Public Health Dent* 55:154-59, 1995.
10. Levy SM, Zarei-MZ: Evaluation of fluoride exposures in children. *ASDC J Dent Child* 59:467-73, 1991.
11. Levy MS, Kiritsy MC, Slager SL, Warren JJ, Kohout FJ: Patterns of fluoride dentifrice use among infants *Pediatr Dent* 19:50-55, 1997.
12. Cury JA: Estabilidade do flúor nos dentifrícios brasileiros. *RGD* 34:430-32, 1986.
13. Cury JA : Dentifrícios fluoretados no brasil. *RGD* 37:139-42, 1989.
14. Cury JA : Dentifrícios fluoretados. *Jornal ABOPREV*, p.3, maio/junho, 1996.
15. Villena RS, Myaki I, Cury JA: Disponibilidad y estabilidad de dentifrícios peruanos. *Rev Estomatol Herediana*. 4:12-20, 1994.
16. Villena RS, Borges DG, Fonoff de NR, Rodrigues CRMD: Estudo comparativo sobre o uso de dentifrícios fluoretados em crianças. *Anais da Sociedade Brasileira de Pesquisa Odontologica. IADR – Brazilian section*: 86, 1996 [Abst. 122].
17. Villena RS: Hábitos de higiene bucal y uso de dentifrícios fluorados en niños peruanos. *Mundo Odontológico*, in press.
18. Pang DTY, Vann WF: The use of fluoride containing toothpastes in young children: the scientific evidence for recommending a small quantity. *Pediatr Dent* 14:384- 87, 1991.
19. Riordan PJ: Dental fluorosis, dental caries and fluoride exposure among 7 years olds *Caries Res* 27:71-7, 1993.
20. Pendrys DG, Katz RV, Morse DE : Risk factors for enamel fluorosis in a fluoridated population. *Am J Epidemiol* 140:461-71, 1994.
21. Levy MS : A review of fluoride intake from fluoride dentifrice. *J Dent Child* 60:115-124, 1993.
22. Masacarenhas AK, Burt BA: Fluorosis risk from early exposure to fluoride toothpaste. *Community Dent Oral Epidem* 26:241-48, 1998.
23. Rock WP Young children and fluoride toothpaste. *Br Dent J* 177:17-20, 1994.
24. Bertley EM, Ellwood RP, Davies RM : Factors influencing the amount of fluoride toothpaste applied by the mothers of young children. *Brit Dent J* 183:412-14, 1997.
25. Villena RS, Ando T: Transversal technique for the placement of fluoride dentifrice: an alternative for young children. *J Dent Res* 75:1107, 1996 [Abst236].
26. Brunn C, Thylstrup A: Dentifrice usage among Danish children. *J Dent Res* 67:1114-17, 1988.
27. Evans RW, Stamm JW: An epidemiologic estimate of the critical period during which human maxillary central incisors are most susceptible to fluorosis. *J Public Health Dent* 51:251-59, 1991.
28. Evans RW, Darvell BW: Refining the estimate of the critical period for susceptibility to enamel fluorosis in human maxillary central incisors. *J Public Health* 55:238-49, 1995.
29. Horowitz HS: The need for toothpastes with lower than conventional fluoride concentrations for preschool-aged children. *J Public Health Dent* 52:216-21, 1992.
30. Pendrys DG: Risk of fluorosis in a fluoridated population. *J Am Dent Assoc* 126:1617-24, 1995.
31. Shulman ER, Vallejo M: Effect of gastric contents on the bioavailability of fluoride in humans. *Pediatr Dent* 12: 237-40, 1990.
32. Reed MW: Clinical evaluation of three concentrations of sodium fluoride dentifrice. *JADA* 87:1401-3, 1973.
33. Winter GB, Holt RD, Williams BF: Clinical trial of low fluoride toothpaste for young children. *Int Dent J* 39:227-36, 1989.
34. Koch G, Pertersson LG, Kling E: Effect of 250 and 1000 ppm fluoride dentifrice on caries. *Swed Dent J* 6:233-38, 1982.
35. Ripa LW: A critique of topical fluoride methods (dentifrices, mouthrinses, operator, and self-applied gels in an area of decreased caries and increased fluorosis prevalence. *J Public Health Dent* 51:23-41, 1991.
36. Beltran ED, Szpunar SM: Fluoride in toothpastes for children: suggestions for change. *Pediatr Dent* 10:185-88, 1988.
37. Levy SM, Kohout FJ, Kiritsy MC, Heilman JR, Wefel JS: Infant's fluoride ingestion from water supplements and dentifrice. *JADA* 126:1625-32, 1995.

ABSTRACT OF THE SCIENTIFIC LITERATURE



HISTOPATHOLOGICAL EVALUATION OF THE DENTAL PULPS IN CROWN-FRACTURED TEETH

A detailed description of the histological findings on pulp tissue removed from 23 crown-fractured incisors. Patients presented for treatment from between 1_ hours to 20 days post-trauma. 16 teeth were enamel/dentin fractures, the remaining 7 fractures involved the pulp; all teeth had completed root development. Pulp tissue was removed and fixed, sections were examined by microscope. Early and late effects on both vascular and neural tissue were described and demonstrated on figures depicting the histological sections. The response of the pulp, in this study, was variable and did not always follow classical stages of inflammation.

Comments: The article reviewed the histological level of pulpal changes after trauma; however, the age of the patients, types of injury, compounding injuries, results of radiographic and vitality testing, among other issues, were not presented. In spite of these omissions, the paper presents a good review and discussion on the dynamic nature of pulp tissue. RFM

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Histopathological Evaluation of the Dental Pulp in Crown-Fractured Teeth, Özçelik B, Kuraner T, Kendir B, A_an E. *J Endodon*25(5): 271-273, 2000.

13 references