ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

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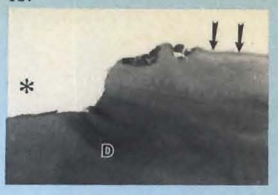
During the third year of life (Phase VII), if things go well, you can expect to see all the dimensions of competence become functional. In the area of intelligence we hope that the two-year old will enter a new level of intellectual function that increasingly features the use of ideas in the mind. Most of the intelligence shown in the first two years of life was problem solving with hands and eyes, on a trial-and-error basis, sensorimotor intelligence according to Piaget. The child over two years of age will often consider alternatives in his head, choose the one most likely to succeed, and then act. It is the shift from trial-and-error to thinking a problem through that takes place in late infancy. He now knows enough about chains of events to anticipate consequences. Piaget said that he is egocentric in his thinking, in that he tends to see things exclusively from his own point of view. He has, however, become a thinker.

Jean Piaget –1952

INTELLIGENCE IS QUICKNESS TO APPREHEND AS DISTINCT FROM ABILITY, WHICH IS CAPACITY TO ACT WISELY ON THE THING APPREHENDED.

—Alfred North Whitehead



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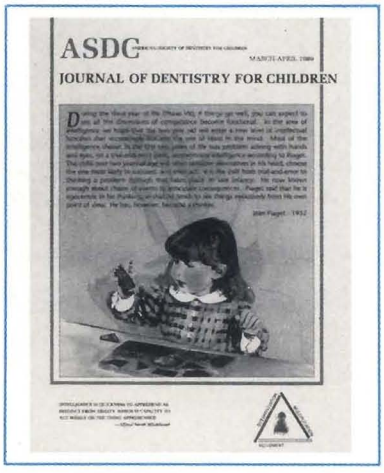

Problem solving by trial and error is increasingly replaced by thinking a problem through, in the third year of life. The child is now able to anticipate consequences. He has become a thinker. Art and design by Sharlene Nowak-Stellmach.

CLINIC

DEMOGRAPHY

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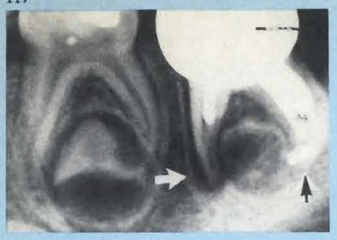

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For the busy reader

A clinical evaluation of a light-cured fissure sealant (Helioseal®)—page 97

A white-shaded, unfilled visible-light-cured sealant on Isosit-base (Helioseal®) was evaluated; retention rate, marginal adaptation, secondary caries, and presence of air bubbles were checked six, twelve, eighteen, and twenty-four months after placement. Clinical results (97 percent fully retained) were evaluated as a function of application techniques described previously.

Requested for reprints should be directed to Dr. Luc G. De Craene, Universitair Ziekenhuis, Kindertandheelkunde, De Pintelaan 185, B-9000 Gent, Belgium.

An allergy to local anesthetics? The consequences of a misdiagnosis—page 103

Adverse reactions to local anesthetics are relatively uncommon and quite variable; a wrong diagnosis can have unfortunate consequences. An example is presented, in which such a reaction was improperly diagnosed as an allergic reaction. The seizure activity after lidocaine administration was thought to be a toxic reaction; intravascular injections are the most frequent cause.

Requests for reprints should be directed to Dr. Stephen J. Goepferd, Department of Pediatric Dentistry, University of Iowa, College of Dentistry, Iowa City, IA 52242.

Localized prepubertal periodontitis: literature review and report of case—page 107

Relatively little is known about this condition; it begins soon after the eruption of a primary tooth and is characterized by mild gingival inflammation, pocket formation, and bone resorption around a limited number of primary teeth. Juvenile periodontitis starts at puberty, and its destruction proceeds very rapidly.

Requests for reprints should be directed to Dr. David R. Myers, Acting Associate Dean for Clinical Science, School of Dentistry, Medical College of Georgia, Augusta, GA 30912.

Effects of trauma to the primary incisors on their permanent successors: multidisciplinary treatment—page 112

Dental trauma is often a local factor in malocclusion. A brief summary is presented of the sequelae of trauma to the primary dentition in both a longitudinally followed sample and in a representative case.

Requests for reprints should be directed to Dr. Y. Ben-Bassat, Department of Orthodontics, Hebrew University, Hadassah School of Dental Medicine, P.O. Box 1172, Jerusalem, Israel.

Endodontic treatment of infected primary teeth, using Maisto's paste—page 117

A method of endodontic treatment, using a modification of Maisto's paste, is suggested for the preservation of infected primary teeth. Adding zinc oxide and other antibacterial materials to the original Walkhoff's paste, for pulp canal medication and final filling, seems to improve the pharmacological effect of the paste by reducing the resorption rate. A case with a 3.5-year follow-up period is presented.

Requests for reprints should be directed to Dr. Eliyahu Mass, Department of Pediatric Dentistry, School of Dental Medicine, Tel- Aviv University, Tel-Aviv, 69978, Israel.

Pediatric dentistry in a period of decreasing numbers of dentists—page 121

The availability of pediatric dental services is considered in terms of the projected decreases in the number of dentists to provide services to the general population.

Requests for reprints should be directed to Dr. H. Barry Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

Dental insurance coverage and the use of dental services by children—page 125

The increasing availability of dental insurance for children, and the relationship between insurance and dental visits are detailed. More than 40 percent (23.7 million) of the nearly 56 million children in the U.S. in 1986 were covered by some form of private dental insurance. A greater percentage of insured children had dental visits, compared with uninsured counterparts.

Requests for reprints should be directed to Dr. H. Barry Waldman, Professor and Chairman, Department of Dental Health, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

The study of caries prevalence in children in a developing country—page 129

This study investigated the prevalence of dental caries in rural Guatemala. Subjects from four communities were examined and evaluated, with particular attention given to several hypothesized causal factors. A correlation was found between caries prevalence and family patterns of sugar consumption, age, socioeconomic status, and place of residence.

Requests for reprints should be directed to Dr. Peter J. Fos, Tulane University Medical Center, School of Public Health and Tropical Medicine, 1430 Tulane Avenue, New Orleans, LA 70112.

Prevalence of selected developmental dental anomalies in children in Sri Lanka—page 137

Dental anomalies of schoolchildren in Kandy, Sri Lanka are described. In the study, 42 percent of the 683 children aged 13-16 years residing in a low-fluoride area had some form of dental anomaly. The most prevalent type was enamel defects. Tetracycline-staining of the teeth and hypoplasias due to systemic childhood diseases (e.g. diarrhea) raise concern as well.

Requests for reprints should be directed to Dr. K.A.A.S. Warnakulasuriya, Department of Oral Medicine, Faculty of Dental Sciences, University of Peradeniya, Peradeniya, Sri Lanka.

The relationship of breastfeeding to oral development and dental concerns—page 140

Infant feeding practices may affect the life-long health of the child. Healthcare professionals should be familiar with appropriate practices, such as breastfeeding, and encourage parents accordingly.

Requests for reprints should be directed to Ms. Kristine M. Westover, 5899 Fiesta Drive, Newburg, IN 47636.

Severe infraclusion ankylosis: report on three cases—page 144

Tooth ankylosis may occur at any time during eruption, exhibiting varying degrees of infraclusion. Cases of fully erupted teeth subsequently becoming totally imbedded in bone are rare; three severe cases are reported here, with etiology and related problems also discussed. Associated periodontal, prosthetic and orthodontic problems can be avoided with early diagnosis and treatment.

Requests for reprints should be directed to Dr. Raphael Pilo, Department of Oral Rehabilitation, the Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.

Tetralogy of Fallot: Characteristics, dental implications and case study—page 147

The sequelae of infection in patients with this syndrome, in which the etiology is unknown but is thought to be related to the embryogenesis of the ventricular septum, are such that the practitioner may have to reevaluate some of the standard and acceptable clinical procedures. Treatment plans must remain appropriate in children with severe congenital heart disease. The importance of home care must be constantly emphasized.

Requests for reprints should be directed to Dr. Roy A. Rockman, DENTAC, Fort Riley, KS 66442.

A clinical evaluation of a light-cured fissure sealant (Helioseal®)

Clinic

Luc G.P. De Craene, DDS
Luc C. Martens, DDS, PhD
Luc R. Dermaut, DDS, PhD
Paul A.S. Surmont, DDS

During the last two decades several studies showed that pit and fissure sealants prevent occlusal caries.[1-27] In most studies ultraviolet (UV)-light-cured sealants and/or autopolymerized fissure sealants were used. The latter gave better long-term retention-rate results, as shown in tables 1A and 1B. Only a few reports of visible-light-cured sealants could be found.[28,29]

In the present study a white-shaded, unfilled visible-light-cured sealant on Isosit-base (Helioseal®)* was used. An evaluation was made of the retention rate, the marginal adaptation, the secondary caries and the presence of air bubbles, six, twelve, eighteen, and twenty-four months after placement. Further, the clinical results were evaluated as a function of the application techniques described by De Craene *et al.*[30,31]

MATERIAL AND METHODS

A total of 322 maxillary and 334 mandibular sites were sealed with a visible-light-cured sealant in ninety-two

* Helioseal®: Vivadent, Schaan-Lichtenstein.

Dr. Luc G.P. De Craene, Dr. Luc C. Martens, and Dr. Paul A.S. Surmont are "Assistant Professor", Department of Pedodontics, and Dr. Luc R. Dermaut is Chairman, Department of Orthodontics and Pedodontics at the State University of Ghent, De Pintelaan 185, B - 9000 Ghent, Belgium.

Table 1A ☐ Occlusal sealant retention rates in permanent teeth: results of clinical trials using Bis-GMA Sealants (1970-1984) (After De Craene *et al*, 1986).

Study	Type of permanent teeth*	Method of cure**	Retention: Completely covered teeth (%) 1	2	3	4 (year)	5	6	7
Brooks, 1979	–	UV	–	–	58	–	–	–	–
Buonocore, 1970-1971	P,M1,M2	UV	99	87	–	–	–	–	–
Doyle, 1975-1978	P,M1,M2	UV	97	66	65	63	–	–	–
Going, 1976-1977	P,M1,M2	UV	–	69	–	50	–	–	–
Horowitz, 1974-1977	P,M1,M2	UV	–	73	–	50	42	–	–
McCune, 1973	P,M1,M2	UV	88	–	–	–	–	–	–
Mertz-Fairhurst, 1978-1984	M1	UV	84	58	60	35	35	37	31
Messer, 1978-1980	M1	UV	50	30	25	–	–	–	–
Rock, 1973-1977	M,M1,M2	UV	86	80	70	–	–	–	–
Stephen, 1978	M1	UV	93	–	–	–	–	–	–
Brooks, 1976-1979	M1	Chem.	95	–	84	–	–	–	–
Charbeneau, 1977-1979	M1	Chem.	79	71	60	52	–	–	–
Fuks, 1982	M1	Chem.A	70	–	–	–	–	–	–
Fuks, 1982	M1	Chem.B	55	–	–	–	–	–	–
Gibson, 1982	M1	Chem.	–	–	–	–	67	–	–
Houpt, 1978-1983	M1	Chem.	94	88	83	73	67	58	–
McCune, 1977-1979	M1,M2	Chem.	92	89	88	–	–	–	–
Mertz-Fairhurst, 1978-1984	M1	Chem.	95	84	80	72	72	68	66
Richardson, 1978	M	Chem.	–	86	–	–	–	–	–
Rock, 1973-1974	P,M1,M2	Chem.	53	52	–	–	–	–	–
Rock, 1980	–	Chem.	–	–	41	–	–	–	–
Rock, 1984	M1	Chem.	–	–	75	–	–	–	–
Simonsen, 1978-1981	P,M1,M2	Chem.	96	96	94	–	–	–	–

*P = Premolars; M1 + M2 = 1st and 2nd molars.
**UV = Ultraviolet light polymerized sealant.
Chem. = Chemically polymerized sealant.

children. The ages ranged between six and seventeen years. The following permanent teeth were considered in the study:

- ☐ The first and second maxillary and mandibular molars.
- ☐ The first and second maxillary and mandibular premolars.
- ☐ The first and second maxillary incisors (palatal pits).

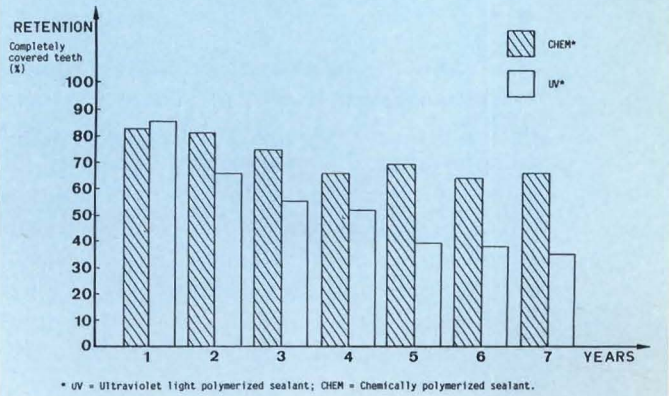
For the maxillary first and second molars, two different sites were scored: the occlusal pits and fissures in a first group and the palatal pits in a second one. For the mandibular first and second molars a distinction was made between the occlusal pits and fissures and the buccal pits.

All sealants were placed at the Department of Pedodontics at the State University of Ghent, Belgium. They were placed by trained practitioners as well as by dental students.

Before the examination of the surfaces with a short, sharp, straight probe, all teeth were cleaned with a dry brush and rinsed with water. Cotton rolls were used to isolate the teeth.[1] This simple method was preferred since no significant difference in clinical efficacy has been found between isolation with cotton rolls and rubber dam for pit and fissure sealing.[32-34]

Depending upon the diagnosis, two different options for a treatment were considered. For "open" fissures, not retentive of the explorer, and not suspected of caries, the noninvasive pit and fissure sealing technique (PFS) was chosen. In case of deep, narrow, discolored, and fissures narrow enough to retain an explorer, and suspected of caries, the invasive pit and fissure sealing technique (PFSI) was preferred. These two techniques may be considered as prophylactic treatments, limited to the enamel.

Table 1B. ☐ The average sealant retention rate in permanent teeth as a function of time. A comparison of results of clinical trials using UVlight polymerized and chemically polymerized sealants (1970-1984). (According to the referred authors in table 1A).



* UV = Ultraviolet light polymerized sealant; CHEM = Chemically polymerized sealant.

The preparation of the fissures was performed with KOMET† Burs nr. 806-314-466514-031 and 806-314-465514-016. Sometimes burs nr. 500-204-0011001-006 and 500-204-001001-008 were used to finish the preparation.[30] The teeth were etched with a 37 percent phosphoric acid (Vivadent Email Preparator Blau) for forty seconds and rinsed with a water-air spray during the same period. Dry cotton rolls were placed and the etched surfaces were thoroughly dried with compressed air, free of oil and moisture. The characteristic frosty white, chalky appearance of the etched

†Komet, Gebr. Brasseler (Lemgo, Germany).
‡Litema, Pluraflex Halogen HL 250EC, Munchen, Germany.

Table 2 ☐ Results of the sealed sites using PFS (24 months).

		Number of sites	Retention (%) +/−	Retention (%) +	Marginal adaptation (%) +	Secondary caries (%) +	Air bubbles (%) +
Max.	7 P	4	25	75	75	0	0
	7 P	5	20	80	80	0	0
	6 O	2	0	100	100	0	50
	6 P	2	0	100	100	0	0
	5 O	13	0	100	100	0	8
	4 O	9	0	100	100	0	0
	2 P	0	0	0	0	0	0
	1 P	0	0	0	0	0	0
Total max. sites		35	6	94	94	0	6
Mand.	7 O	5	0	100	100	0	0
	7 B	4	0	100	100	0	0
	6 O	8	13	88	63	13	25
	6 B	1	0	100	100	0	0
	5 O	9	0	100	100	0	0
	4 O	11	0	100	100	0	0
Total mand. sites		38	3	97	92	3	5
Total sites		73	4	96	93	1	5

Abbreviations: Max. = maxillary
Mand. = mandibular

7 = Permanent second molar
6 = Permanent first molar
5 = Permanent second premolar
4 = Permanent first premolar
2 = Lateral incisor
1 = Central incisor

O = Occlusal
P = Palatal
B = Buccal

enamel must be apparent. If not present, the etching procedure was repeated. In order to obtain a real homogeneous white-shaded sealant, the bottle was shaken well. The sealant (Helioseal®) was applied according to the manufacturer's instructions by means of a special cannula tip on the bottle. A small plastic application tip, included in the operating assortment, was used to spread out the sealant in all fissures. The sealant was then polymerized with a visible light source (Litema‡) for forty seconds. During polymerization the light exit-window was kept about 1-2 mm from the sealed surface.

After polymerization the sealant application was controlled. If the tooth was sealed by a dental student, it was checked by a trained instructor. Attention was paid to the following factors:

- ☐ Presence of the sealant in all pits and fissures.
- ☐ No underfilling or overfilling: The sealant should be spread, starting from the fissures and ending in a thin coating toward the cusps.
- ☐ Absence of air bubbles.
- ☐ Good marginal adaptation: Any apparent roughness was removed by polishing.
- ☐ Adequate retention: There was an attempt to dislodge the sealant immediately after placement.
- ☐ Total polymerization.
- ☐ No occlusal interferences. A small amount of occlusal interference was tolerated, as excess of sealant (without filler) quickly wears away. Impeding occlusal contacts were adjusted with appropriate composite finishing burs.

Evaluations were made six, twelve, eighteen and twenty-four months after placement. An evaluation after twenty-four months was only performed for sites sealed with the PFS, since the invasive technique was only recently introduced in our department. Most of the sealed teeth were examined for retention, marginal adaptation, secondary caries, and air bubbles by five different trained operators. As far as retention was concerned, the sealants were diagnosed as intact (+), partially lost (±) or totally lost (−).

Also checked were marginal adaptation, secondary caries, and air bubbles, using a mirror and a short, straight, sharp probe. When a defect was noticed, the sealant was reapplied during the same visit, to prevent recurrence of caries. In case of a small localized secondary caries lesion, a preventive posterior resin restoration (PPRR) or a preventive glass-ionomer restoration (PGIR) was performed.

If the bite-wing radiographs revealed interproximal caries or the secondary caries lesion was extensive, an amalgam restoration (AA) or a posterior resin restoration (PRR) was placed.

RESULTS

The results of the sites sealed with Helioseal using the PFS show Helioseal® was fully retained in 97 percent of the sites and partially lost in 3 percent of the sites. The marginal adaptation was found to be good in 84 percent. Secondary caries was found in only 2 percent of the sites. Air bubbles were present in 3 percent of all evaluated sites. Using the PFSI, the sealant was fully retained in 97 percent of the sites, and partially lost in only 3 percent of the sites. The marginal adaptation was found to be good in 97 percent of the sites. No secondary caries was found and air bubbles were present in 4 percent of the sites.

Similarly good results were seen for the sites sealed with Helioseal®, twelve and eighteen months after placement. Only the eighteen-month evaluation of the maxillary sites sealed using the invasive technique indicates some negative results.

In Table 2 are shown the results of the sites sealed using the noninvasive technique, after twenty-four months. It is obvious that even after twenty-four months, Helioseal® was fully retained in 96 percent of all sites. A good marginal adaptation was found in 93 percent of the sites and secondary caries was found in only 1 percent of the sites.

The results show that the retention rate is better for the premolars than for the molars. The percentages of the sites where the sealant was fully retained are always higher for the first and second premolars than for the first and second molars. This finding is in agreement with several other studies.[5,9-12,20,25]

Figures 1A, 1B, and 1C illustrate the results of the sealed sites using the noninvasive and invasive techniques after six, twelve, and eighteen months. In these figures it can be seen that the marginal adaptation is better, when the fissure is enlarged as a preventive measure. Good marginal adaptation was found, after six months, in 97 percent of the sites, where the fissures had been prepared. Without preparation, 84 percent of the sites showed satisfactory adaptation. After twelve months and eighteen months, these percentages are, respectively, 89 percent and 81 percent for the enlarged fissures and 82 percent and 79 percent for the fissures without any preparation. It should be observed that, in contrast with these findings, the same figures illustrate a tendency to a lesser susceptibility to secondary caries for PFS than for PFSI.

There are fewer air bubbles in the sealants, when the fissures are enlarged. After twelve and eighteen months, there were air bubbles in respectively 2 percent and 3 percent of the sites. Air bubbles were found, however, in 8 percent and 10 percent of the sites, where no enlargement of the fissures occurred.

It should be emphasized that, in the author's opinion, a statistical analysis of the results was not opportune, due to the variety of groups and the small number of sites in some of them. The data only indicate tendencies as far as differences between PFS and PFSI are concerned.

DISCUSSION

The results shown in Table 2 confirm the clinical success of pit-and-fissure sealants as described by several authors (Table 1A).[1-27]

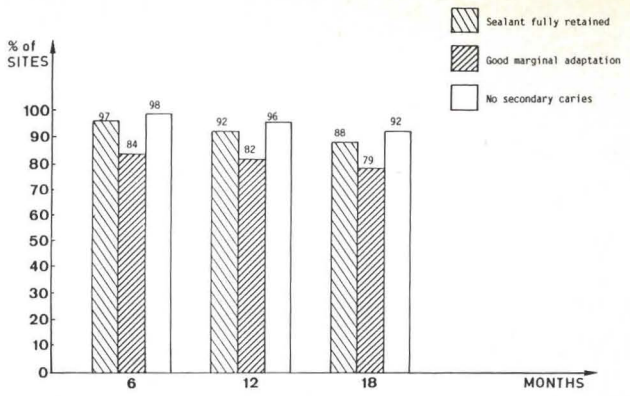


Figure 1A. Schematical representation of all results using the non-invasive technique (PFS) after 6, 12 and 18 months.

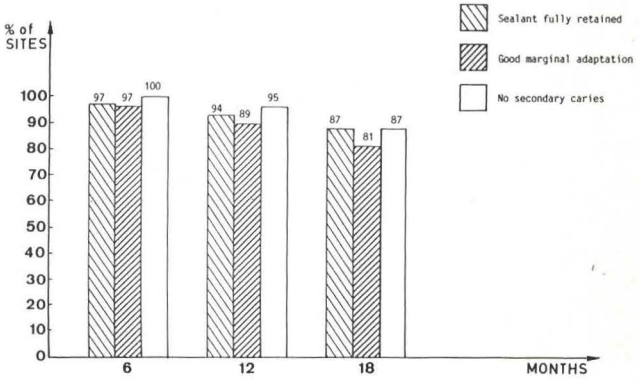


Figure 1B. Schematical representation of all results using the invasive technique (PFSI) after 6, 12 and 18 months.

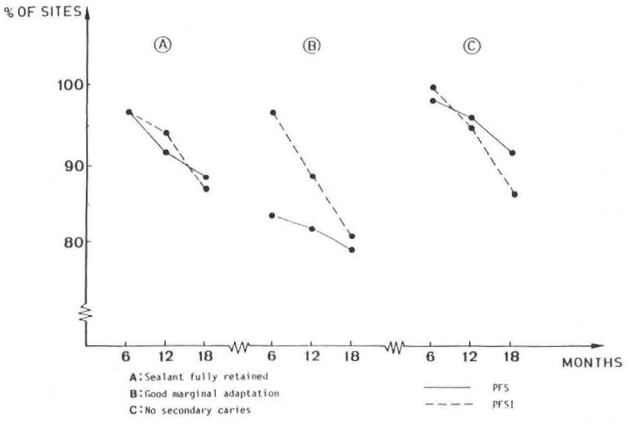


Figure 1C. Schematical representation comparing the results of PFS with PFSI after 6, 12 and 18 months.

Earlier results with visible-light-cured sealants indicate that these new products appear to be equally as retentive as the self-cured sealants.[28,29] More longitudinal studies over a longer period of time, however, are needed.[28,34] A white- shaded, unfilled, visible-light-cured sealant was used and evaluated in the present study. This type of sealant has other benefits. By using visible-light-cured products, the working-time is practically unlimited; and the chance of enclosing air bubbles is small, because no mixing is required. White-shaded sealants enhance detection by the dentist, dur-

ing the recall evaluation. The patient himself, as well as the parents, can check the sealant's retention. Finally, the white color is esthetically accepted and no complaints concerning the sealant's color, taste or flavor were reported.

Helioseal® was chosen because it is one of the unfilled sealants with a good tag penetration. Minor occlusal interferences, moreover, are readily worn away.

The direct and easy application with the cannula tips, furthermore, saves time. The tips can be bent to allow easy access to any site. It is, moreover, a very economical system without waste of material. With the small plastic application tips, included in the operating assortment, the sealant can be spread into all fissures, without incorporating air bubbles.

In the literature, the choice between the invasive and noninvasive techniques remains a matter of debate.[36] In the present investigation, Figures 1A, 1B and 1C illustrate that the risk of microleakage is reduced when the fissured are enlarged. The easy penetration of the sealant in the enlarged fissures and better adhesion to the walls, are probable reasons. The latter was also mentioned by Tadokoro.[37] According to Le Bell, these results may be explained by the fact that the fissures were opened up before sealing, which allowed a plug of resin to be formed, instead of a thin layer of varying thickness.[38] In addition to greater adherence, better marginal adaptation, and fewer air bubbles can be expected, when fissures are enlarged. In the authors' opinion, the most important advantage of the invasive technique is the ability to determine the extent of the discoloration in the pits and fissures and eventually to detect an incipient caries lesion.

From the present study it can not be concluded that mechanical preparation of the fissures results in higher retention rates of sealants, as found by other authors (Tables 1A, 1B and 2).[39-41]

Long-term follow-up examinations are still necessary to determine the potential benefits of the mechanical preparation for the retention of the sealant.[42]

The higher retention rates for the mandibular sites compared to the maxillary sites, as indicated by several authors could not be confirmed.[5,9-12,20,25] In some of these studies, a lower retention rate for the buccal and palatal sites of the lower and upper molars is mentioned.[5,10-12, 25] Again these findings could not be confirmed in the present study.

CONCLUSION

Based on the results of this study, the new visible-light-cured sealants appear to be as good as the self-cured sealants, and better than the UV-light-cured products.

The comparison between the invasive and noninvasive application techniques resulted in an observably better marginal adaptation and fewer air bubbles in the fissures that were enlarged. More long-term studies are necessary, nevertheless, to determine the potential benefits of both the mechanical preparation before sealant application and the use of visible-light-cured products. In our department, a clinical study is now in progress to compare the efficacy of application and the clinical results of six different visible-light-cured sealants.

The authors wish to thank Dr. R. De Moor and Dr. H. De Nys-Beyls, instructors in the Department of Pedodontics, for collecting the data, and Mr. P. De Pourcq for the processing. They are grateful to Mrs. B. Vandevoorde-Jouret for typing the manuscript, and to Mrs. R. Houtmans and the Orodent Company (Deurne, Belgium) for making the fissure-sealant, Helioseal, available for this study.

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INJURIES TO CHILDREN

There is an inverse relationship between the probability of very young children being injured and the degree of knowledge that young parents possess about the psychological characteristics and physical capabilities of the growing child. It is difficult for young parents to imagine all the dangers to which an infant may be exposed, especially if it is their first child and they have no experience of looking after children.

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An allergy to local anesthetics? The consequences of a misdiagnosis

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Adverse reactions to local anesthetics are uncommon. Nevertheless, most dentists will encounter a patient who will have an adverse reaction following the administration of a local anesthetic. A proper understanding of the various potential adverse reactions to local anesthetics can avoid a mistaken diagnosis of an allergy which can result in unnecessary dental consequences.

REPORT OF A CASE

A seven-year-old white female was examined initially in the graduate clinic of the pediatric dental department. She was referred by a general dentist because of her extensive caries and an allergy to local anesthesia.

Medical history

The child was currently receiving 10 mg of propranolol t.i.d. for migraine headaches. She reportedly was allergic to a preservative in processed milk, which was manifested as a skin rash. The most remarkable finding was the occurrence of a seizure immediately following an intraoral injection of a local anesthetic at five years of age. This was her first and only seizure as well as her first injection of a local anesthetic. Her parents were informed that she was allergic to local anesthetics.

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Dental history

The child has visited several dentists since her seizure episode. None was willing to treat her, assuming that she was allergic to local anesthetics.

Investigation

An investigation of her dental and medical records concerning the seizure incident revealed that approximately 0.4 cc of 2 percent lidocaine with epinephrine 1:100,000 was administered for an inferior alveolar nerve block, when she started having generalized jerking movements lasting thirty to forty seconds. She then became drowsy and experienced difficulty enunciating words, although she responded appropriately to questions and directions. She exhibited left ptosis, fixed dilation of the left pupil, and with the right pupil reactive to light. She was moving her extremities well and was able to walk without difficulty. Deep tendon reflexes were initially 3+/4+ with unsustained clonus, 1-2 beats bilaterally, which resolved before transport to the local community hospital. Over the next thirty minutes, her condition improved with resolution of the ptosis and dilation of the left pupil, and return of normal speech.

An evaluation by the hospital neurologist revealed a normal neurological examination, with some residual fifth-cranial-nerve palsy. A CT scan and EEG were normal. The neurologist concluded that the local anesthetic had most likely reached the trigeminal ganglion and optic nerve, and that the seizure activity was a vagal response.

DISCUSSION

Adverse reactions to local anesthetics are uncommon.[1] It is estimated that a half million local anesthetic administrations are performed daily in the United States.[2] Local anesthetics are among the safest drugs in current use as evidenced by their low incidence of adverse reactions. Nevertheless, most, if not all, dentists will encounter a patient who will have an unpredictable reaction to a local anesthetic. There are three categories of systemic reactions to local anesthetics: toxic, allergic, and idiosyncratic.[3,4] Systemic reactions to local anesthetics occur much more frequently than is assumed and usually are so mild and transient that they remain unrecognized.[3] Occasionally serious reactions occur that require immediate attention and life support, and dentists must be able to recognize and treat those reactions.

Toxic reactions

Toxic reactions to local anesthetics resulting from an increased blood level of the drug have four possible causes:

- ☐ An excessive dose of the local anesthetic.
- ☐ Inadvertent intravascular injection.
- ☐ Slow detoxification or biotransformation.
- ☐ Slow elimination or redistribution.

According to Bennett, the blood level necessary for a toxic effect depends upon the patient's physical condition, rapidity of injection, the amount of drug used, route of administration, and the patient's age.[4] Dentists must be aware of the appropriate local anesthetic dosages as well as the anatomy of the area to be injected. The greater the vascularity of an area, the more rapid the absorption and the greater the subsequent blood levels of the drug. The injection of a local anesthetic should occur slowly over a period of not less than a minute per carpule. Injection at this rate will not usually cause a toxic blood level.[4] Local anesthetics themselves are vasodilators and enhance rapid uptake of the anesthetic agent; a vasoconstrictor, therefore, should be used. Local anesthetics are depressants whose toxic effects depress certain inhibitory centers in the brain, allowing central nervous system excitation to occur unabated. The exact site of this inhibition is unknown, although the amygdala has been implicated as a primary site of action.[4]

The central nervous system is a sensitive barometer of the blood level of local anesthetics and at low levels of toxicity, symptoms of talkativeness, drowsiness, tinnitus, circumoral numbness, dysarthria, metallic taste, diplopia, and nystagmus can occur.[5] With increasing blood levels, tremors of the face, hands and feet are possible, which may culminate in tonic-clonic seizures activity at the highest end of the spectrum. Tonic-clonic seizure that occur ten to fifteen seconds after deposition of the local anesthetic are most likely due to an intravascular injection. Seizures that occur two to five minutes after injection, and preceded by gradually increasing stimulation, are the result of rapid absorption of the local anesthetic. Since redistribution and biotransformation of the anesthetic continues throughout the episode, it is rare that a seizure will last more than thirty seconds.

A proportionate period of central nervous system depression usually follows central nervous system excitation and is manifested as lethargy, unresponsiveness, lack of movement of the extremities, sleepiness, and muscular weakness. The incidence of convulsions associated with the injection of local anesthetics varies from less than 1 per 1,300 up to 4 per 1,000 administrations.[1] The majority of toxic reactions to local anesthetics require no treatment and are mild, immediate, and transient. If convulsions are not rapidly self-limiting, benzodiazapen should be administered intravenously or sublingually in the smallest dose possible to minimize post convulsion central nervous system depression. Oxygen should be administered during a toxic overdose, when respiratory depression occurs. Toxic reactions can be avoided by close monitoring during the injection, injecting slowly, and withdrawing the needle at the first signs of an adverse response. Dentists must be familiar with classical symptoms and treatment so that no time is wasted.

Allergic reaction

An allergic reaction is classified according to the immune system's antigen-antibody response.

IMMEDIATE REACTIONS

Immediate reactions occur within seconds to hours after exposure to the offending agent. Generally, the immediacy of the response correlates with it's severity and involves anaphylactic, cytotoxic, and immune complex reactions.

Type I, anaphylactic reactions, are mediated by IgE and are the most serious, due to the sudden onset and potential severity. Anaphylaxis can be localized or generalized in nature. The most common form of localized anaphylaxis involves the skin and mucous membranes, causing urticaria and angioedema, which are usually not severe, but may be the first indication of more a severe,

generalized reaction. The second most common type of an immediate anaphylactic reaction involves the respiratory system in the form of an asthmatic reaction. Although extremely rare, generalized anaphylaxis is rapid, and life-threatening. Sudden onset of syncope, hypotension, respiratory failure, cardiac arrest and death can occur within minutes of exposure to an insignificant amount of a drug.

Type II responses are the result of IgE and IgM interactions with complement, causing a cytotoxic reaction. Type III immune responses result in vascular or connective tissue edema and inflammation. There are no known occurrences of local-anesthetic- induced type II or type III responses.[6]

DELAYED REACTIONS

A type IV response, mediated by sensitized lymphocytes, is expressed most commonly as contact dermatitis and accounts for 80 percent of allergic responses to local anesthetics.[7] Delayed reactions occur more than forty-eight hours following exposure to the offending allergen and include symptoms such as localized edema in the area of injection or the development of joint pain, tenderness, and malaise.[5]

Dental anesthetics are either esters or amides. The esters, represented by procaine, have a breakdown product, paraaminobenzoic acid, a highly antigenic agent. Amide anesthetics do not contain paraaminobenzoic acid, which may account for the rarity of sensitization to these drugs. For this same reason, cross-hypersensitivity among amides, or between esters and amides is not seen. Paraben, methyl paraben, and p-hydroxybenzoate preservatives for local anesthetics may be the cause of allergic responses. Presently, dental cartridges containing Carbocaine, Xylocaine, Citanest, and Marcaine do not contain these preservative.[7,8] Local anesthetics are low molecular weight compounds, which by themselves are unlikely to elicit an allergic response. During their biotransformation, metabolites form haptens, which may combine with body proteins to produce an antigen-antibody response.

Treatment of an allergic reaction should be in proportion to its severity. Mild reactions may require no therapy. The reaction should be recorded and the patient made aware of the particular drug which caused the response. This information will be of value to dentists and physicians who will treat this patient in the future. For mild rash, urticaria, or angioneurotic edema, an antihistamine such as diphenhydramine (Benadryl) may be administered orally. For more severe localized reactions diphenhydramine may be administered intravenously or intramuscularly. The children's dosage is 5 mg/kg/24 hrs. Epinephrine, 0.01 ml/kg to a maximum of 0.5 ml should be administered subcutaneously to the child with severe allergic reactions. Combined therapy including oxygen, antihistamines, epinephrine, and steroids might be necessary.

Provocative skin testing protocols have been advocated for use in children with suspected allergic reactions to local anesthetics.[9,10] The protocol involves initial intradermal injections at low concentrations. Following a negative response, increasing concentrations of a local anesthetic are injected subcutaneously until the patient receives 1-2 ml of the undiluted local anesthetic corresponding to the amount to be used by the dentist.

The most important considerations concerning allergic reactions involve prevention. The careful review of a patient's medical history may alert the dentist to current allergies, which place the child at an increased risk for an allergic reaction to local anesthetics.

IDIOSYNCRATIC REACTIONS

Idiosyncratic reactions are extremely rare and are usually unrelated to the anesthetic drug, being psychogenic or related to underlying morbidity.[5] Treatment for idiosyncratic reactions varies according to the symptoms displayed. Of prime importance is maintenance of the airway, respiration, and circulation. A thorough preanesthetic review of the patient's medical history may avoid idiosyncratic reactions.

EVALUATION AND MANAGEMENT

A careful review of the patient's episode following the injection of a local anesthetic revealed no evidence to support the diagnosis of an allergic reaction to the local anesthetic. The child's seizure activity following the administration of lidocaine was most likely a toxic reaction. The ocular complications imply that the lidocaine spread to the oculomotor nerve causing a transient nerve palsy. Intravascular injections are the most frequent cause of systemic toxicity and are related to the needle's length and aperture, speed of injection, location of the injection and aspiration prior to injecting the local anesthetic.[11]

SUMMARY

In this case, inappropriately labeling the child as "allergic to local anesthetics", resulted in her inability to receive appropriate dental care. It was a major disservice to her and led to the potentially serious con-

sequences of neglecting the dental disease present. The small caries lesions that would have required amalgam restorations at five years of age progressed to painful toothaches requiring stainless steel crowns and pulpal treatment.

Although adverse reactions to local anesthetics are uncommon, most dentists can anticipate encountering a patient who will have an adverse reaction to a local anesthetic. This case illustrates the need for dentists to be knowledgeable regarding the signs and symptoms of the potential adverse reactions and their appropriate management. Most importantly, prevention is based upon knowledge of anatomy, dose determination, and the use of proper armamentarium and technique, which are key factors in making a safe and effective drug even safer.

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EXPRESSIVE LANGUAGE DELAY

The wait-and-see posture with respect to specific expressive language delay is predicated on the belief that the problem is self-correcting for most children and that it is not associated with later difficulties. The active intervention posture with respect to expressive language delay is predicated on the belief that expressive language delay is not self-correcting for many children, that it is a significant risk factor for later developmental problems, and that it can be treated successfully. The present research does not address the issue of long-term risks of early expressive language delay. We have shown, however, that expressive language delay is not selfcorrecting in the short term for many 2-year-old children. Furthermore, we have shown that it is possible to screen for those children with a high degree of selectivity. These findings bolster the active intervention approach.

The best advice to the parent of the otherwise normal child with limited expressive skills might include accurate information concerning: (1) the uncertainties regarding the long-term sequelae of early expressive language delay and the efficacy of typical therapy (2) the importance of careful assessment and differential diagnosis in any child with a severe expressive delay, and (3) the increasing prudence of intervention as the problem persists beyond the third birthday, even given the uncertain effects of such intervention. One might argue that in the absence of definitive research it should be assumed that early treatment for expressive language delay may be helpful and is at worst benign, and, therefore, the pediatrician should routinely recommend it for 2-year-old children. Research suggests, however, that the unnecessary labeling and treatment of a child as handicapped may initiate a chain of events that are deleterious, even if the treatment per se is benign. Thus, there are risks and costs associated with early treatment that must be weighed against the likelihood that the child will need and can benefit from therapy.

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Localized prepubertal periodontitis: literature review and report of case

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The etiology and pathogenesis of periodontal diseases has been extensively investigated during the past decade. There is increased awareness that the disease entity known as "periodontitis" is in all probability a family of related but reasonably discrete diseases.[1,2] Page and Schroeder, for example, believe that there are sufficient differences in the clinical, histopathological, and microbiological features of periodontitis to allow categorization into at least four forms.[2] Adult periodontitis is the most prevalent form of periodontal disease. Less frequently occurring forms described by Page and Schroeder include rapidly progressive periodontitis, juvenile periodontitis, and prepubertal periodontitis.[2] Simpson adds acute necrotizing gingivoperiodontitis to this list of forms of periodontitis.[1]

Earlier authors used the term periodontitis to describe what is now characterized as juvenile periodontitis (JP). Juvenile periodontitis starts at puberty, and periodontal destruction proceeds very rapidly. Classically, juvenile periodontitis involves the permanent first molars and incisors. Not all of these teeth, however, are always involved; conversely, other teeth may also be involved. Prepubertal periodontitis (PP) is a comparatively rare condition that has sometimes been confused with juvenile periodontitis, first because both occur before adulthood; and second, because of earlier confusion regarding the definition of juvenile periodontitis. Relatively little is known about prepubertal periodontitis. In recent years, Page and others have focused attention on prepubertal periodontitis. These investigators described five cases and outlined some of the clinical and histopathological features of prepubertal periodontitis. They differentiate between localized and generalized forms of the disease. Localized prepubertal periodontitis begins soon after eruption of a primary tooth and is characterized by mild gingival inflammation, pocket formation, and bone resorption around a limited number of the primary teeth. A chemotactic deficiency of either the neutrophils or monocytes may be present.

In contrast, generalized prepubertal periodontitis follows a more severe clinical course characterized by marked gingival inflammation, recession, and cleft formation of the gingiva and rapid bone loss. Root resorption may occur also. Delaney and Kornman report that the most prominent pathogen to be Hemophilus (Actinobacillus) actinomycetemcomitans (Ha).[4] Prepubertal periodontitis is frequently associated with other microorganisms such as S. sputigena, B. intermedius, and E. corrodens. Page *et al* report profound

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chemotactic defects in both the neutrophils and monocytes of these patients.[3] Also, these patients often have otitis media and recurrent skin and upper respiratory infections.

Page and Baab advanced the hypothesis that cementum may play an important role in early periodontitis and described three male siblings that they had studied.[5] The youngest child had exfoliated six of eight incisors by three years of age, beginning at about 1.5 years of age. The remaining incisors and canines, although suffering significant bone loss, manifested no clinical signs of inflammation, although an attached layer of microbial plaque extended almost to the root apex of one exfoliated tooth. *In vitro* examination revealed abnormally low chemotaxis of peripheral blood monocytes.[6]

Page and Baab examined other reports of early periodontitis in which developmental abnormalities in cementum or other calcified tissues seemed likely.[5,7-11] Page and Baab concluded that cemental deposition may have been faulty, predisposing the affected individuals' teeth to early periodontitis.[5] Lindskog and Blomlof reported that root surfaces of teeth from patients with juvenile periodontitis examined with SEM exhibited hypoplastic and aplastic cementum. This was true for both the root surface areas exposed to periodontal pockets, and the root surface areas still surrounded by alveolar bone. Hypoplastic or aplastic cementum was not found on root surfaces from individuals with other forms of periodontitis or on normal tooth roots obtained at autopsy. These findings were advanced as strong supporting evidence for their hypothesis.[5]

Page and Baab suggested from their review of the literature that abnormal deposition or maintenance of cementum, such as that observed in mild cases of hypophosphatasia, may be "a major determinant of site specificity and susceptibility."[5] Furthermore, many cases of prepubertal periodontitis, and other forms of severe periodontitis, are unusual in that clinical manifestations of inflammation may not be present, and destruction may be confined to specific teeth while adjoining teeth remain completely unaffected.[5] The affected teeth may only have in common the fact that their respective roots formed at the same time. These features could be explained by an underlying and predisposing cemental deposition or maintenance abnormality. The result would be a defective periodontal attachment highly susceptible to microbial invasion and subsequent destruction as suggested by Gottlieb over forty years ago.[13] Page and Baab concluded that future studies of patients with early periodontitis should include histological evaluation of cementum and measurement of serum alkaline phosphatase and urinary phosphoethanolamine.[5]

The purpose of this report is to describe the clinical, laboratory, and histological findings in a young child with prepubertal periodontitis.

CASE REPORT

Clinical findings

S.A., a five-year-and-one-month-old (DOB 1-18-81), well- developed, white female was referred to the Medical College of Georgia in February 1986 for evaluation, because of premature loss of her primary central incisors. Examination revealed a primary dentition that was normal, except for the absence of the maxillary and mandibular central incisors and advanced mobility of the maxillary lateral incisors. The gingiva was normal except for some recession and mild inflammation around the maxillary incisors. There was no calculus present and only minimal amounts of bacterial plaque were seen. The remaining oral soft tissues were within total limits (Figure 1). The patient was wearing a lingual arch type mandibular partial denture fixed to the first primary molars with stainless steel crowns (Figure 1). The appliance was placed in March 1983, after the mandibular central incisors were removed because of extreme mobility and alveolar bone loss. The mother reported that she had kept the primary central incisors after they were extracted. The dental history also stated the child used a pacifier during early childhood and was treated with a quadhelix appliance from August 1984 to February 1985 to correct a posterior crossbite.

In January 1986, at age five, the child's primary maxillary central incisors were removed by the primary care dentist, because of extreme mobility and extensive alveolar bone loss.

Radiographic findings

A radiographic examination consisting of panoramic, bitewing and occlusal films showed that the primary lateral incisors had alveolar bone surrounding only the apical portions of the roots and an appearance suggestive of a circumferential, cone-shaped pattern of bone loss (Figure 2). The radiographic appearance of the crest of the alveolar bone in the primary molar area appeared to be within normal limits.

Medical and laboratory evaluation

A small amount of subgingival plaque was subsequently removed from the maxillary right lateral incisor. The result of an anaerobic culture of the subgingival plaque

Figure 1. Intraoral photographs (February, 1986) showing gingival recession associated with the primary maxillary lateral incisors. The remaining gingival tissues appear healthy.

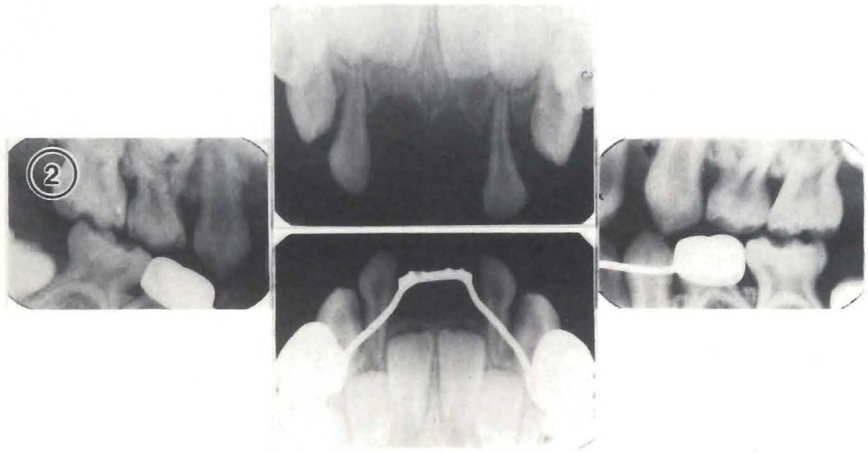


Figure 2. Intraoral radiographs (February, 1986) revealing extensive alveolar bone loss around roots of the maxillary lateral incisors.

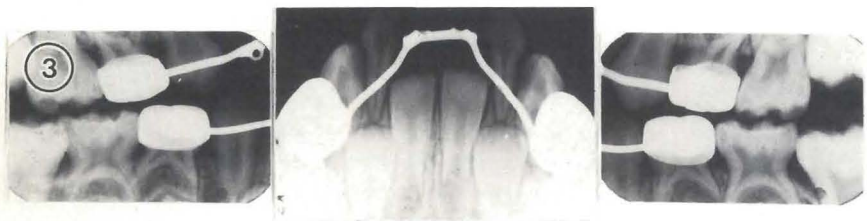


Figure 3. Follow-up radiographs (March, 1987) show no significant changes in the alveolar bone since February, 1986.

material for Hemophilus (Actinobacillus) actinomycetemcomitans was negative. The child was referred for medical evaluation.

The child's medical history was negative. She was an adopted child and the medical histories of the natural parents were unavailable. The results of a physical examination, including a complete blood work-up, urinalysis, urinary phosphoethanolamine and serum alkaline phosphatase, were within normal limits.

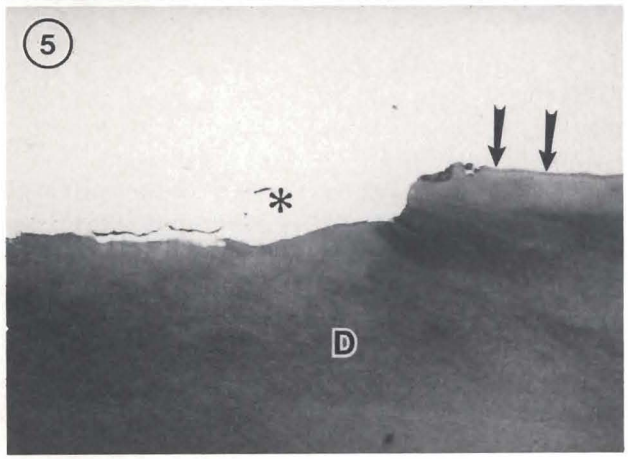
Follow-up dental examination

In July 1986, the child was seen by the primary care dentist, who recommended removal of the maxillary lateral incisors because of extreme mobility. The extracted teeth were immediately placed in formalin, and processed for routine histologic examination. A maxillary fixed lingual arch partial denture was placed because of esthetic concerns.

The child was seen for follow-up evaluation at the Medical College of Georgia in March 1987. The oral hygiene was good and all soft tissues appeared healthy. None of the remaining primary teeth displayed evidence of abnormal mobility and radiographic examination revealed no changes in the alveolar bone levels since the previous examination (Figure 3). The patient was advised to return to the primary care dentist for periodic follow-up and preventive dental services.

Macroscopic examination of the extracted teeth

Three of four extracted, air-dried, primary central incisors exhibited several square millimeters of eroded root surface. These areas were found along the root surfaces from just below the cementoenamel junction to the apical portions of the teeth (Figure 4). Although the two mandibular incisors did not show extensive areas of erosion, one of them had an eroded area in the mid-root region. The two maxillary incisors exhibited extensive



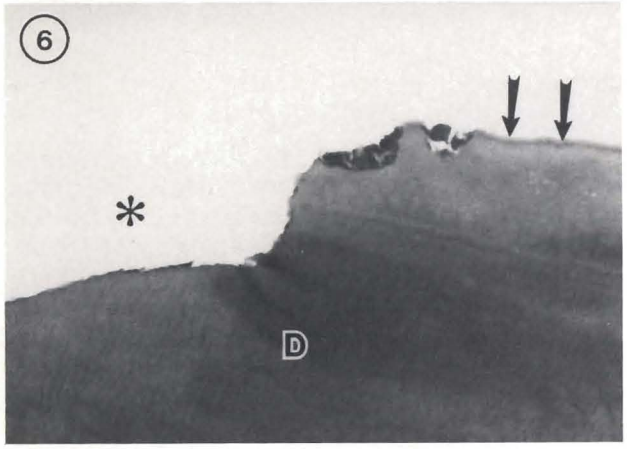
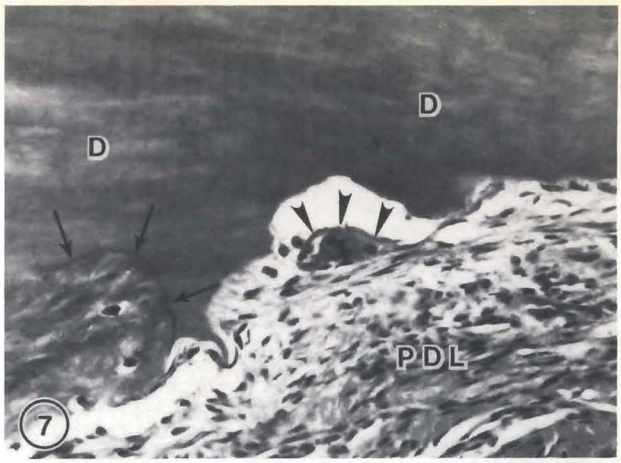


Figure 4. This photograph shows a large eroded area (arrowheads) of tooth structure on the facial aspect of a maxillary incisor. An arrow points in the direction of the crown and the root surface (A) toward the tooth apex is shown. The asterisk shows the general area of the lesion to be illustrated in Figures 5 and 6.

Figure 5. This photomicrograph shows a small portion of the eroded area seen in Figure 4. The arrows indicate the intact root surface between the eroded area (asterisk) and the crown of the tooth. The dentin (D) of the root is indicated. (H & E, x50)

Figure 6. This higher power photomicrograph shows the intact root surface (arrows) as well as an area of deeply eroded root surface (asterisk). Note that the lesion is well into the dentin (D) and that no cementum remains in the area of the lesion (asterisk). (H & E, x125)



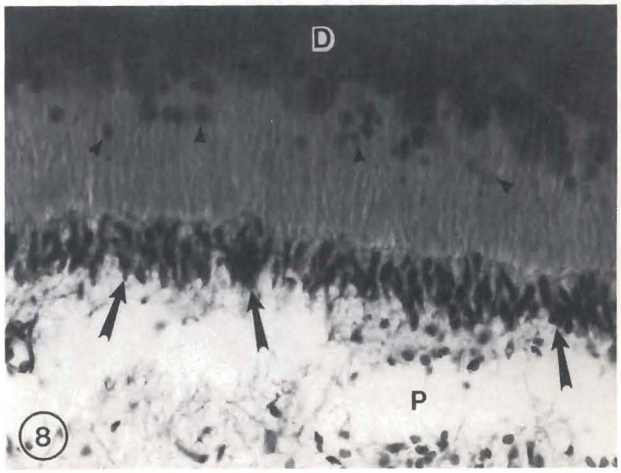


Figure 7. This photomicrograph of a section of a primary incisor, extracted and placed in neutral buffered formalin for fixation. The cementum is absent in this area of the root. The dentin (D) and periodontal ligament (PDL) are shown. Note the large, multinucleated dentinoclast (arrowheads) pulled away from its lacuna in the radicular dentin. The arrows indicate a cement line in an adjacent area of the root, which appears to be undergoing cemental repair. (H & E, x325).

Figure 8. This photomicrograph of a section from another primary incisor, extracted and fixed in neutral buffered formalin. The pseudostratified, odontoblastic cell layer (arrows) and other adjacent pulpal (P) tissues are indicated. Notice that the predentin contains numerous globules of newly formed dentin (arrowheads) that await assimilation by the mature dentin (D). (H & E, x325).

erosion. In these two teeth, it seemed unusual to find the eroded areas fairly distant from the apices of these teeth. Their root surfaces also showed areas of cemental and dentinal erosion. In general, the areas of erosion occurred farther apically than those seen in the teeth removed at an earlier age.

Histological examination of the extracted teeth

The four extracted primary incisors, which had been kept by the child's mother, were prepared for histological examination. These teeth were not in fixative and

were dry. The two maxillary lateral incisors, which were extracted in July 1986, were placed immediately in formalin for fixation at the time of extraction. The six teeth were decalcified and dehydrated through ascending alcohols, placed in xylene and then infiltrated with paraffin. Six-microns-thick paraffin sections were deparaffinized and stained with hematoxylin and eosin (H & E). These stained preparations were mounted on glass slides, covered with coverslips and then photographed with a Zeiss Photomicroscope II. The stained sections of the previously unfixed teeth illustrated the microscopic appearance of the cemental and dentinal erosion seen at the macroscopic level (Figures 5 and 6). In the incisors that had been placed in fixative at the time of extraction, there was some evidence of dentinoclastic activity in some areas of the root (Figure 7). In addition, the pulps of these teeth appeared to be forming new dentin (Figure 8), while undergoing an earlier-than-expected resorptive process along the roots.

Since the remaining teeth had not been placed in a tissue fixative at the time of removal, there was no way to tell whether or not dentinoclasts or other cell types had been active in the eroded areas. In some areas there appeared to be attempts at root repair where cementum had been laid down in a previously resorbed area. Whether these repair areas represent responses to normal changes in root morphology or represent attempts to repair the apparent premature resorption seen in some areas could not be determined.

DISCUSSION

The presence of extensive cemental and dentinal erosion is unusual for a two-year-old child, since physiological root resorption would not be expected at this time. Dysplastic cementum has been described as a feature occurring in hypophosphatasia. Since the serum alkaline phosphatase and urinary phosphoethenolamine were within normal limits, however, hypophosphatasia was ruled out. Since four of the teeth have been out of the mouth approximately three years, there was no evidence of cellular activity which could explain the areas of cemental erosion. Limited evidence of cellular resorptive activity was apparent, however, on the root surfaces of the maxillary lateral incisors removed at age five and placed in fixative. This suggests that a physiological resorptive process was occurring, but it was occurring earlier than expected. It is not, however, known whether this amount of cellular activity could account for the extensive erosion of the roots, or how this activity relates to the premature loss of alveolar bone. Moreover, in the absence of extensive evidence of cell-mediated cemental resorption, this histological data may lend further support to the hypothesis of Page and Baab suggesting defective cementum as the underlying problem in prepubertal periodontitis.[5]

The authors wish to thank Mrs. Bena Clary and Mrs. Helene Exum for typing this manuscript and Ms. Vera Larke for her assistance with the photographic plates.

SUMMARY

This case describes a young, healthy, white female who demonstrated anterior alveolar bone loss along with premature loss of her primary incisors. The alveolar bone loss remains unexplained. The root surfaces of most of the primary anterior teeth exhibited one or more eroded areas devoid of cementum with some evidence in two teeth of cellular resorptive activity. These findings suggest that premature root resorption was occurring concurrently with unexplained extensive alveolar bone loss. The child will be examined periodically to determine whether this process of bone loss with subsequent tooth loss will involve additional primary or permanent teeth.

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Effects of trauma to the primary incisors on their permanent successors: multidisciplinary treatment

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Ilana Brin
Yerucham Zilberman

Trauma to the primary incisors may cause structural defects of the developing succedaneous teeth or affect their positions.[1-10] In previous publications, we reported on the effect of trauma to the primary incisors on the crown and root development of the succedaneous teeth and their alignment in the dental arch.[7-10]

The material for those studies was comprised of 124 children whose primary incisors were traumatized and who were recalled for clinical and radiographic examinations, after the eruption of their permanent incisors. The prevalence of the posttrauma sequelae in the permanent dentitions in our sample is shown in the Table.

Most of the developmental disturbances of the crowns of the succedaneous teeth followed trauma that occurred during early developmental stages (from a third to full-crown completion), corresponding approximately to five years of age.[7,8] This was in agreement with Andreasen and Ravn.[3]

The most common consequences in this age were defects of mineralization, i.e., discoloration and hypoplasia. The incisal third of the permanent incisor crown was found to be the most frequent location of these defects. Unexpectedly, this location was independent of the developmental stage of the permanent bud at the time of trauma.[8] The most common types of trauma followed by defects of mineralization in the permanent incisors were intrusion and exfoliation of the primary incisors.[7] This supported a previous finding of Andreasen and Ravn, who found intrusion to have the most deleterious effect on the development of the successors.[1,4]

The impact of the primary root at the time of trauma may disturb root development of the permanent bud by deflecting or displacing it, thus causing damage to Hertwig's epithelial root sheath.[1] Disturbances in root development of maxillary permanent incisors and/or in the surrounding bone are a less frequent consequence of early dental trauma (Table). They were found in teeth that were traumatized in a wide range of developmental stages (from initial calcification to two-thirds of root completion).[9] As can be seen, the developmental stage of the permanent bud at the time of trauma was not crucial in causing disturbances in root development; rather the magnitude and direction of the traumatic force were probably the important factor.

In the next stage, the influence of trauma to the primary incisors on the alignment of the permanent successors was studied.[10] It was hypothesized that the traumatic force might affect directly the position of the permanent buds and consequently their alignment. Also, early loss (by exfoliation or extraction) of the primary incisor due to trauma was considered as a possible cause of lack of guidance to the erupting successors or

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Table ☐ The prevalence of disturbances in the permanent incisors following trauma to their primary predecessors.*

Type of problem	Number	Percent
Discoloration n=414	134	32.4
Hypoplasia 4=414	46	11.0
Root dilaceration n=136	6	4.7
Arrest of root formation n=136	2	1.5
Odontome-like formation n=136	1	0.8
Sequestration n=136	1	0.8

* The total number of teeth (n) in each line differs, as the various disturbances were studied in different subgroups originating from the pool of 124 traumatized children.

loss of space, resulting in secondary crowding and malposition. When the group of traumatized children (117 patients from the original sample) was compared with a control group of corresponding age taken from a random population, a higher prevalence of malaligned permanent successors was found in the trauma group. Early loss of primary incisors (either by exfoliation or extraction) caused a higher percentage of cases with at least one malposed permanent successor in the anterior segment. The phenomenon of early loss was not associated, however, with loss of space in most of the children, unless a severe delay in the eruption of the permanent incisors occurred. Thus, the malalignment following early loss of the predecessors could be related to lack of guidance to the erupting successors. In addition, it could be suggested that the magnitude of the trauma that caused loss of the primary incisor could also deflect the developing bud from its eruptive path.

The prevalence of impacted or extracted permanent incisors due to trauma to their predecessors was very low and was associated with a history of a severe trauma.[10]

It is in these severe cases of impaction or root malformation that the dentist is challenged. The variety of problems confronting the dentist when treating children presenting with serious sequelae of injury to their primary incisors can be categorized as follows:

- ☐ Severe malformation of the permanent tooth. In extreme cases, the possibility of delivery of orthodontic forces to the malformed root, endodontic treatment, utilization of the tooth as an abutment are limited and should be compromised.
- ☐ Total loss of the permanent tooth bud. Severe trauma seldom causes extreme developmental disturbances as odontome-like formation or sequestration of the bud. In these instances a prosthesis or closure of the space should be considered as treatment options.
- ☐ Severe malposition or impaction of the permanent tooth bud. These cases often require surgical intervention followed by sophisticated orthodontic treatment. Posttreatment retention of these cases might present a special problem, due to strong tendencies to relapse.[1] Thus, special retention measures, like immediate permanently fixed retainers, should be considered.
- ☐ Periodontal problems. These may arise due to coronal malformations or unusual malpositions. Extremely high impactions may end up without attached gingiva; with bony defects; and esthetic problems, due to irregular gingival margins.

CASE PRESENTATION

A 10.5-year-old girl was recalled for a check-up, as one of the subjects in the trauma survey. At the age of three years the girl fell from the 4th floor. As a result, she suffered a double fracture of her left mandible: a fracture of the body through the crypt of the first permanent molar, and a fracture of the left ascending ramus. Luxation of the maxillary central and left lateral incisors, and left canine also occurred. The radiographic examination at the time of the accident showed more than a third of the permanent central incisor crowns and about a third of the lateral incisor crowns to be mineralized; inspite of the eccentric projection of the periapical radiograph it appears that the left central incisor bud was displaced by the trauma (Figure 1).

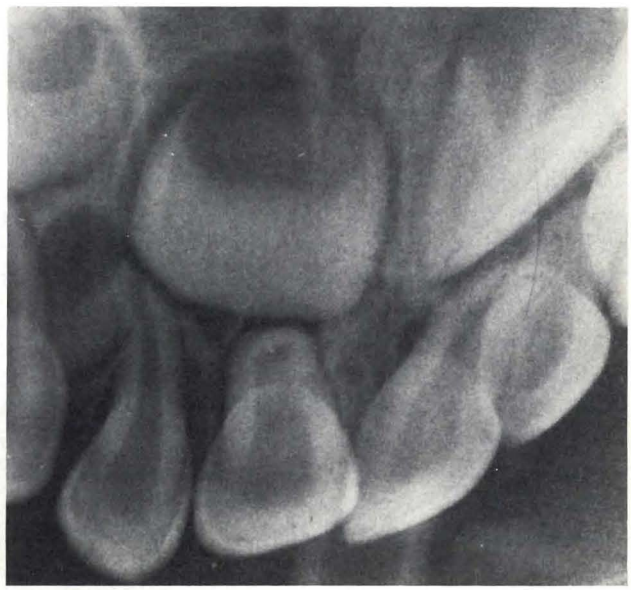

Figure 1. Immediate posttrauma radiograph of the maxillary anterior segment; age three years.

Immediate posttrauma treatment consisted of open reduction of the mandibular fractures, removal of the bud of the first permanent molar and stabilization of the fracture by wiring. Two years later, the girl presented with a fistula in the upper anterior vestibule. Radiographic examination at this stage showed disturbances in the development of the pulp chambers of the primary incisors (arrest of dentin formation or pulp obliteration), external root resorption of the primary central and left lateral incisors, as well as periapical lesions in conjunction with the roots of the primary central incisors (Figure 2). The permanent incisors showed continuation of their development; the position of the left permanent central incisor, however, was considerably apical of the position of its antimere. Both lateral incisor buds appeared severely deformed and signs of hypoplastic lesions of the central incisors were visible as well. At this stage, extractions of the maxillary primary central and left lateral incisors and conservative treatment of the carious teeth were performed.

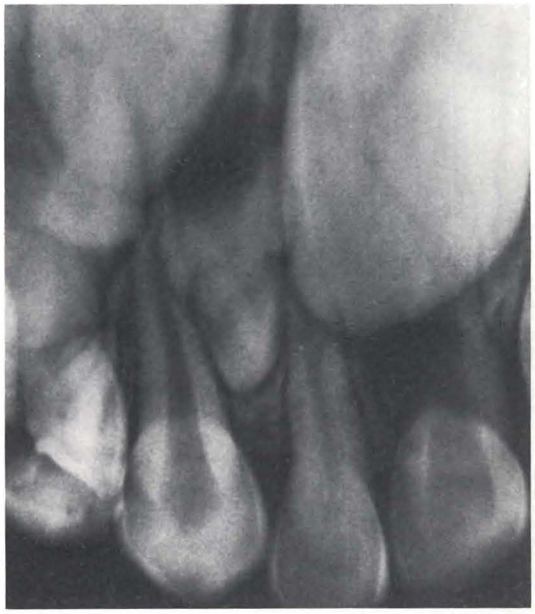

Figure 2. Radiograph of the maxillary anterior segment at the age of five years (two years following the injury).

At the present recall, 7.5 years after the trauma, the girl presented with a straight profile, symmetric, brachycephalic face. Intraoral clinical examination (Figure 3) showed a Class II molar relationship, normal overjet, unerupted maxillary left central incisor and lower left second premolar. Considerable loss of space was caused by a mesial shift of the upper left buccal segment and upper midline shift to the left. The lower dentition drifted to the left, resulting in a lower dental midline shift, too. The erupted permanent incisors as well as the upper molars were hypoplastic and discolored.

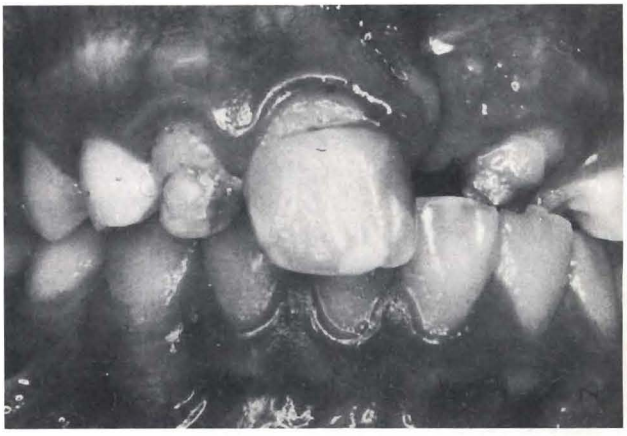

Figure 3. Clinical photograph of the dentition at the age of 10.5 years.

Radiographic examination at the present check-up showed the upper left central incisor impacted in a high position. Its crown showed signs of hypoplastic defects, while the root appeared to be short and deviated. The extent of the root malformation was not fully established, however, due to superposition of the left canine, which was found to be transposed with the left lateral incisor. A radiographic view of the patient's left mandible (Figure 4) showed the wiring in the region of the first permanent molar, in close proximity to the bud of the second premolar, which appeared with an enlarged dental sac. No permanent molar buds could be identified.

The objectives of the orthodontic treatment were to resolve the space problem and align the unerupted teeth in both arches.

In the treatment plan for regaining space, the following points were considered: the straight profile presented by the patient suggested a nonextraction approach; the edentulous lower left segment, however, contraindicated distal movement of the upper left segment. This together with the severe hypoplasia of the lateral incisor crowns resulted in a decision to extract these teeth. These unusual extractions were supposed to resolve the space problem, while leaving the posterior relationships unchanged.

Due to precautionary measures, only the right lateral incisor was extracted at the first stage, while the extraction of its antimere was postponed until the fate of the left central incisor was clear. A removable appliance was used to gain some space for the impacted teeth, because

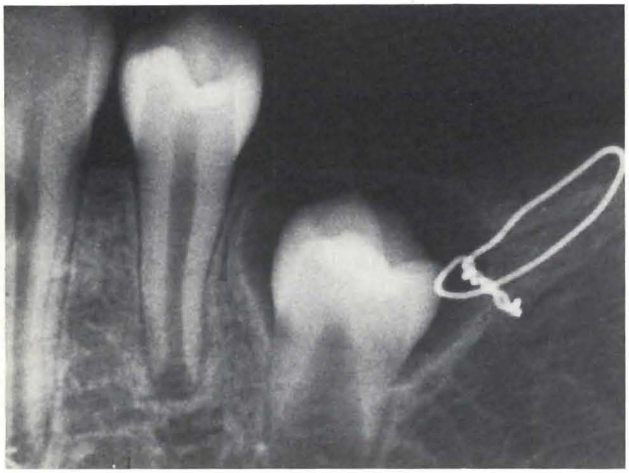

Figure 4. Radiograph of the left mandibular posterior region, at the age of 10.5 years.

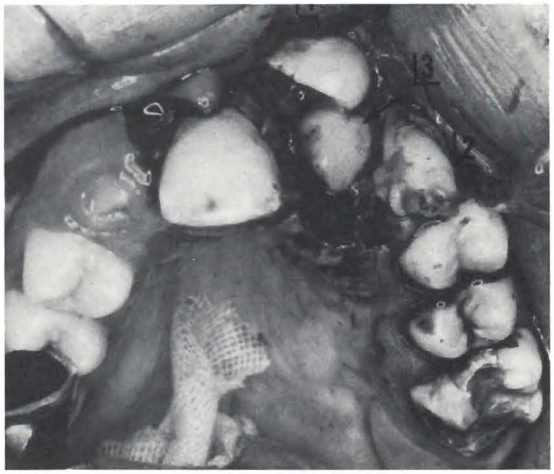

Figure 5. Clinical photograph at the time of surgical exposure of the impacted left maxillary central incisor and canine. The transposition of the lateral incisor with the canine can be seen. The arrow indicates the left maxillary permanent canine.

of the extracted right lateral incisor.

At the second stage, surgical exposure of the impacted left central incisor and canine was performed (Figure 5). Because the patient was under general anesthesia, the exposure of the left mandibular premolar, as well as removal of the wire, was also undertaken. The central incisor was found to be located in a high labial position, while the canine was transposed with the lateral incisor and in a more palatal and incisal position to the central incisor. An orthodontic eyelet was bonded to the central incisor at the time of surgery.

Gentle orthodontic traction was applied to the central incisor utilizing an elastic band attached to a removable appliance. During the process, the maxillary left canine erupted spontaneously. Repeated radiographs of the region helped evaluate fully the left incisor root, which was obscured previously by the transposed canine. In spite of the severe malformation of the left central incisor root, it seemed reasonable to bring it into the arch. At this stage, the left lateral incisor was extracted. The upper arch was bonded and aligned (Figure 6). At that time, the lower left second premolar erupted spontaneously, but rotated, and into crossbite with the upper left first molar.

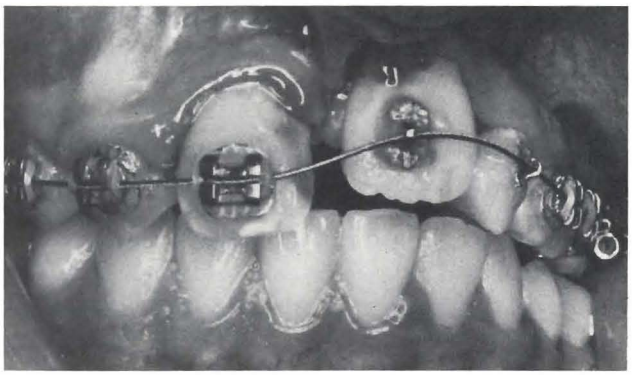

Figure 6. Clinical photograph of the maxillary arch during alignment.

The periapical radiograph, taken before debonding, showed a slender deformed root of the left central incisor and a bony defect in the midline. At the completion of the orthodontic treatment, the upper left central incisor was well aligned. The midlines were not aligned, due to a shift in the lower arch. The left central incisor presented with partially detached gingivae and an irregular gingival margin. Following debonding, the upper incisor segment was retained with an immediate fixed retainer (Figure 7).

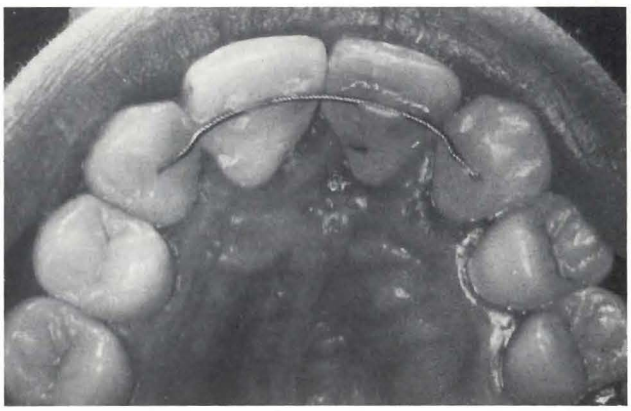

Figure 7. Clinical photograph at the completion of orthodontic treatment.

At this stage, all the supplementary dental treatments were completed. Open curettage and gingivoplasty were performed by a periodontist, to improve the gingival architecture. Further reshaping of the malformed central incisors was intended. Exploration of the hypoplastic defect showed the need for root canal treatment before restoration of the left central incisor. Endodontic treatment was performed and only then were the teeth finally restored.

Because of the narrow bony ridge in the left mandible, a suggestion to transplant the lower right third molar into it was rejected. At the present time, the maxillary left second molar is partially supported by the lower second premolar, because of extractions in the maxillary arch only and the spontaneous shift of the mandibular dentition to the left. Further follow-up is planned to observe possible overeruption of the maxillary left second and third molars. Splinting of the second molar and extraction of the third will be considered.

Two and a half years after debonding at the age of fifteen years, the patient presented with a satisfactory occlusion, harmonious face, and esthetic smile.

CONCLUSION

The case presented in this communication represents the complexity of problems confronting the dentist as a result of severe trauma to the primary dentition. The combination of the various developmental consequences described, often requires originality in the solution of the problem, as well as a multidisciplinary treatment approach.

The authors wish to thank Dr. J. Lustman for allowing access to the files of the traumatized children.

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SMOKING AND HEALTH: A 25-YEAR PERSPECTIVE

Reflecting the extent of Americans' rejection of smoking, the good news is very good indeed; given the remaining size of the smoking population, however, the bad news represents a public health tragedy of major proportions.

Editorial. Am J. Public Health, 79:141-143, February, 1989.

Endodontic treatment of infected primary teeth, using Maisto's paste

Eliyahu Mass, DMD
Uri L. Zilberman, DMD

Chronic periradicular infection in primary teeth may result in their early loss, recurrent exacerbation and occasionally damage to the underlying permanent tooth bud.[1-3] Many practitioners are opposed to extended pulp treatment in primary molars for various reasons, such as, inability to perform classical endodontic mechanical preparation and sealing, and the possibility of injury to the bud of the succedaneous tooth.[4,5] They limited their efforts to the cases in which the insult was contained within the pulp chamber, otherwise the teeth were extracted.

Several authors have reported moderate to high success rates in preserving chronically infected primary teeth.[6-12] Most of them described endodontic techniques using zinc-oxide-eugenol cement as the final filling material in the canals. Other materials, used for the same purpose, were based on the Walkhoff paste.[13] The paste consists of sterilized iodoform as the vehicle for a carefully blended mixture of parachlorphenol-camphor-menthol. Maisto described a paste that in addition contained zinc-oxide, thymol and lanolin.[14] The exact formula contained zinc-oxide, 14g; iodoform, 42g; thymol, 2g; chlorphenol camphor, 3cc; and lanolin, 0.50g. The added materials change the proportions of the components, which may cause changes in the quality of the compound. It was believed that the qualities of the preparation were thus improved for use in the endodontic treatment of permanent teeth.

This paper describes the use of Maisto's paste, which was adapted for the endodontic treatment of infected primary teeth.

LITERATURE REVIEW

In 1932, Gerlach described a method of performing pulpectomies in primary teeth by sealing eugenol in the canals for forty-eight hours and then filling them with gutta-percha points. She claimed that the gutta-percha points could be removed from the tissues, when the crown was ready to exfoliate. Even with chronically infected teeth with fistulas, she suggested that "a conscientious effort should be made to save the tooth before extracting it, especially in the case of a very young child."[15] Rabinowitch's technique for pulp treatment of primary teeth required four to seven appointments, during which he used desensitizing paste, formocresol solution, Howe's solution and filled the canals with zinc-oxide-eugenol cement. He considered that bone destruction, because of abscesses or root resorption, were contraindications to treatment.[16] Velling suggested to treat infected primary teeth by sealing a cotton pellet

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dampened in formalin solution in the pulp for three to five days. The final filling material was zinc-oxide-eugenol cement inserted in the pulp chamber. He performed this "pulpotomy" technique for necrotic pulps.[17] Droter suggested a two-visit treatment for primary teeth with necrotic pulps. The pulp chamber was cleaned of all pus and debris, but no attempt was made to ream or file the canals. At the first visit, a cotton pellet dampened in "pulpotomy liquid" was sealed in the pulp chamber for five days. At the second visit, a rapid setting zinc-oxide-eugenol cement was placed directly over the pulp stumps. The only contraindication was treatment under general anesthesia, "since these cases are one-step procedures".[6] In a later paper, Droter used the same procedure in primary teeth with necrotic pulps and fistulas.[7] Gould reported a one-visit method, using camphorated monochlorphenol as the sterilizing agent and a thick mix of zinc-oxide-eugenol cement as the final filling of the canals.[8] Spedding described a two-visit technique for treating nonvital primary teeth. A cotton pellet dampened in camphorated chlorphenol or formocresol solution was sealed in the pulp chamber between visits. The final filling material was a thick mix of formocresol zinc-oxide-eugenol.[18] O'Riordan and Coll described a one-visit pulpectomy procedure for primary teeth. After mechanical preparation, they inserted paper points moistened with formocresol in the canals for five minutes. Zinc-oxide- eugenol cement was used for the final filling. Contraindications were inability to determine an apical stop during mechanical preparation and lack of adequate periodontal and bony support[19] The same technique was used by Coll *et al* with the same contraindications.[11]

Most of the "pulpectomy" techniques used zinc-oxide-eugenol cement as the final filling material. Other materials containing iodoform were used for the same purpose. Castagnola and Orley used Kri 1† paste for pulpectomies in permanent teeth.[20] Rifkin used Kri 1 paste as the final filling material for pulpectomies in primary teeth in a two-visit technique. He used Kri 3‡ solution as the medicament between visits.[9,10] The same method was used by Garcia-Godoy.[12] Maisto suggested another iodoform containing paste, for endodontic treatment of permanent teeth.[14] Tagger and Sarnat used Maisto's paste as a temporary medication in endodontic treatment of primary teeth. Their final filling material was a mixture of iodoform and zinc-oxide-eugenol paste.[21]

ILLUSTRATIVE CASE

A four-year, three-month-old girl was treated under general anesthesia. The pulp of the lower left second primary molar was necrotic. The tooth was mobile, both horizontally and vertically. No swelling was noticed on the vestibular or lingual gingiva. The radiographic examination showed widening of the periodontal ligament, and a very early stage of development of the underlying permanent tooth bud. The first permanent molar was still covered with bone (Figure 1). Treatment was accomplished under rubber dam. After complete removal of the caries lesion, a wide access was prepared to the pulp canals. Debridement of the necrotic tissues was done with a barbed wire broach and No. 20 file. No attempt was made to file the pulp-canal walls. The canals were thoroughly irrigated with saline solution and dried with paper points. A modification of Maisto's paste* was pushed down the pulp canals with a file and then plugged in with a cotton pellet and zinc-oxide powder. The pulp chamber was covered by a quick setting cement. A preformed, stainless steel crown was immediately adapted and cemented. The postoperative radiograph shows an overfilling of the paste in the distal canal and underfilling in the mesial canals (Figure 2).

The following three and a half years were uneventful and the tooth remained stable. The overfilling of the paste in the distal canal had been resorbed up to the

Figure 1. Diagnostic bitewing radiograph. Note radiolucent lesion in periodontal ligament of distal and mesial roots.

†Pharmachemie AG. Switzerland. Iodoform paste for root canal filling. Formula: p-Chlorphenolum, 2.025%; Camphora, 4.86%; Mentholum, 1.215%; Iodoform, 80.8%; Excip. ad pastam. IKS 29947.

‡Pharmachemie AG. Switzerland. Menthol solution. Formula: p-Chlorphenolum, 25%; Camphora, 60%; Mentholum, 15%. IKS 29943.

*Zinc-oxide, 7g; iodoform, 14g; thymol, 1g; chlorphenol camphor, 1g; lanolin, 0.25g.

middle part of the root. The underlying bud seemed to develop normally and the first permanent molar erupted to its normal position with no interference. No pathological resorption of the roots is seen (Figure 3).

DISCUSSION

Pulpectomy means total removal of the pulp tissue from the root canals.[22] This cannot be achieved in the primary dentition, because of the complexity and the irregularity of the root canals and the inability to determine an anatomical apex as in the permanent teeth.[4] It is suggested, therefore, that the term "pulpectomy" should not be used in endodontic treatment of the primary teeth. Ingle defined the technique for primary teeth as "debridement and filling of pulpless canals."[5] The procedure should be termed, therefore, "pulp canal treatment". The biomechanical endodontic treatment of permanent teeth is a well-established procedure. It seems that, in endodontic treatment of infected primary teeth, the qualities of the paste used for filling are those which determine the prognosis.

For many years, the most common filling material was, and sometimes still is, zinc-oxide-eugenol cement used by itself, or in different combinations with paraformaldehyde, camphorated monochlorphenol menthol and formocresol. This material is not easily resorbed, however, and its antibacterial effect is limited.[11,23]

In recent years, there was a tendency to use a more potent antibacterial paste, reintroducing iodoform in high concentrations. Castagnola and Orlay demonstrated that the Kri 1 paste used for pulpectomy in permanent teeth gave good results. They showed that the resorption of the Kri 1 paste from the apical part of the root canals was a sign of success.[20] The same pattern of resorption was also found in the case presented. Iodoform-containing pastes are easily resorbed from the periradicular region, and cause no foreign body reaction as does zinc-oxide-eugenol.[23] Over-filling and resorption of the paste containing iodoform from the root canals had no effect on the success of the treatment. It might be regarded, furthermore, as having a positive healing effect. Barker and Lockett demonstrated in dog teeth, resorption of iodoform paste from the apical canal, which was replaced by ingrowth of periodontal tissue.[24] In order to reduce the resorption rate of the paste from the canals, treatment of infected primary teeth was done with a modification of Maisto's paste, in which a higher proportion of zinc-oxide reagent was added.

Many authors regard primary teeth in which infection has gone beyond the pulpal tissues, and into the periradicular tissues as contraindicated for treatment.[8,11,16,19,25] The case presented should have been considered for extraction according to the criteria of the authors. The tooth and its periradicular tissues were badly infected. The child presented behavioral problems and was treated under general anesthesia, which was suggested as a contraindication for root canal treatment in primary teeth by Droter.[6,7] This report is another indication that badly infected primary teeth and their periradicular tissues can be treated with success, using a paste containing a lower concentration of iodoform. The simplicity of the method described, and the good results achieved, should encourage the practitioner to use the Maisto's paste in many so-called lost cases. If a badly infected primary tooth can be preserved

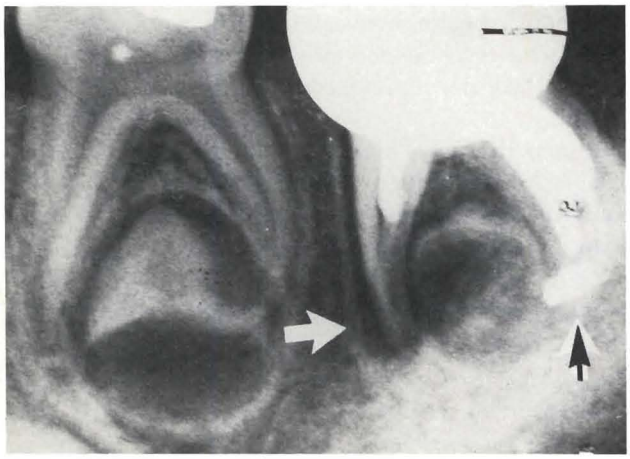

Figure 2. Immediate posttreatment periapical radiograph. Note overfilling and radiolucent lesions.

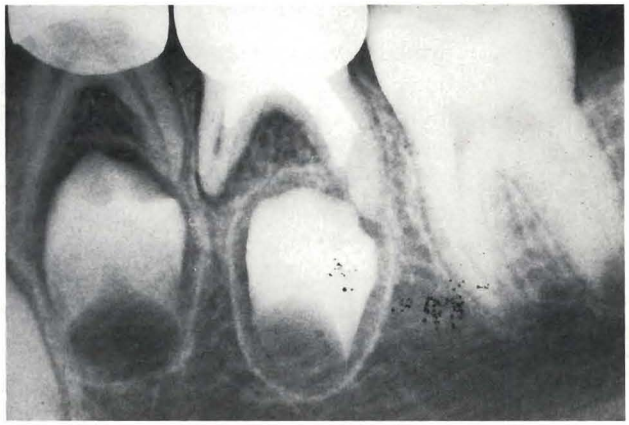

Figure 3. Periapical radiograph, three and a half years after treatment. Note replacement of bone and normal development of the underlying tooth bud.

for any length of time, without physical or psychological hazards, the effort should be considered worthwhile.

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A DEFLUORIDATOR FOR DEVELOPING COUNTRIES

In the developing countries, many people, especially in rural areas, are still consuming untreated water from lakes, rivers, surface wells, boreholes or artesian wells, which often contains biological or chemical agents detrimental to health. In over 95 percent of drinking-water sources the fluoride content is below the level needed for the prevention of dental caries; on the other hand, in some areas the water supplies contain excess fluoride, which causes dental and skeletal fluorosis.

Water with a high fluoride content is usually found at the foot of high mountains and in areas with certain geological formations, particularly those of marine origin. Typical examples are belts extending from Turkey through Syria, Jordan, Egypt, Libya and Algeria to Morocco, from Egypt through Sudan and Kenya to Tanzania, and from Turkey through Iraq, Iran, Afghanistan, India and northern Thailand to China. Since fluoride, as it occurs in drinking-water, is colorless, odorless and tasteless, its presence in excess only becomes evident if chemical analysis is performed or if cases of dental or skeletal fluorosis are found.

A defluoridator for individual households can be made for approximately US $4.00,

Phantumvanit, P. *et al:* A defluoridator for individual households, World Health Forum, 9:555-558, 1988.

Pediatric dentistry in a period of decreasing numbers of dentists

Demography

H. Barry Waldman, BA, DDS, MPH, PhD

As the decade of the 1980s draws to a close, the outlook for dentistry, and in particular pediatric dentistry, appears far more favorable than it was at the beginning of the decade. The series of developments resulting in the improving expectations for pediatric dentistry were summarized in an earlier presentation.

"Projected increases in the number of children, an increasing awareness of the need for, and the value of dental services, and increase in the number of young parents whose own favorable experience with dental services is associated with high-speed dentistry and other major technical and material advances, increasing third party coverage, and an increase in the percent of children using the services of dentists—all augur favorably for the future of pediatric dental practice."[1]

CHANGES IN THE NUMBER OF PEDIATRIC DENTISTS

The improving future for pediatric dental practice is reflected in the increase in the number of pediatric dentists, which began in the 1970s, and continues into the second half of the 1980s. Although data from the reports by the American Dental Association and various reports to the President and the Congress on the status of health personnel differ in absolute number, each

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Table 1 ☐ Number of pediatric dentists: selected years 1970-1986, [2-4]

Year	Number	
	ADA	Report to President
1970		1,076
1976	1,218	
1979	1,776	
1980		2,063
1982	2,949	
1984		2,398
1986		2,600

Table 2 ☐ Pediatric dentists per 100,00 population: selected years 1960-1986, [2-5]

Year	Pediatric dentists Per 100,000 population
1960	0.1
1965	0.3
1970	0.5
1975	0.7
1980	0.9
1986	1.1

Table 3 ☐ Number of students enrolled in first year of pediatric dentistry programs: selected year 1972-1987, [5,6]

Year*	First year enrollment
1972	163
1974	177
1976	165
1978	173
1980	190
1982	158
1984	164
1986	152
1987	165

*Represents the start of the academic year.

Table 4 ☐ Projected number of active dentists and dentists per 100,000 population with adjustments for female dentist practice activity: 1986-2020. [2]

	PART A Report to the President		PART B Adjusted number of dentists		
Year	Number of dentists	Dentists per 100,00 population	Decrease in dentist equivalents*	Number of dentists	Dentists per 100,000 population
1986	143,000	58.9	2,209	140,791	58.0
1990	150,300	59.9	2,498	147,802	58.9
2000	156,300	58.3	4,551	151,749	56.6
2010	154,700	54.6	6,458	148,242	52.3
2020	145,800	49.2	7,938	137,862	46.5

*See appendix for procedure explanation

series presents a marked increase (Table 1).

By 1986, there were 1.1 pediatric dentists per 100,000 population, a 57 percent increase since the mid 1970s (Table 2). In addition, in 1987, the number of students enrolled in the first year of pediatric dental specialty programs returned to the levels of the 1970s (Table 3).

Despite the projections which "augur favorably for the future of pediatric dental practice," this continuing increase in the number of pediatric dentists could signal a return to the first days of the 1980s, when journal articles addressed concerns of a developing oversupply of pediatric dentists.[7,8] If we are to ensure the economic viability of dental practice, there must be a realistic balance between the size of the pediatric population, the demand for dental services by both children and the general population, and the number and productivity of pediatric and general dental practitioners. Although pediatric dentists specialize in the care of the young patient, extensive amounts of service are provided by general practitioners. While the extent of services by general practitioners is a function of interest and ability to provide pediatric services, general practitioner busyness, economics and related factors must also be considered.

As we about to enter the 1990s, there are significant differences in the environment for pediatric and overall dental practice from that which existed in the first days of the 1980s. For example:

- ☐ There has been an increasing use of dental services by a growing population of children.[1]
- ☐ There has been an increasing use of dental services by the general population; an increase in the percent of the population that reported dental visits; and an increase in the number of visits per person and expenditures per person.[9]
- ☐ There has been a dramatic decrease in dental school entering class sizes from 6,301 places in 1978 to 4,100 in 1988; and a projected decrease to 3,630 seats in 1996.[2,10]
- ☐ There will be a national decrease in the ratio of dentists to population during the 1990s (Table 4 — Part A).
- ☐ The decrease in the dentist to population ratio will be paralleled by a general decrease in the absolute number of dentists (Table 4 — Part A).
- ☐ The projected decrease in the number of dentists is accentuated further by variations in the productivity and dental activity patterns of female dentists.*(See following section.)*

FEMALE DENTISTS: AN EXAMPLE OF CHANGE IN DENTISTRY

The complexity in determining the numeric adequacy of practitioners in general, and pediatric practitioners in particular, may be illustrated by reviewing the practice activities of the increasing number of female dentists.

By 1987, female students constituted almost a third (32.3 percent) of the entering dental school classes.[11] The continuing increase in the number of female dental students, with a corresponding decrease in the number of male students, is resulting in a rapid transformation of the once almost all male dental profession in the United States. Whereas in the past century, the percent of female dentists fluctuated between 1 and 2 percent, by 1986, female dentists represented 6.3 percent of the profession.[12] And by 1990, they will increase to 9 percent of all dentists; 15.7 percent by 2000; 29.4 percent by 2020. Indeed, there will be an actual decrease in the number of male dentists after 1990 (Table 5).

Table 5 ☐ Number of active dentists by gender: estimated 1986 and projected for selected years 1990-2020. [2]

Year	Number of active dentists	Male dentists	Female dentists	Percent female of all dentists
1986	143,000	134,000	9,000	6.3%
1990	150,300	136,800	13,500	9.0
2000	156,300	131,700	24,600	15.7
2010	154,700	119,800	34,900	22.6
2020	145,800	102,900	42,900	29.4

Table 6 ☐ Percent of active dentists in practice by gender and hours in practice related activity: selected years, December 31, 1976-1986. [2,14]

	30 + hours per week		Less than 30 hours per week	
	Male	Female	Male	Female
1976	79.8%	51.5%	8.5%	24.5%
1980	77.8	50.6	9.4	17.7
1982	77.8	53.6	9.5	17.8
1984	78.3	55.6	10.6	17.5
1986	78.6	56.2	10.6	17.5

Table 7 ☐ Primary dentist activity by gender: December 31, 1986. [2]

	Male		Female	
	Number	Percent	Number	Percent
Practicing dentist 30 + hrs/week	105,320	78.6%	5,060	56.2%
Practicing dentist > 30 hrs/wk	14,170	10.6	1,580	17.5
Dental school faculty	3,250	2.4	460	5.1
Government & armed service	7,570	5.6	830	9.2
Intern, resident or student	2,550	1.9	840	9.4*
Other (e.g hospital, health organization)	1,140	0.9	230	2.6
Total active dentists	134,000	100.0%	9,000	100.0%

*This particular figure would be affected by the comparative greater number of recent graduates as compared to the relatively small number of older female dentists.

While both male and female practitioners, in the past, provided dental services to children, and will continue to provide them in the future, many female dentists demonstrate particular interest in the care of children. For example, whereas, female dentists constituted 7 to 8 percent of the dental profession in 1988, female dentists represented 13 percent of the U.S. dentists who were identified as pediatric dentists by the American Academy of Pediatric Dentistry.†[13]

The working hours and professional activities of female dentists reportedly differ from those of their male counterparts. For example:

- ☐ Since the mid 1970s, results from studies of dental practice activity indicate that more than three quarters of male dentists, compared to 50 to 56 percent of female dentists, work 30 or more hours per week in practice arrangements (Table 6).
- ☐ Female practitioners who graduated dental school after 1975, report scheduling fewer appointments per week and working fewer weeks per year than their male counterparts.[12]
- ☐ A greater percentage of female dentists report dental school, government, armed services, hospital, and health organization activity than their male counterparts (Table 7).

†Five hundred and forty-four women out of an approximate total of 4,200 pediatric dentists have been identified by the Academy. The listing includes Academy members, and other practitioners who have been identified as pediatric dentists by the American Dental Association, listing in yellow pages and name submissions. As of November 1988, some duplications in the male and female listings still remained. It also should be noted that Academy membership requires two years of approved advanced education in pediatric dentistry. The marked increases in the numbers of dental school female graduates is a very recent event. Additional time is required to permit many of these dental school female graduates to complete graduate and specialty training programs and establish eligibility for Academy membership.

DECREASES IN THE NUMBER OF AVAILABLE DENTISTS

The differences in working hours and professional activities of male and female dentists translate into a marked reduction in the number of dentist equivalents available to provide needed services for the general and pediatric populations; as much as a reduction of 2,500 dentist equivalents in 1990; 4,550 in 2000 (Table 4 — Part B). These adjusted reductions will accentuate the projected decreases in the number of dentists and the dentist-to-population ratios which are projected to begin in the 1990s (Table 4 — Parts A and B).

On the other hand, one could argue (based on the evidence of the number of female pediatric dentists) that the general increasing numbers of female practitioners would balance out the pediatric component of the decreases in dentist equivalents.

OVERVIEW

It would seem all but impossible to plan for health personnel requirements for pediatric and general dentistry into the twenty- first century. Uncertainties exist in the need and demand for services. Government and third-party-payment systems seem to change as frequently as tomorrow's morning newspaper. We are just beginning to experience the effects of the dramatic changes in dental school enrollment. Is it even practical to consider, in the final years of the 1980s, the availability of male and female dentists to provide pediatric and general dental services in the next decade and the early years of the next century? But can we afford not to review these and so many other developments?

Many earlier reviews of developments in pediatric services and personnel requirements were produced during the periods of the last recession and the first

years that followed the reverses in the economics of the dental profession during the recession. By that time, general and pediatric practice still had not returned to reasonable levels of busyness. And most important, the enormity of the curtailment of dental school enrollment had not been realized; nor had the true long-term impact of the continuing downturn in enrollment been analyzed adequately.

But as the decade of the '80s comes to an end, the reports on the prospects of the dental profession have changed dramatically. The decreasing numbers of practitioners to serve a growing general population could signal an increasing dependency for pediatric dental services on pediatric dentists and a relatively smaller number of general practitioners who, because of a favorable competitive environment, would be interested in providing services to younger patients. We will need to continue to monitor:

- ☐ The evolving demand for pediatric dental services.
- ☐ The increasing use of dental services by a growing general population.
- ☐ The number and activities of male and female general practitioners who provide pediatric services during this period of decreasing numbers of dentists.
- ☐ The enrollment of pediatric dental programs.

Throughout the decade of the '80s, our attention has been directed to controlling the numbers of pediatric dentists during a period of increasing numbers of practitioners. The changing realities of dentistry in the next decade and beyond will require a readjustment in our general outlook and a reevaluation of many of our plans.

APPENDIX

Available data for 1986: 1. Male dentists: 78.6 percent were in practice 30 or more hours per week; 10.6 percent for less than 30 hours per week. 2. Female dentists: 56.2 percent were in practice 30 or more hours per week; 17.5 percent for less than 30 hours per week. 3. The average dentist spent 42.5 hours per week in his/her dental office (i.e approximately 8 hours per day for a 5 day week).[15]
Assumptions: 1. The average dentist working 30 or more hours per week worked 42.5 hours or approximately 8 hours per day for a five day week. 2. An average dentist, who spent less than 30 hours per week in dental practice activities, spent 24 hours or 3 days per week in dental practice.
Procedure: To determine the difference in the number of dentist equivalents between the work activities of male and female dentists in 1986: If the 9,000 female dentists worked at rate of male dentists, 9,000 x 78.6% = 7,074 x 42.5 hrs/wk = 300,645 hrs/wk + 9,000 x 10.6% = 1,926 x 24.0 hrs/wk = 46,224 hrs/wk = 346,869 hrs/wk. If the 9,000 female dentists worked at rate of female dentists, 9,000 x 56.2% = 5,060 x 42.5 hrs/wk = 215,050 hrs/wk + 9,000 x 17.5% = 1,580 x 24.0 hrs/wk = 37,920 hrs/wk = 252,970 hrs/wk.
Difference: 346,869 - 252,970 = 93,899 hrs/wk. 93,899 hrs/wk ÷ 42.5 hrs/wk per average dentist = 2,209 dentist equivalents.

A similar procedure was carried out for the years between 1990 and 2020. Note: In determining "dentists equivalents" resulting from differences in male and female dentist working hours, the differences in the number of weeks worked per year were not included in the calculations. Thus, the reduction in "dentist equivalents" reported in this presentation would be a conservative estimate.

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Dental insurance coverage and the use of dental services by children

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Results from National Health Interview Surveys in the 1980s document the increase in the use of dental services by the general population and by children of all ages, males and females, whites and blacks and in all family income groups.[1,2] However, "...the reported use of dental services by children is a balance between increased percentages visiting a dentist and many children requiring numerically fewer visits to complete necessary treatment."[3]

Pediatric dentists and general practitioners are reaching segments of the population which, in the past, may have never received dental services or for which dental services may have consisted primarily of emergency procedures to eliminate pain and infection. Preventive check-ups and services may never have been carried out. In our changing environment for the delivery of dental services, successful dental practice and general medical practice increasingly require that health providers recognize the variations of the new populations being served. To this end, the following presentation will consider the availability of dental insurance for children in the many age, race, and income demographic categories and the relationship of this insurance to the use of dental services.

SOURCE OF INFORMATION

The data for this presentation were drawn from reports on the 1980 national Medical Care Utilization and Expenditure Survey (NMCUES) and the 1979/80, 1983 and 1985 National Health Interview Surveys (NHIS).[1,2,4,5]

The national household component of NMCUES consisted of a national probability sample of 6,600 households representing the general population. These households were the source of data on 17,900 individuals. Over a fifteen-month period, five interviews were conducted with respondents, regarding events related to medical care received during 1980, including use of services, charges incurred, source of payment and health insurance in force at the time of the interview. The NHIS is a continuous cross-sectional, national survey conducted by household interview. Each week a probability sample of households is interviewed by personnel of the U.S. Bureau of the Census to obtain information on the health and other characteristics of each member of the household. Information available from the 1986 survey of the civilian noninstitutionalized population represents data from 61,522 interviewees.† There was approximately a 1 percent nonresponse rate for the dental component of the survey.[1]

REVIEWING THE GENERAL INCREASE IN THE USE OF DENTAL SERVICES

Between 1983 and 1986, there was an increase in the percentage of all children with reported visits to dentists in the previous two years and a decrease in the percentage of all children who had never visited a dentist. By

†Because of variations in reported age cohorts for children in the different survey reports and the inclusion of different questions in each survey, in many instances comparisons between surveys can be difficult and at times impossible.

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1986, a third of all children between two and four years of age and over 71 percent of children between five and seventeen years of age had visited a dentist in the previous year (Table 1).

Between 1983 and 1986, children between two and four years of age were reported to have increased their total number of dental visits. During the same period, older children were reported to have decreased the total number of dental visits. The number of visits per child, reported during the 1980s, however, was greater than for 1978/79, just before the last economic recession. Finally, between 1983 and 1986, the number of visits per child remained constant for children between two and four years of age and decreased slightly for older children (Table 2).‡

Table 1 ☐ Percent of all children with a dental visit within the past year: 1978/79, 1983, 1986.[1,2,5]

Age	1978/79	1983	1986
Under 5 yrs.	14.3%		
2-4 yrs.		28.4%	33.5%
5-14 yrs.	64.2		
5-17 yrs.		67.0	71.5

Table 2 ☐ Total number of dental visits and visits per child: 1978/79, 1983, 1986.[1,2,5]

	1978/79	1983	1986
Total number of visits			
		(in thousands)	
2-4 yrs.		7,166	8,109
5-11 yrs.		47,268	46,934
12-17 yrs.		63,362	49,452
Visits per child			
Under 5 yrs.	0.4		
2-4 yrs.		0.7	0.7
5-11 yrs.		2.1	2.0
5-14 yrs.	2.0		
12-17 yrs.		2.9	2.8

USE OF PREVENTIVE SERVICES

In addition to the increasing use of general services carried out by dentists, national surveys document the increasing use of preventive dental services by dental practitioners and the use of personal preventive services by respondents and their families. For example, almost all children use fluoridated toothpastes, and there is increasing use of fluoride mouth rinses and fluoride supplements. In addition, the 1986 NHIS provides general information on the use of dental sealants. The use of dental sealants is reported in 11.5 percent of children between nine and eleven years of age (Table 3).

DENTAL INSURANCE

Overall

In 1986 there were almost fifty-six million children in the United States between two and seventeen years of age. Over 40 percent of these children (23.7 million) were covered by some form of private dental insurance.*

Dental coverage for children of all ages increased during the 1980s. By 1986, a greater percentage of children between five and seventeen had dental insurance coverage than the overall population. Only the adult population between thirty-five and fifty-four years of age had a higher rate of dental insurance coverage (Table 4).

Demographic characteristics in 1986

- ☐ By gender: A somewhat higher percentage of male children than female children had dental insurance coverage.
- ☐ By race: Minority children had less insurance coverage than their nonminority counterparts. Compared to all minorities and nonminority children, black children had the lowest rate of insurance coverage. Black children, in the various age-groups, had two thirds the rate of insurance coverage as their white counterparts.
- ☐ By residence: Children in Metropolitan Statistical Areas (MSAs) had a higher rate of insurance coverage than children in non-MSAs; children in the noncentral areas of MSAs had the highest rate of coverage.
- ☐ Geographic region: Children in the West had the highest rate of coverage. Children in the South had the lowest rate of coverage.

‡For a more detailed presentation on the increasing use of dental services, see a previous report by this writer in the Journal of Dentistry for Children.[3]

*Any insurance plan specifically designed to pay all or part of the dental expenses of the insured individual, except oral surgery. The insurance can be either a group or an individual policy, with the premiums paid by the individual, an employer, a third party, or a combination of these. Benefits can be received under the plan in the form of payment to the individual or to the dentist. The term dental insurance excludes free care, such as public assistance, public welfare, Medicaid, care given under the Uniform Services Dependents Medical Care Program and the Crippled Children Program or similar programs.[1]

Table 3 ☐ Percent of children with selected preventive dental practices: 1983, 1986.[1,2]

Age	Use fluoride toothpaste		Use fluoride supplements		Use fluoride mouth rinses		Have dental sealants
	1983	1986	1983	1986	1983	1986	1986
2-4	91.9%	91.2%	12.7%	14.4%	7.9%	8.3%	0.9%
5-8		94.0		12.2		29.9	6.4
9-11		94.5		7.2		34.7	11.5
5-11	95.2		9.7		17.6		
12-14		93.2		2.7		24.8	8.8
15-16		93.4		1.2		15.7	6.4
12-17	95.0		2.3		15.7		

Note: 1986 data include use of fluoride mouth rinses at home and fluoride mouth rinse programs at school. 1983 data do not differentiate between location of fluoride rinse activities.

Table 4 ☐ Percent of children with dental insurance: 1980, 1986.[1,4]

Age	1980	1986
2-4		40.2%
<5	35.5%	
5-11		42.8
5-14	38.5	
12-17		43.1
15-24	26.5	
18-24		32.3
All Ages	34.4%	37.8%

Note: 1980 data include children with dental insurance for full or part of year and with or without Medicaid coverage. These differentiations were not continued in 1986.

☐ By income: Children in higher income families had much greater rates of insurance coverage than children in lower income families. The rate of coverage for children in the higher income families was more than double the rate for the children in families with incomes between $10,000 and $19,999, the income cohort that is just above the Medicaid coverage level (Table 5).

Table 5 ☐ Percent of children with dental insurance by various demographic characteristics: 1986.[1]

	Age		
	2-4 yrs.	5-11 yrs.	12-17 yrs.
Gender			
Male	40.3%	43.8%	44.0%
Female	40.0	41.7	42.2
Race			
White	42.6	45.6	45.6
Black	26.1	28.3	30.2
Hispanic			
Mexican Amer.	36.8	29.8	36.8
Other	28.4	31.9	33.0
Place of Residence			
Metro. stat. area	44.0	45.4	46.1
Central city	38.3	39.1	37.8
Non-central	47.6	49.2	50.9
Non-metro. stat. area	27.7	34.4	34.2
Geographic Region			
Northeast	40.6	44.5	45.9
Midwest	43.2	47.6	49.8
South	33.0	35.0	34.3
West	48.2	48.4	48.0
Family income			
<$10,000	6.8	7.0	10.6
$10,000-$19,999	29.5	28.0	28.3
$20,000-$34,999	52.6	53.7	50.5
$35,000 +	61.7	64.0	63.0

Table 6 ☐ Children's dental insurance status by dental visit pattern: 1986.[1]

	Age			
	2-4 yrs.		5-17 yrs.	
	Insurance	No Insurance	Insurance	No Insurance
Number of visits per child per year	0.8	0.7	3.0	1.9
Percent with 1 or more visits in past year	37.1%	27.9%	81.4%	62.5%
Percent with 3 or more visits in past year	3.3	2.7	20.0%	14.1%
Last dental visit was for a check-up	31.7%	22.3%	61.8%	43.9%

MEDICAID DENTISTRY

The current presentation on dental insurance coverage for children does not include Medicaid fund sources. No review of third party support for dental services would be complete, however, without some mention of Medicaid support for the 12.3 million children who live below the federally defined poverty line.

While spending for Medicaid dentistry constitutes a minor component of total national dental expenditures (in 1986, total Medicaid dental spending represented 1.8 percent of national dental expenditures), it must be emphasized that the Medicaid program may provide the only access to dentistry for the poor. In 1980, Medicaid support provided funds for dentistry for 20 percent of the children below five years of age; 13.6 percent for children between five and fourteen years; 10.8 percent for the population between fifteen and twenty-four years.[4] (Total national data since 1980 are not available). During the 1980s, however, the Medicaid program, which at one time accounted for 55 percent of all public health expenditures for children, has changed. There have been decreases in Medicaid dentistry, decreases in the number of recipients, decreases in total constant dollar expenditures (removing the effects of inflation), and decreases in constant dollar expenditures per recipient.**

DENTAL VISITS AND INSURANCE COVERAGE

Overall

In 1986, for all age-groups, dental insurance was a factor in the use of dental services. A greater percentage of children with private dental insurance had reported dental visits, than their uninsured counterparts. Insured children, as compared to their uninsured counterparts, had more visits per child, a greater percentage with one or more visits, and a greater percentage with three or more visits. And most noteworthy, the rate for children without dental insurance whose last dental visit was for a check- up was two thirds the rate for children with insurance (Table 6).

**For a more detailed presentation on Medicaid dentistry see a previous report by this writer in the Journal of Dentistry for Children.[6]

By race

Black and white children with insurance, as compared to their noninsured counterparts, had more dental visits per child, a greater percentage with one or more dental visits in the last year and a greater percentage with check-up for the last dental visit. Black children with private dental insurance had fewer dental visits and check-ups during the last visit, however, than white children with insurance (Table 7).

Table 7 ☐ Children's dental insurance status by dental visit pattern and race: 1986.[1]

	Age			
	2-4 yrs.		5-17 yrs.	
	Insurance	No Insurance	Insurance	No Insurance
Number of visits per child per year				
White	0.7	0.7	3.1	2.0
Black	0.8*	0.4*	1.8	1.2
Percent with 1 or more visits in past year				
White	37.3%	28.7%	83.0%	65.2%
Black	31.3	23.9	68.0	51.9
Last dental visit was for a check-up				
White	32.5	22.9	62.5	46.3
Black	24.0	19.2	54.2	35.1

*Figure does not meet standard of reliability or precision (more than 30 percent relative standard error in numerator of rate)

OVERVIEW

Pediatric practitioners must be prepared to emphasize the provision of services to a wider population spectrum, if the increase in the use of services by children is a "balance between increased percentages visiting a dentist and many children requiring numerically fewer visits..."

The need then, is to balance the greater dental needs of minority children, children who live in nonmetropolitan areas, and children from the southern region of this country, with the reality that smaller percentages of these groups of children, than their particular demographic counterparts, have dental insurance.[7]

To some degree, many of these "other" children receive dental services under the auspices of the Medicaid program. And increasing numbers of children are being covered under private dental insurance plans. But, in actuality, as increasing segments of the population demand dental services, pediatric dentists and the profession in general will be called upon to provide services to segments of the population that have limited third-party support. Innovative financial efforts, varied working programs with government agencies and any number of arrangements with commercial dental practices could provide the needed resources for the desired services.

But most important, private dental insurance is spreading throughout the general population and in particular, there has been increasing coverage for children. Once again, the news for pediatric dentists continues to improve!

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The study of caries prevalence in children in a developing country

Epidemiology

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This paper describes a study of the prevalence of dental caries in a developing country, and the factors which affect the prevalence. One purpose of this study was to collect baseline data in one area of rural Guatemala on the current dental caries prevalence in school-children. In addition, information on family practices which affect caries prevalence was collected. Specific goals of the study were as follows:

- ☐ To survey the dental health of school children and examine the relationship of caries prevalence to age, sex, socioeconomic status, and place of residence.
- ☐ To determine whether there is a relationship between caries prevalence and family practices related to dental health.

This paper focuses on the epidemiological concerns of the study. The epidemiological data will be used to relate past and present attitudes, beliefs, and practices to the prevalence of dental caries in developing countries. This information will be used to develop educational interventions for children and adults.

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REVIEW OF EPIDEMIOLOGICAL EVIDENCE

Currently considered one of the most prevalent diseases in the world, dental caries was of little significance before the 17th century. Caries has existed in man for thousands of years, evident in human skulls. But only one or a few teeth were affected in very few individuals. Beginning in the 1600s in Europe, dental caries progressively affected more individuals, more teeth, and more tooth surfaces.[1-2]

Now a major social health problem, the peak incidence of dental caries occurs in childhood, when 68 percent of five-year- old and 93 percent of 15-year-old children in industrialized countries are affected.[3] During the past two decades, the World Health Organization (WHO) has developed an epidemiological methodology, uniform classification system, and an Oral Health Data Bank to facilitate epidemiological research on dental health. The Decayed-Missing-Filled Teeth (DMFT) index is now used world-wide for dental health surveys. Information is accumulated from many countries in the Global Oral Health Data Bank. In the past decade, dramatic changes have been recorded in the trends of caries prevalence.[4]

Caries prevalence has traditionally been highest in the industrialized countries, where the DMFT index for twelve-year-old children reached 7 and 10 before 1970. Since that time, there has been a spectacular decrease in caries prevalence in developed countries, with the average DMFT index dropping to 3.3.[5] In nine industrialized countries studied by a WHO Joint Working Group in Oral Health there had been a 30 percent to 50 percent reduction in caries prevalence in children five to twelve years of age, between 1973 and 1983.

In contrast, caries prevalence in the developing countries was extremely low until after the middle of this century. During the past two decades it has begun to increase at an alarming rate, first in the urban areas, and more recently, in the rural areas. In 1982, data showed for the first time that the mean DMFT index for twenty-three developing countries had surpassed that for developed countries, reaching a level of 4.1. Virtually all had higher prevalence rates in their urban populations, with the range of 3 to 5 DMFT in children at twelve years of age. No recent studies on caries-prevalence-increase in Guatemala have been reported; but a fifteen-year-old study conducted in villages, near the Guatemalan capital, showed a deft of 6.51 for six-year-old children and a DMF of 4.94 for those twelve years of age.[7]

In cooperation with the International Dental Federation (FDI) and national dental associations, the World Health Organization (WHO) has established goals for oral health for the year 2000. These are related to the overall WHO goal of "health for all by the year 2000". The goals pertaining to dental caries are:

- ☐ Fifty percent of five- to six-year old children will be caries- free.
- ☐ The global average will be no more than 3 DMFT in children at twelve years of age.
- ☐ Eighty-five percent of the population should retain all of their teeth at eighteen years of age.
- ☐ A 50 percent reduction in present levels of edentulousness at thirty-five to forty-four years of age.
- ☐ A 25 percent reduction in present levels of edentulousness at age sixty-five and over.[8]

The data indicate that many of the highly developed countries are doing far better than expected in reducing caries prevalence below a DMFT level of 3. The National Dental Caries Prevalence Survey of U.S. school children during 1979-80 evaluated the caries experience of children between ages five and seventeen. When compared to the National Center for Health Statistics 1971-73 Health and Nutrition Examination Survey, an overall one-third decrease in the prevalence of caries was shown.[9-10] The results of a more recent survey show the prevalence of dental caries in the five-to-seventeen-year age-group now to stand at 50 percent. To date this information has appeared only in news releases from NIDR, but an official report is expected in the next few months.

IMPLICATION OF SUGAR IN DENTAL CARIES

The role of sugar in dental caries has been overwhelmingly implicated. Once sugar, in the form of refined carbohydrates, appears in the diet, there is a marked increase in bacterial metabolism, resulting in the increased release of acidic end- products. More important than the total intake of sugar are the frequency of intake and the concentration of sugar. The more often sugar is in the mouth, the longer the pH remains low, demineralization occurs, and remineralization cannot occur. This is what occurs with frequent consumption of sugary snacks. Sugar ingested with meals seems to have less effect, perhaps because of dilution by other foods. The high concentration of sugar in beverages and snacks is a significant factor in depressing the plaque pH quickly to very low levels.

Recently, the "incrimination" of sugar in the development of caries was questioned. The question appeared

logical in that personal reductions in sugar ingestion and snacking have not resulted in significant reductions of caries prevalence. This reasoning, however, fails to take into account that caries is a progressive disease and that other factors such as oral hygiene and use of fluoride also play a role.[12] A Finnish study reported in 1982 that any amount of sugar consumption plus poor oral hygiene had a synergistic effect on the incidence of caries.[13]

Research to determine the role of sugar in caries has been conducted from many perspectives, including microbiology, chemistry, anthropology, and history. In 1983, Holloway attempted to summarize all such research. He reported studies conducted by Moore and Corbett on human skulls, dating back to 500 B.C. They found the prevalence of caries to be very low until about 1500 A.D. The most frequent site of caries was at the cementoenamel junction, which is the same pattern found in wild primates. Beginning in the 17th century, the rate of caries prevalence doubled each century until the 1960s, when it peaked in industrialized countries. With the rapid rise in prevalence, the sites of caries expanded to include interstitial areas and occlusal fissures. Corbett and Moore also traced the history of sugar consumption in Britain. They showed increased sugar consumption to be correlated with the rise in dental caries, a rise that began at nearly zero before the 17th century, which is when the New World sugar industry was established and began export to Britain. Per capita sugar consumption rose from ten pounds in the 1600s to twenty pounds by the 19th century, until today it stands at a level of ninety pounds per person.[14]

Other research reiterates the significance of plaque pH in relation to enamel demineralization. Chemical analysis reports sugar to be the dietary substrate for acid production. From a microbiological standpoint, it has been determined that cariogenic bacteria can consolidate their attachment to teeth using polymers made from sucrose, in addition to producing acids rapidly from sugar.[15-16]

Several studies have compared figures for per capita sugar consumption and caries prevalence. Correlation has been found, with caries experience leveling off above a certain mean sugar consumption.[17] Sugar data from FAO food balance sheets have also been evaluated. There is a direct correlation of sugar-consumed and caries-prevalence in twelve-year-old children, with only borderline significance for six-year-old children. For both age-groups, a limited availability of sugar (less than 50g per person per day) is always associated with a dmft or DMFT scores of less than 3. All countries identified at this level, or below, were developing countries.[18]

STUDY SITE CHARACTERISTICS

The study was conducted in the northwestern section of the Province of Solola in the Western highlands of Guatemala. The provincial office of statistics estimates a population near 100,000 people.

All residents are members of an ethnic subgroup known as Nahula or Catalina Quiches and speak a dialect of the Maya-Quiche language. Approximately 20 percent of the adult men and 5 percent of the adult women are bilingual in Spanish. Adult literacy is the lowest of any region in Guatemala. An estimated literacy rate for this region is less than 20 percent.[19] The main town of Nahuala has had primary schools for over twenty-five years, but many of the outlying villages have only recently begun building schools. Both teacher and student attendance, as well as motivation, are low.

Health services in the main town are provided at a government health center, staffed by a physician and two nurses; and at a parish clinic, staffed by a native doctor and a community health worker. Within the region, there are two other government health posts, staffed sporadically by auxiliary nurses; and two other parish clinics, staffed by community health workers. A student dentist staffs each of the two main parish clinics for eight months, each year. The community health workers are trained to extract teeth, as are a few other men in outlying communities. Skills in this area are low, sometimes resulting in fractured roots, infections, and/or nerve damage.

Nearly all of the people make a living from subsistence agriculture, raising either corn, beans for drying, coffee, or vegetables. Some are involved in the making and selling of wooden furniture and in marketing produce. Houses are adobe or cornstalks with straw, metal, or tile roofs. Electricity is found only in the main town and major villages. Although the Pan American highway cuts through the region, the main town and major villages of the study area are accessible only by rough dirt roads. Outlying villages are reached by a network of footpaths. Few individuals own motorized or animal transportation.

STUDY DESIGN

To assess dental caries prevalence among school children in the target population, dental examinations were performed on all children in attendance, at seven area schools. A total of 1,200 children were examined, ranging in age from four to seventeen years. The schools were chosen to reflect the differences in enrollment, geographic isolation, and economic bases of the area com-

munities. Enrollment figures were obtained from the district supervisors for all the schools in the area. The schools were then categorized as large (200-450 students), medium (100-200), or small (100). Students from 50 percent of schools in each category were chosen to be examined; three large, one medium, and four small.

Other selection criteria were related to the communities in which the schools are located. Geographic isolation referred to the distance the community is located from a market center, measured in walking time. The walking time for all communities in the area was determined to range from zero to four hours. The economic bases of the communities were defined as either subsistence, cash, or mixed. The large schools were selected to represent one of each, and the small schools were equally divided between mixed and subsistence. The medium school's community has a mixed economy. In this case, the willingness of the school director became the deciding factor, but this was not a consideration in the selection of the other schools. Table 1 demonstrates the schools selected and their characteristics.

Table 1 ☐ Characteristics of schools.

School	Students	Isolation	Economy
NAHC	277	local	mixed
SCLL	401	local	subsistence
STMV	204	1 hr.	cash
PYBR	173	2 hrs.	mixed
PALA	44	3 hrs.	subsistence
PATZ	33	4 hrs.	subsistence
MONT	68	1 hr.	mixed

Table 2 ☐ Dental caries status of total sample by age.

	Total N = 1199	Age 6 N = 96	Age 12 N = 118
Mean DMf (def)	3.65	5.38	2.39
St. Deviation	3.56	4.42	2.79
% Caries-free	23.7	17.7	33.9

DATA COLLECTION AND RESULTS

The dental examinations were done using natural light and no instruments by the investigator and a single trained assistant. Both investigators were simultaneously trained by a visiting U.S. dentist. Due to the remoteness of the study site, (and impracticality of sterilization and transportation of examination instruments) instruments were not used to examine study subjects. To ensure the appropriateness of data, reliability was checked by comparing examinations with the student dentists. Dental caries was defined as any visible lesion, or white or brown spot in the enamel, on any tooth surface. The number of extracted and restored teeth was also noted. The examination results plus name, age, sex, total number of teeth, and socioeconomic status were recorded on a standard dental examination form.

To discern any relationship between socioeconomic status and caries prevalence, a visual indicator to assess socioeconomic status was needed. After discussion with community representatives and other investigators who are familiar with rural Guatemala, footwear was chosen as an appropriate indicator. The three classifications were (a) no shoes = lowest income, (b) rubber or plastic shoes or sandals = middle income, and (c) leather shoes or sandals = high income. The decision to use this indicator was not made until 22 percent of the children had already been examined; only the remaining seventy-

Table 3 ☐ Dental caries status by school.

	(all ages)			
School	N	DMF	S.D.	Percent c.f
MONT	68	1.37	2.18	52.9
NAHC	277	6.07	3.81	11.2
PALA	44	5.11	4.40	15.9
PATZ	33	2.06	3.09	51.5
PYBR	171	3.00	2.81	20.5
SCLL	401	2.61	2.99	30.9
STMV	204	3.68	3.24	16.7

	Six-year-old children				Twelve-year-old children			
	N	def	S.D.	Percent c.f	N	DMF	S.D.	Percent c.f
MONT	9	3.22	3.60	33.3	3	2.66	2.08	00.0
NAHC		9.80	1.92	00.0	2	4.76	3.68	20.0
PALA	9	10.11	5.49	11.1	2	2.00	2.82	50.0
PATZ	6	5.66	5.24	33.3	3	0.66	1.15	66.7
PYBR	11	2.00	2.57	45.5	27	2.29	2.27	25.9
SCLL	38	4.68	3.56	11.4	40	1.32	2.03	45.0
STMV	21	5.85	4.35	9.5	18	1.88	2.05	38.9

Table 4 ☐ Distribution of children by DMF and age (in years).

DMF	Age-Group 4-6	7-11	12-17	Number
0	18.3%	18.6%	36.1%	284
1-3	22.9	32.0	40.1	402
4-6	21.1	23.0	17.2	253
> 6	37.6	26.4	6.6	259
	100%	100%	100%	1198

X = 101.36 df = 6 p<.001

Table 5 ☐ Percent of children by age and sex in different caries levels.

DMF	Ages 4-6 male	female	Ages 7-11 male	female	Ages 12-17 male	female
0	75.0	25.0	50.0	50.0	53.2	46.8
1 - 3	60.0	40.0	49.4	50.6	46.4	53.6
4 - 6	52.8	47.0	54.1	49.9	41.7	58.3
> 6	56.1	43.9	57.4	42.6	60.9	39.1

Table 6 ☐ Relationship of caries and socioeconomic status.

SES	Number	DMF	S.D.
Low	246	2.79	3.10
Middle	507	4.33	3.80
High	182	3.05	3.27

Table 7 ☐ Percent of children caries-free by socioeconomic status and age.

Ages	Low	Middle	High
4-6 yrs.	60.0	6.7	33.3
7-11 yrs.	40.7	34.7	24.6
12-14 yrs.	11.8	64.5	23.7

eight percent of the children not yet examined, therefore, were classified according to socioeconomic status.

The children examined ranged in age from four to seventeen years. For some statistical analyses, the children were grouped by age corresponding to dental development; ages 4 - 6 (N = 109), ages 7 - 11 (N = 740), and ages 12 - 17 (N = 349). Table 2 shows the number of decayed-missing-filled teeth (DMF/def) and the percent of children free from caries in the total sample and for the index ages of six and twelve years. For the total sample, the DMF is 3.65 (S.D = 3.56) and 23.7 percent are caries-free. For children six years old, the def is 5.38 (S.D. = 4.42) and 17.7 percent are caries-free. Of the children twelve years old, 33.9 percent are caries-free and the DMF is 2.39 (S.D. = 2.79).

Information from frequency distribution is shown in Table 3. The overall DMF ranges from 1.36 in MONT to 6.07 in NAHC, with those same schools having the highest (52.9) and lowest (11.2) caries-free rates, respectively. Also, the subjects were compared by age. Six-year-old and twelve-year-old children were evaluated from all schools.

The association between caries and age was found to be highly significant (X = 101.36, df = 6, < .001). The distribution of caries between different age-groups is shown in Table 4. The nonlinear relationship was tested with analysis of variance and the differences between age-groups found to be highly significant (p- value < .001). The sex of the subjects did not affect the results. Of those examined, 48 percent were girls and 52 percent were boys. When controlling for age, caries was found to be not associated with sex. Table 5 shows cross-tabulations and Chi square values for each age-group, with df = 3 and p-value > .05.

Log-linear analysis was used to verify that socioeconomic status is related to dental caries prevalence after controlling for age. Examination of the log-linear highest indicates that children with the most caries are most likely in the low socioeconomic group. A summary of the children in each socioeconomic group and their DMF (with standard deviations) is presented in Table 6. The percent of children found to be caries-free in each socioeconomic group is shown in Table 7.

The relationship of family consumption of sugar and caries prevalence was also studied. All families living in four small villages were surveyed concerning family practices related to dental health. All family members above the age of one year were examined for decayed and missing teeth (none had restored teeth). The ninety-six families included 501 eligible individuals. Ages ranged from one to sixty-nine years. For the following analyses, the age limitations of each group were determined in accordance with increments and losses of the dentition.

The DMF index and percent of persons having no caries were calculated for the total sample and for each

community. These results are presented in Table 8. The DMFT for this sample ranged from 0 to 28. The distribution was negatively skewed with 51.2 percent of those examined with no caries or only one lesion.

DISCUSSION

The results of this study can be discussed best by comparing them with WHO and NIH data. In 1983, WHO reported the average DMF index for developed countries to be 3.3 for five-to-twelve year old children, the lowest it had been in decades. At 3.65, the DMF for the target population was slightly higher. With only 17.7 percent of six-year-old children, free of caries, the population studied is far below the WHO goal of 50 percent of that age-group, caries- free. In all but one of the schools (NAHC), the twelve-year-old children were considerably below the 3.00 DMF goal of WHO. To meet the WHO goal for the year 2000, the latter level should be maintained, the overall DMF lowered, and a major decrease in dental caries among six-year-old children accomplished.

In the 1980 NIH survey of U.S. school children aged five through seventeen, an overall DMF of 2.91, which is lower than the DMF for all the children in this study, was reported. Among U.S. children, 36.6 percent were caries-free as compared with 23.7 percent in this study. For U.S. six-year-old children, the deft is 2.55 compared with a 5.38 deft in study subjects of the same age.

The relationship of caries to age is expected to be positive. In the population studied, however, the relationship between caries and age was found to be negative. Caries-prevalence was highest in the four through six-year-old range. The question remains as to why the primary teeth of this population are so affected. A highly plausible theory would be the occurrence of hypoplasia, which is manifested in enamel surface defects and irregularities due to disturbances during tooth formation.[20] The high incidence of this condition in the primary dentition and its relationship to caries in Guatemala and other developing countries has been previously reported.[21]

Significant differences were found in the DMF and caries-free levels among the schools, which are located in seven different communities. These differences might be due to any one of a combination of factors that were not fully investigated in this study. One factor could be geographic location, which determines access to sugar. This was not specifically addressed, since PALA is equally isolated, but has very different DMF and caries-free rates. Meanwhile, MONT, with the lowest DMF, is not particularly isolated, being only a half-hour walk from a major market.

The economy of the community (cash income vs subsistence agriculture) would affect ability to purchase sugar and snacks. In this study population, two of the three schools with the highest DMFs are indeed in cash-income communities with STMV (DMF 3.68) exceeding

Table 8 ☐ Dental health status of villagers studied.

Age		Community 1	2	3	4	Total
	N =	180	109	8	90	=467
1-6	DMF	.32	.48	.67	2.07	.73
	S.D.	1.19	1.20	1.11	3.73	1.90
	Percent C.F.	92.9	28.4	22.4	10.4	77.9
7-11	DMF	.96	1.13	1.19	1.39	1.14
	S.D.	1.37	1.93	1.56	1.09	1.46
	Percent C.F.	57.1	56.3	56.3	27.8	50.0
12-17	DMF	.73	1.12	2.40	1.63	1.13
	S.D.	1.17	1.16	3.56	0.89	2.02
	Percent C.F.	67.6	47.1	40.0	12.5	47.8
18-50	DMF	3.17	3.70	4.42	3.59	3.56
	S.D.	2.93	4.61	4.73	5.95	4.31
	Percent C.F.	21.0	30.0	12.9	27.0	22.8
> 50	DMF	10.33	8.62	–	19.8	11.38
	S.D.	8.65	4.41	–	9.86	7.43
	Percent C.F.	0	0	–	0	0.0
Total	DMF	2.12	2.83	2.44	3.47	2.61
	S.D.	3.24	4.15	3.67	6.16	4.25
Total	Percent C.F.	46.7	44.0	40.9	26.7	41.1

Note: There are 34 missing DMF values
Percent C.F. = percent caries-free

NAHC (DMF 6.07) in affluence. The anomaly is PALA with the second highest DMF (5.11), which is a very poor subsistence agricultural community.

A very significant variable in the development of caries, which could not be investigated in this type of field study, for practical reasons, is the role of fluoride. The natural fluoride content in the water supply of each of these communities might vary significantly, to account for many of the differences in caries prevalence among the communities. The community PYBR is the only one in the study where the def of six-year-old children was less than the DMF of the twelve-year-old children. In PYBR, 45.5 percent of the six-year-old children were caries-free, half again as many as in any other community. In 1982, this community completed a new public water system to pipe in drinking water from a distant spring. The fluoride content of this new water could be the cause of the distinctive data for this community.

It is interesting to note that NAHC, with the highest DMF index and lowest caries-free rates, is the only community with access to dental care. The school children in NAHC have received dental health education each year, as well as receiving sporadic fluoride treatments and toothbrushes from the student dentists. While the children there do have ready access to sugary snacks, such snacks are equally available to the children of STMV.

The significant relationship between caries-prevalence and socioeconomic status in the population, with the highest rate of caries occurring among those in the middle-income group, holds true across the sample except for those five, six, and twelve years old. It can be theorized that those in the middle group can afford more sugar and snacks than those in the low group; but not toothbrushes, which the high group can purchase. The five-year-old and six-year- old children in the high group may be more indulged with sugary treats by their parents. But brushing is not yet emphasized as with their older siblings (over ten years), who tend to have very low caries-rates. The high prevalence of caries among twelve-to- fourteen-year-old children in the low socioeconomic group warrants further investigation.

The use of footwear as the indicator of socioeconomic status has never been statistically tested. This measure may not be completely valid, especially in reference to different age-levels. Families may make more effort to obtain shoes for older children, especially boys, while younger children with rapidly growing feet are given the cheapest shoes or left barefoot. A separate study of this indicator alone should be undertaken.

SUMMARY

This study has shown that prevalence of dental caries in a rural section of a developing country is related to age, socioeconomic status, and specific location. Caries prevalence is also directly correlated with family consumption of sugar. No correlation could be found, however, with regard to sex.

Further study should be conducted on the relationship of individual practices (sugar consumption and hygiene) to caries- prevalence. In particular, data could be collected on practices in the communities where the school surveys were conducted in order to define the factors underlying the high prevalence of caries in some and lower prevalence in the others.

The fluoride levels in the drinking water and the possible effect of hypoplasia on caries-prevalence in primary teeth are topics for further research. The latter condition should be investigated to determine the cause of its high prevalence, which might be an important consideration in future dental health interventions.

Dental health education should be directed as soon as possible to communities, such as those in this study, where dental caries prevalence and sugar consumption are still low. It is usually more successful to encourage the adoption of new behaviors and attitudes or redirect them in a similar direction than to ask people to give up a valued behavior.[22,23] In this situation, it would be preferable to encourage continuation and effective use of traditional hygiene methods and the current low levels of sugar consumption than to wait until sugar consumption is likely to become entrenched at high levels and traditional hygiene practices abandoned.

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AIDS EDUCATION IN SCHOOLS

Although education has been identified as a crucial component of any attempt to stop the spread of AIDS in the adolescent population, few data exist in this area and few schools are currently offering formal programs that specifically address AIDS prevention. From the studies that have been done thus far, it is known that adolescents have inconsistent levels of knowledge of the facts. In a recent survey of 860 16- to 19-year-old Massachusetts students, limited understanding of AIDS, its modes of transmission, or its prevention were shown. In addition, not all teenagers from a Connecticut sample were aware that an asymptomatic carrier state exists. Others did not understand the IV drug use-AIDS connection. Moreover, there is no evidence that the majority have modified their sexual behavior as a result of knowledge regarding their level of risk for HIV acquisition.

Although few data exist concerning educational interventions regarding HIV, it is clear that only the programs that are designed with the principles of adolescent development in mind and borrow from other curricula that were successful in altering behaviors in other areas of adolescent health will be useful. For example, the concepts of self-efficacy, peer instruction and support, and social skill training are primary components of the "Here's Looking at You 2000" drug prevention curriculum of kindergarten through grade 12. The refusal skills taught in the first grade are continually reinforced and modified through each year from a developmental perspective. Health education models, such as "PRECEDE," can provide frameworks in which to build interventions. Lessons from the business community regarding the importance of "framing" and "packaging" when trying to promote healthy life-styles as a product for teenagers should be incorporated into currently existing and future programs. Concurrently, the development of model programs should include age-and ethnic group-appropriate written and visual materials as well as attitude and knowledge surveys regarding HIV infection.

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Prevalence of selected developmental dental anomalies in children, in Sri Lanka

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Studies on anomalies of teeth in Caucasian children have been well documented.[1-6] There is only meager information, however, on oriental populations.[7,8] In particular, data on Asian children are very limited. The purpose of this investigation is to report on various aspects of selected dental anomalies of Sri Lanka school children at the stage of development when the permanent dentition becomes established and to compare these data with data from western populations. Highlighting common dental anomalies may impress the family dentist of the need for early detection.

SUBJECTS AND METHOD

The sample consisted of 683 school children (253 males and 430 females), ranging in age from thirteen to sixteen years of age, attending six representative schools in Kandy, Sri Lanka. They were lifetime residents of the area. The drinking water in the area contained <0.1 ppm F^-. All children in grades 8 and 9 were included in the study. A dental examination was performed by one examiner, with the subject facing natural light but avoiding direct sunlight. Teeth were not cleaned or dried before inspection, except in a few subjects whose gross plaque accumulations prevented inspection of the gingival third of the crown. In such cases teeth were cleaned using dry gauze. The children were examined for the following anomalies:

☐ Hypodontia

When anomalies related to hypodontia were recorded, a dental radiograph, if possible, was taken at the nearby Dental Faculty. Missing first molar teeth were presumed to have been extracted and where premolars were missing, the possibility of extraction for orthodontic reasons was considered by inquiry and the hypodontia score was corrected. For other missing teeth, hypodontia was diagnosed in accordance with Helm's guidelines: "The tooth is not visible clinically or by X-ray, and the child's dental development and oral health militate against tooth having erupted and been extracted."[9]

☐ Tooth form

The following abnormalities of tooth form were investigated: (a) double teeth, (b)peg-shaped maxillary incisors, (c)palatal pits in maxillary incisors, (d)dilacerations.

☐ Tetracycline discoloration

The criteria for recording tetracycline discoloration were that teeth were a creamy yellow/yellow brown/grey color and that this disturbance of discoloration always extended the full width of the tooth at the affected level and that the condition was bilaterally symmetrical.[10] No fluorescence tests were used in the study. A drug history was not recorded because the children's recall of the names of drugs taken was poor, and parents were not available for questioning during examinations.

☐ Developmental defects of enamel

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The following defects were recorded, based on FDI criteria: (a) white opacities, demarcated or patchy; (b) yellow/brown opacities, localized hypoplasia; (c) horizontal grooves, chronological hypoplasia; (d) enamel pits and defective enamel.[11]

RESULTS

Of the 683 children examined, at least one developmental dental anomaly was detected in each of 289 subjects (42.3 percent). Prevalence was higher in males than in females.

☐ Hypodontia

Number of children with hypodontia was twenty-eight (ten males, eighteen females). Of these, twenty-five subjects were radiographed. Among them six children, in whom the radiographs confirmed the presence of unerupted maxillary canines. The distribution of the rest of the missing teeth is shown in Table 1. A 3.2 percent prevalence rate for hypodontia was recorded.

☐ Tooth form

None of the subjects had double teeth or dilacerations. Ten subjects had peg-shaped maxillary lateral incisors. Bilateral peg-shaped maxillary lateral incisors were noted in one subject. Another had a peg-shaped lateral incisor on the left side, while the one on the right side was missing.

Thirty-six children (5.3 percent) had deep palatal pits (invaginations). In the radiographs, six of these pits extended to the pulp chambers of the teeth. In two children the classical dens-in-dente was seen.

☐ Tetracycline discoloration

The most frequently seen tooth discoloration was tetracycline staining (Figure 1), clinically detected in ninety-one subjects (13.3 percent). In almost all the affected children, staining was present in the anterior teeth. In two subjects, the enamel surfaces were pitted. The degree of tetracycline discolorations noted is shown in Table 2.

☐ Developmental defects of enamel

The enamel defects noted in the study are listed in Table 3. There were no cases of amelogenesis imperfecta in the study group. Figure 2 illustrates a case of chronological hypoplasia with horizontal enamel grooves.

Table 1 ☐ Number of the various teeth congenitally missing and confirmed with radiographs.

Teeth	Children number	Missing Teeth number
Mandibular second premolar	10	14
Maxillary and mandibular second premolar	1	4
Maxillary lateral incisor	7	11
Mandibular central incisor	1	1

Table 2 ☐ The distribution of color range seen in tetracycline stained teeth.

Color	Number	Percent
Yellow	60	66
Dark yellow	6	7
Brown	13	14
Gray	12	13
All	91	100

Table 3 ☐ Developmental defects of enamel in 683 children.

Enamel defects	Children Number	Percent
White opacities		
Demarcated single	31	4.5
Diffuse patchy or horizontal lines	19	2.8
Hypoplasia		
Chronological hypoplasia (horizontal grooves)	38	5.6
Localized, yellow and brown (Turner's)	43	6.3
Other	07	1.0
All	138	20.2

DISCUSSION

This is the first study to report on dental anomalies of Sri Lankan school children. The population of Sri Lanka is on the whole heterogeneous, from both ethnic and genetic points of view. Although a representative sample in terms of ethnicity was obtained, the results of this study may not represent the country as a whole, due to other reasons. There is no ideal age, when the complete permanent dentition can be studied with respect to dental anomalies, although the age may affect prevalence rates. The age-range of thirteen to sixteen years selected for this study represents a time when the full permanent dentition has erupted, except the third molars. This study did not attempt to examine for supernumerary teeth, because they may have been extracted. Mass radiography was not feasible.

Hypodontia on the average was found in 3.2 percent, in both sexes. This prevalence is similar to that reported earlier as well as recently from the U.S.; but reports from Iceland and Norway recorded a much higher prevalence (8 to 10 percent).[2,5-7] The most frequently missing tooth was the mandibular second premolar, similar to findings by many others.[5,6,12,13] Others have noted maxillary lateral incisors, however, to be the most frequently missing in hypodontia cases.[2,4,] Further, when all four teeth were missing, as in the case of one subject, second premolars were affected, a finding highlighted by Muller *et al.*[2]

Peg-shaped lateral incisors were seen in 1.5 percent of the sample, which is close to the prevalence rate reported by Le Bot, but higher than that reported by Clayton.[4,14] Presence of deep palatal pits in maxillary incisors among 5.3 percent of the sample was, however, strikingly high and of clinical importance. Hallet, at a

Figure 1. A case of moderately conspicuous tetracycline- discolored dentition.

Figure 2. Chronological hypoplasia with defective horizontal grooves of enamel in incisor teeth.

symposium held in London in 1953, classified invaginated teeth into four classes.[15] Among these, the pits in classes 3 and 4 extend to the pulp chamber. In the present study, six subjects out of thirty-six (25 percent) could be considered to be in these groups where, as viewed in the radiographs, no or minimal dentine was present over the pulp chamber. This defect enables caries to endanger the pulp tissue rapidly.[16] Early identification of this anomaly is important, to prevent pulpal and periapical infection.

Tetracycline discoloration was noted in 13 percent of the subjects, which raises concern over the prescribing trends in third-world countries. Reports from Western countries and Australia show that the prevalence was increasing, or being noted more frequently, since the first reference to the anomaly in 1956.[10,17] Discoloration of the clinical crown by tetracycline was found, however, in 7 percent in the United Kingdom, circa 1969; 3.4 percent in Australia; and 2.3 percent in the United States, in the same period.[10,18,19] In 1978, a report from Norway recorded a prevalence of 0.4 percent.[20]

Developmental defects of enamel constituted the most frequently found anomaly (20 percent). This was lower, however, than that recorded in other countries.[21,22] This could well be due to poor lighting and to lack of examination facilities needed to detect enamel lesions. Although the prevalence of white demarcated opacities was low, it was found that prevalence of chronological and localized hypoplasia was higher than in other reports.[21,22] This perhaps is due to untreated infection of the primary predecessors and a high incidence of childhood illnesses, such as diarrhoea, which may affect tooth formation and is commonly encountered in the tropics.

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Nutrition

The relationship of breastfeeding to oral development and dental concerns

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The breastfeeding infant uses as much as sixty times more energy ingesting his food than does a baby drinking from a bottle.[1,2] The breastfeeding baby has to open wide, move his jaws back and forth, and squeeze with his gums to extract the milk.[1,3] It has been found that the digastric muscle in infants is two times stronger than in adults in order to accomplish this task.[1] As these muscles are strenuously exercised in suckling, their constant pulling provides an important influence on the thrust and physiological growth of the mandible. Together with the pumping action, a strong negative pressure produced by the infant's mouth around the nipple draws the milk out of the breast. This has the added benefit of aiding the opening and drainage of the pharynx and eustachian tubes, helping the infant to reduce the risks of ear infections and respiratory infections, in addition to the risk reduction provided by the maternal immunological components in the milk.[4]

ORAL DEVELOPMENT

The relationship of infant feeding practices to the developing occlusion and to tongue-thrusting is somewhat controversial. Some studies have shown or suggested

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that breastfeeding decreases the incidence of thumb-sucking and other deleterious oral habits.[5] Straub proposed that many rubber nipples (in bottle feeding) allowed formula to flow too rapidly, causing the infant to push his tongue forward to block the flow of milk while swallowing, to prevent choking.[7] Thus, Straub and others felt that bottle feeding encouraged tongue-thrusting and poor oral development. This belief led to the development of orthodontic nipples such as the "Nuk" or "Mam", which allow the milk to flow more slowly and require more milking motions and activity of the infant.[8] Some studies have also shown increased incidence of tongue-thrusting with bottlefeeding.[2,5,7] Other studies have considered the lack of muscular activity required for bottlefeeding, thus contributing to poor orofacial development.[9] Many of these beliefs have been seriously questioned, however, in light of other research evidence demonstrating no relationship between tongue-thrust, oral malocclusion, and infant feeding practices.[5,10]

Tongue-thrusting in infancy is normal.[2,5,6] Part of the difficulty in interpreting results and comparing studies has been a lack of standardization in what constitutes tongue-thrusting, small sample sizes of breastfed infants, variable lengths of duration of breast or bottlefeeding, lack of information on other types of oral habits of children (e.g. thumb-sucking), and failure to consider and/or correct for other sociopsychological influences between cultures or groups of breastfed or bottlefed infants. A study of particular interest found no significant difference in tongue-thrusting, between White American infants that were either breastfed (up to twelve months), or bottlefed.[2] Both of these groups showed significantly greater incidence of tongue trusting, however, than a group of native Americans who breastfed their infants from eighteen to thirty-six months. Although no cause-and- effect relationship can be shown between infant feeding methods and later oral development, based on the available evidence, breastfeeding does provide the advantage of greater oral muscle exercise over bottlefeeding.

NUTRITIONAL QUALITY OF BREAST MILK

Breast milk has many systemic nutritional and immunological advantages over proprietary formulas.[4,11] Breast milk contains adequate levels of most vitamins and minerals. Of particular interest in dental health are questions concerning vitamin D and fluoride.

Infant formulas are fortified with vitamin D; consequently most formula-fed infants receive adequate vitamin D. The adequacy of the vitamin D content of breastmilk is controversial. Fat- soluble vitamin D levels tend to be low (approximately 40-50 IU/l), while 25-hydroxy vitamin D (75 (OH)D) is high in breastmilk (855 pg/ml) as compared to that in infant formulas (299 pg/ml).[12,13] This form must be further hydroxylated to form vitamin D. Some investigators found a sulfate analogue to vitamin D in breast milk within the water-soluble fraction, and suggested that it increased the vitamin D adequacy in human milk.[14,15] More recent studies have not been able to detect this form of vitamin D, however, and it appears to have limited biological activity.[11,12,15] One group of investigators compared vitamin D supplemented and placebo- treated breastfed infants.[16,17] At three months of age, the supplemented group had a higher bone-mineral content than the unsupplemented group. At one year of age, no difference in bone mineral content was found, but the supplemented group was significantly taller by an average of 2.5 cm. The long-term significance of these results is unknown. Nevertheless, nutritional rickets caused by vitamin D deficiency is uncommon in breastfed infants; and when it occurs, it is usually associated with strict vegetarian maternal diets that do not contain vitamin D fortified milk or supplements.[11] It appears most appropriate to recommend supplementation of vitamin D in breastfed infants when the mother's prenatal and lactating intake of the vitamin is low, and/or exposure to sunlight for the mother and infant is limited. Supplementing a woman with fluoride has little or no effect on the fluoride content of her breastmilk. A fluoride supplement is often recommended for exclusively breastfed infants.[8] Because these infants frequently consume little or no tap water, it has been suggested that they should receive fluoride supplements (until water is added), whether or not they live in communities with an optimally fluoridated water supply.[18] The fluoride content of water must be taken into account for children receiving water plain and/or used to dilute formula, juice, or other beverages. The American Academy of Pediatrics has established guidelines for fluoride supplementation.

Table ☐ Supplemental fluoride dosage schedule. (mg/day*)

Age	Concentration of fluoride in drinking water (ppm) <0.3	0.3-0.7	>0.7
2 wks -2 yrs	0.25	0	0**
2-3 yrs	0.50	0.25	0
3-16 yrs	1.00	0.50	0

*2.2 mg sodium fluoride contains 1 mg fluoride.
**0.25 mg fluoride should be given to infants at age 6 months who are still breastfed exclusively.
From *Pediatric Nutrition Handbook*, American Academy of Pediatrics, 1985.

NURSING CARIES

Nursing caries is generally attributed to sleeping with a bottle of milk or juice in the mouth, and bathing the teeth with a carbohydrate-rich substrate overnight.[19,20] Breastfed babies, however, also occasionally display the symptoms of nursing caries. This usually is limited to babies with teeth who sleep with their mothers and nurse at-will throughout the night. Most infants, however, discontinue a night feeding by three to six months of age, usually before teeth have erupted. Nursing caries may also be seen in children allowed to breastfeed at-will during the day, until they are two or three years of age. Again, this is quite rare, but there are some mothers who practice ad lib breastfeeding night and/or day until the child weans itself. The dentist should advise these mothers of the possible detriment to the primary teeth.[21-23]

Nursing caries may also be due to the free use of a bottle of milk, juice, Jello-water, or Kool-Aid during the day. Parents should be made aware of the cariogenicity of milk, fruits, and their juices. The security provided by sucking is reinforced by the reward of the beverage, making a vicious cycle. Not only does this practice have a deleterious effect on the teeth; it can also be the beginning of aberrant eating and snacking habits that may continue into adulthood.[23]

Another cause of nursing caries is the use of a pacifier dipped in honey. The practice is mostly seen in Europe, but occasionally in the United States. Not only is the honey a prime cause of decay, it is also potentially harmful to the child under age two. Honey can harbor spores of *Clostridium botulinum* that are rendered harmless in the low pH of the adult stomach. In the child, however, the stomach pH is higher and may not kill the spores before they enter the intestinal tract, where they may germinate. This can result in infant botulism.[24] Parents should be warned against using honey in any form for a child under age two.

WEANING AND BEIKOST

Transmission of *Streptococcus mutans* usually occurs from mother to infant shortly after the teeth erupt. Sucrose in the diet enhances the growth of *S. mutans* colonies, increasing the baby's susceptibility to caries formation. Teeth may be most vulnerable to decay during and shortly following eruption. This time period, which usually coincides with weaning, would be ideal for the introduction of preventive strategies, such as the avoidance of sucrose and the judicious use of fluoride.[20] Sucrose-free prepared formulas should be used, if weaning occurs before the first birthday. Prepared baby foods with sucrose should be avoided, as should sucrose-containing table foods.

Beikost is the term for infant foods other than breastmilk or formula. The introduction of beikost occurs anywhere from three weeks to one year. The optimal time to begin beikost feeding is four to six months of age, with iron-fortified rice cereal. The next foods should be vegetables or fruits and other grains. A rather commonly held theory is that vegetables should be introduced before fruits so that the child will learn to accept the vegetables before developing a taste for the sweeter fruits. This practice is anecdotal, but may help children avoid a "sweet tooth". Allergic foods, as a group, should be delayed until nine to twelve months of age.

During the first year of life (particularly in the first few months of life), the infant has an immature gastrointestinal system or an "open gut" which is more sensitive to irritants and may allow some proteins or allergens to cross the mucosal barrier and enter the bloodstream intact. Because of this immaturity, infants tend to be more susceptible to developing food allergies than adults. For these reasons, it is recommended that foods such as unheated cow's milk, egg white, citrus fruits, meats, and wheat products be introduced after a child is six to nine months of age.[8,11,25] These foods are relatively allergenic, and early introduction in infant diets may lead to increased risk of allergy development. Heredity plays a significant role in the development of allergic disease.[8] In families with a history of allergies, prolonged breastfeeding (at least 1 year), and delayed introduction of solids may decrease incidence or severity of food allergies.[8,11] In addition to concerns regarding allergy development, early introduction of cow's milk to infants younger than six months of age is implicated in iron deficiency anemia and occult blood loss from the gastrointestinal tract.[26] Current recommendations for the introduction of cow's milk are that milk be fed in gradually increasing amounts in infants consuming at least a third of their energy requirements from supplemental foods, and that nonmilk energy should be increased to a half within two to three months of the introduction of cow's milk.[26]

Infant feeding practices may affect the life-long health of the child. Healthcare professionals should be familiar with appropriate practices, such as breastfeeding, and encourage parents accordingly.

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COW'S MILK WHEY PROTEIN AND INFANTILE COLIC

Infantile colic is a common and troublesome disorder for the infant and his or her parents. In spite of this, the nature of the disorder is still not fully understood. Most probably there are several causes. In recent years psycho-social factors and/or a failure in the parent-infant interaction to respond to their infants' increased need for cuddling and carrying have been suggested as the dominating primary cause. To the best of our knowledge, these hypotheses for the primary cause of infantile colic have not been proven in any controlled study.

Recently, Hunziker and Barr reported results of a randomized controlled trial in which increased carrying reduced crying in "normal" infants. However, the study did not answer the question why colicky infants cry more than "normal" infants.

We published results indicating that cow's milk can elicit symptoms of infantile colic in certain infants. In controlled, double-blind study, we found that bovine whey proteins given to the mother induced symptoms of infantile colic in her colicky breast-fed infant.

We found that the symptoms of infantile colic vanished completely or diminished noticeably in 24 of 27 infants, mostly within two days, after introduction of a cow's milk-free diet.

Lothe L. and Lindberg, T.: Cow's milk whey protein elicits symptoms of infantile colic in colicky formula-fed infants.

Pediatrics, 83: 262-266, February, 1989.

Case reports

Severe infraclusion ankylosis: report of three cases

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Tooth ankylosis is defined as an anatomical fusion of tooth cementum with alveolar bone. It can occur at any time during eruption, before or after the tooth emerges into the oral cavity.[1] The term "impacted" denotes a tooth that becomes ankylosed before eruption. "Depressed" and "submerged" refer to teeth that have erupted, but subsequently become ankylosed; while the eruption of adjacent teeth continues concomitantly with vertical alveolar bone growth.[2] In such cases, the crown shows varying degrees of infraclusion.[1] Cases of fully erupted teeth that become totally embedded in bone are rare.

Radiographic examination of ankylosed teeth usually reveals loss of periodontal membrane space, indicative of fusion of root cementum with alveolar bone. In some instances, however, the space may be so narrow that it is impossible to diagnose it from the radiograph. The final diagnosis, therefore, should be based on clinical examination, in which the teeth are usually found to be immobile and exhibit a characteristic solid sound on percussion.[2,3]

The incidence of ankylosis according to recent studies varies between 1.3 percent and 9.9 percent.[2,4] It occurs most frequently in primary mandibular molars, al-

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Figure 1a. Panoramic radiograph showing submerged left second primary molar with underlying second premolar.

Figure 1b. Periapical radiograph showing horizontally impacted second premolar, inferior to second primary molar.

though any tooth may become ankylosed.[5] Ankylosed primary molars are more common in Caucasians and there is no reported sex predilection,[2,5]

Three theories for the etiology of this entity have been suggested:

- ☐ The genetic theory suggested by Via showed a prevalence of ankylosis in 44 percent of siblings compared to 1.3 percent in a control group of nonsiblings, indicating a strong familial tendency.[6]
- ☐ The trauma theory described by several authors is based on a previous traumatic incident that caused injury to the bone or periodontal ligament.[7,8] As a result of the regenerative process the tooth becomes ankylosed. This theory was discredited by Rubin and Biederman who, in an experimental study on puppies, were unable to reproduce ankylosis.[9]
- ☐ The disturbed local metabolism theory suggested by Biederman claims that root resorption normally precedes the disappearance of the periodontal membrane of the primary tooth.[10] In cases of disturbed local metabolism, the periodontal membrane disappears first, resulting in union of bone and tooth structure due to their close proximity.

Vorhies *et al* and Thornton and Zimmerman investigated the fusion of cementum and dentin to bone, histologically.[11,12] The questions regarding the selectivity of the site of ankylosis (primary molar area) or at what stage of eruption ankylosis occurred could not, however, be clarified.

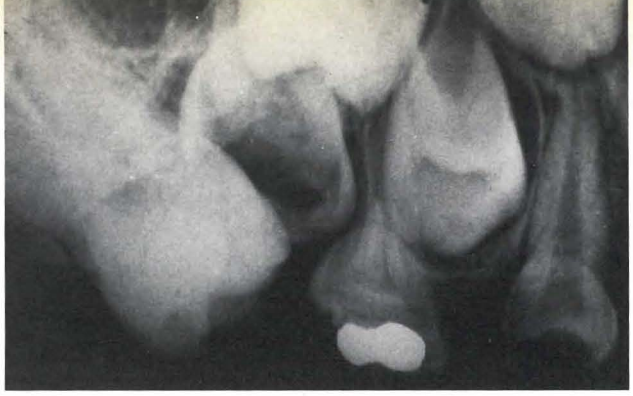

Figure 2. Maxillary periapical radiograph showing the right first permanent molar tipped mesially and submerged second primary molar with extensive caries. The crown of the second premolar is superimposed on the roots of the primary molar.

The purpose of this paper is to present three additional cases of severe infraclusion ankylosis, to review the relevant literature, and to discuss the etiology and related problems of severe infraclusion ankylosis.

Case 1

A nine-year-old Caucasian male presented for a routine examination to the dental clinic of Tel Aviv University. His dental and medical history was noncontributory. Clinical examination showed normal age development of the dentition, except for a missing left second mandibular primary molar. The adjacent left first mandibular permanent molar was inclined mesially, while the canine and first mandibular premolar were inclined distally, with the midline shifted to the left. The lower incisors were tipped lingually and the overjet was accentuated. A submerged left second primary molar and a horizontally impacted left second mandibular premolar, confirmed a diagnosis of infraclusion ankylosis (see Figures 1a,1b).

The patient was referred for surgical removal of the submerged primary molar and orthodontic treatment.

Case 2

A seven-year-old Caucasian male presented at the Tel Aviv University School of Dental Medicine complaining of severe pain on the right side of the maxilla of a few days duration. The patient's general medical history was noncontributory. Clinical examination revealed normal development for the patient's age, except for a missing right second maxillary primary molar. The right first maxillary permanent molar was inclined mesially, and the gingiva on its mesial side was edematous. Probing of the gingiva in this area revealed a carious tooth. Radiographic examination showed a deep caries lesion in the submerged right second maxillary primary molar. The roots of the tooth could not be discerned on the radiograph, because the crown of the right second maxillary premolar was superimposed on the submerged tooth (Figure 2). A diagnosis of submerged right second maxillary primary molar was established and the treatment consisted of extraction of the submerged tooth followed by orthodontic intervention.

Case 3

A twenty-five-year-old Caucasian male presented at the Dental Clinic of Tel Aviv University complaining of dull persistent pain in the left maxilla. His history was noncontributory. Clinical examination showed the left second maxillary premolar and right third maxillary molar to be missing. The patient was not aware that the teeth were missing and said no teeth were extracted. Caries lesions were present in the right second maxillary premolar and the left second maxillary molar. The left first maxillary molar had an extensive amalgam restoration and was sensitive to vertical percussion. Inspection of the soft tissue on the left side of the maxilla showed a soft tumor-like swelling on the hard palate in the region of the first maxillary molar. The swelling was sensitive to palpation.

Caries lesions were present in the right maxillary second premolar and maxillary left second molar, later confirmed by bitewing radiographs; the right third maxillary molar and left second maxillary premolar were absent; the root canals of the left first maxillary molar were filled; and a radiopaque mass surrounded by a radiolucent area was seen in conjunction with the left first maxillary molar. The radiopaque mass was thought to be an impacted tooth crown of an undeveloped left second maxillary premolar, and the radiolucent area around the crown appeared to be the pericoronal space.

The impacted tooth was removed through the palate. It was identified as the left second primary molar. A deep caries lesion was on the distoclusal aspect and a shallow pigmented lesion was on the buccoproximal aspect. The roots were completely resorbed.

Two months later, the patient was completely recovered, and was referred for treatment of the caries lesions and for a prosthesis.

DISCUSSION

Severe infraclusion ankylosis occurs more frequently among maxillary primary molars than among mandibular molars.[1] Case 3 is one of the more extreme submerged infraclusion cases reported. The fact that the left second primary molar had at some stage erupted into the oral cavity is proven by the existence of the caries lesions. This case is associated with a congenitally missing left second premolar. According to Brearley and McKibben, the congenital absence of succedaneous teeth is not always associated with ankylosis of the corresponding primary molars.[1] In case 3, it is not known in what stage the tooth became ankylosed; presumably, though, soon after its emergence. Adams *et al* claim that if a primary molar becomes ankylosed soon after its emergence into the oral cavity, it may be entirely reengulfed by the alveolar bone.[13]

A review of the literature revealed three additional cases of submerged teeth in infraclusion, Krakowiak reported a case of a submerged tooth entirely engulfed by alveolar bone, found during routine radiographic survey of a twenty-two-year-old woman.[14] The primary molar was positioned below the antrum with two occlusal restorations. There was no evidence of the succedaneous premolar. Additional cases were reported by Stanhope and Albers.[2,15] Albers' case was of a submerged second maxillary primary molar with an alloy restoration, adjacent to the apex of the first permanent molar.[2]

Cephalometric studies have shown that the submergence of reimpaction of ankylosed primary molars is due to enclosure by surrounding tissues and not by active tooth movement. The loss of occlusal height of the ankylosed tooth is related to the rate of facial growth.[16] Although many theories have been proposed for the etiology of this disorder, further study is needed to establish the precise cause of tooth reimpaction.

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Tetralogy of Fallot: Characteristics, dental implications and case study

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The tetralogy of Fallot was first described by Dane, Nichols, and Stenson. Fallot separated the disease from other forms of cyanotic heart disease in 1888.[1] The purpose of this paper is to familiarize the reader with this disease entity and relate how it complicates dental treatment.

FREQUENCY AND ETIOLOGY

The overall incidence of the tetralogy of Fallot is 10 percent of all forms of congenital heart disease and is the most common cardiac malformation resulting in cyanosis after one year of age. As with most congenital heart disease, the exact etiology is unknown, but is thought to be related to the embryogenesis of the ventricular septum.[1] The literature reports a few cases in association with rubella in the first trimester, Down syndrome, and Noonan syndrome. The disease afflicts males more frequently (59 percent).[2]

CLINICAL FEATURES

The defects of the tetralogy of Fallot consist of: 1) obstruction of right ventricular outflow due to pulmonary artery atresia or stenosis, 2) ventricular septal defect, 3) right ventricular hypertrophy, 4) aorta that straddles the ventricular septal defect and arises partially from each ventricle (Figure).[1-3] The basic and most important factor that determines the patient's response to the disease and degree of cyanosis is the resistance to blood flow across the stenotic pulmonary circuit. Increased resistance to pulmonary blood flow results in increased cyanosis.[3]

Children afflicted with tetralogy of Fallot are prone to hypoxic spells or blue spells. These hypoxic spells are marked by anxiety and a sudden increase in cyanosis, which is thought to be the result of an abrupt reduction in pulmonary blood flow. During a hypoxic spell the child may become unconscious and develop severe pa-

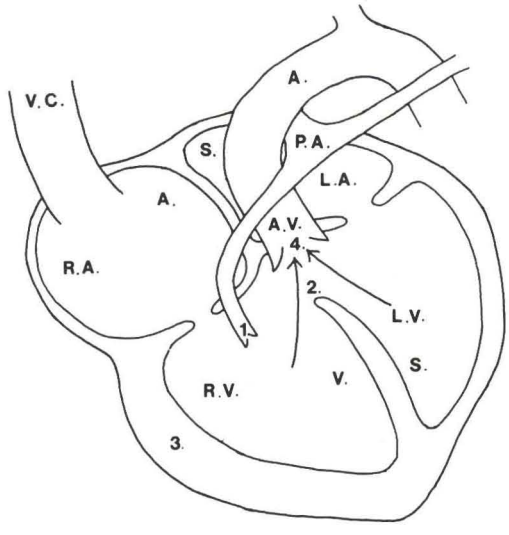

Figure. A diagram of the heart and defects in the tetralogy of Fallot: 1. Pulmonary stenosis 2. High ventricular septal defect 3. Hypertrophied right ventrical 4. Dextropositioned aorta.

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ralysis. Any situation that stimulates hyperpnea may precipitate a blue spell. Hyperpnea results in an increased oxygen demand and cardiac output. Since pulmonary blood flow is relatively fixed in these patients, the net result of the hyperpnea is a lowered arterial oxygen saturation. Unless terminated, these hypercyanotic states may lead to convulsions and can be fatal. Treatment of hypoxic spells consists of 1) O_2 administration, 2) placing the child in a knee-chest position, 3) administration of morphine sulfate and/or propranolol. In extreme cases general anesthesia is administered as a therapeutic modality.[3]

In an attempt to compensate for periodic dyspnea, children with tetralogy of Fallot undertake several postural changes. Infants prefer to lie on one side in a fetal or knee-chest position. Older children avoid standing upright for long periods of time without movement or they squat after physical activity. Squatting is believed to increase the childs arterial oxygen saturation by 1) increasing systemic vascular resistance, thus decreasing the right to left shunting; 2) pooling the markedly desaturated blood in the lower extremities.

Cyanosis leads to clubbing of the fingers and toes, which usually presents after three months of age and is proportionate to the degree of cyanosis. It is the result of a hyperplasia of capillaries with an increase of blood flow through extensive arteriovenous aneurysms. This increases the amount of connective tissue in the terminal phalanges of the fingers and toes.[3]

Hematological changes are the physiologic response to chronic hypoxia. In an attempt to compensate for low arterial O_2 concentration, the body responds with an increased production of red blood cells. This polycythemia may result in a hematocrit of 50 mg percent to 80 mg percent and increases the total blood volume and viscosity, causing an increased work load for the heart. An additional liability of this compensatory polycythemia is the potential production of thrombic lesions in diverse organ systems. Red blood cell precursors may replace platelet stem cells in the bone marrow, leading to a thrombocytopenia. A patient may exhibit a bleeding tendency, therefore, as a result of either a thrombocytopenia or hypofibrinogenemia (a result of thrombosis). In some cases a relative iron deficiency anemia results, if insufficient iron is not provided to compensate for the increased production of red blood cells.[4] It has also been reported that coagulation factors are commonly abnormal in patients with a hematocrit in excess of 60 mg percent.[5] Although the nature and degree of hemostatic disturbances are not fully understood, the possibility of hemorrhage must receive special attention before any surgical procedure is used.

The susceptibility to cerebral abscesses increases in patients with cyanotic heart disease with right to left shunting, because infectious material is not filtered in the lung. Although rare in the first two years of life, cerebral abscesses become a life threatening complication in early childhood. The incidence of cerebral abscesses in children over two years of age is 20 percent. Prompt recognition and treatment are mandatory, because of the 30-40 percent mortality rate. Any patient with congenital heart disease who develops an unexplained fever with headache should be evaluated for a possible brain abscess.[2] Valachovic *et al* reported on a child with congenital heart disease in whom a culture from a brain abscess contained flora similar to that found in the oral cavity.[6] In that case, it was speculated that a first primary molar in which a pulpectomy was done, three years before the onset of the brain abscess was the focus of the infection. Although the tooth was asymptomatic and was clinically normal, it was speculated that the resorption process exposed lateral and accessory canals which were not debrided during the pulpectomy procedure. Theoretically, the bacteria harbored in these canals could have produced the focus of the bacteremia that resulted in the brain abscess.

MEDICAL MANAGEMENT

Medical treatment of tetralogy of Fallot is primarily directed toward the prevention and the treatment of complications of the disease. Corrective open heart surgery is the definitive treatment, but timing of this surgery is linked to key anatomical variables. The size of the child's pulmonary arteries, rather than the age of the child is the primary factor in determining the child's candidacy for definitive corrective surgery. Five years is considered to be an appropriate age for surgery, but this can be variable depending on the child's clinical status.[1,3,8]

Frequently, children with tetralogy of Fallot undergo a palliative surgical procedure designed to reduce their cyanosis by increasing blood flow to the lungs. The most common of these systemic-to-pulmonary-circulation shunts is the Blalock-Taussig shunt. In this procedure, the end of the subclavian artery on the side opposite the aortic arch is anastomosed to the pulmonary artery on the same side. This shunt redirects systemic circulation to the pulmonary circuit and provides palliation until the child is a candidate for total surgical correction.[8]

The hematological profile is closely monitored. Iron deficiency anemia is treated with iron supplementation. The HCT and Hgb are determined frequently and the presence of a rising HCT ($>$ 65 percent) or Hgb ($>$ 25 grm/100ml) may be an indication for early surgical correction.[7]

Propranolol is used in the treatment and prevention of hypoxic spells.

Finally, common pediatric illnesses that could lead to dehydration or thrombic complications should be treated aggressively and promptly. As previously discussed, these children are at risk to subacute bacterial endocarditis.

CASE REPORT

A 3.5-year-old male patient was examined at the pediatric dental clinic at Fort Riley, Kansas in April 1986. The patient's mother reported that the child was born, following a full-term spontaneous vaginal delivery. Her pregnancy was uneventful and she denies taking any medications. At birth the infant appeared dusky and a heart murmur was detected on clinical examination. A cardiac catherization and echocardiogram showed a large ventricular septal defect with almost complete pulmonary atresia. The infant's pulmonary blood flow was the result of several collateral vessels arising from the descending aorta. A diagnosis of severe tetralogy of Fallot was made.

During the neonatal period, the child was managed medically with the following medications: 1) digoxin (0.2 mgs b.i.d.), 2) Aldactone (6.25 mgs, OD), 3) Fer-in-sol (.3 cc t.i.d.). The infant was discharged at the age of sixteen days, weighing 3.0 kgs. By 4.5 months of age the infant became more cyanotic. Cardiac catherization revealed closure of the pulmonary collateral circulation. Chest films revealed right ventricular hypertrophy. At this time a palliative Blalock-Taussig shunt was performed. The patient tolerated the procedure well and his cyanosis improved.

He exhibited promising growth and weight gain during the ensuing postoperative period. The child was managed medically for the next several years by a pediatric cardiologist. He was examined at three-month intervals. Hematological values were closely monitored as well as his growth and development. With the exception of digoxin, the child received no medications.

At the time of the initial dental examination in April 1986, the child's medical condition was stable. His peripheral pulses were brisk and capillary perfusion was normal. There was no evidence of hepatosplenomegaly. Clubbing of the fingers, pectus deformity (carinatum), and moderate cyanosis were evident. There were numerous carious teeth in all quadrants of his mouth. Oral hygiene was poor and the gingivae appeared cyanotic. The child was extremely apprehensive and as he became agitated, the cyanosis worsened. Preventive services included oral hygiene instructions, diet counselling, and supplemental brush-on fluoride (.4 percent SnF_2). After consultation with the parent and physician, it was decided that hospitalization and restoration of all carious teeth, under general anesthesia, would be the treatment of choice.

The child was admitted on May 6, 1988, to Irwin Army Hospital, Fort Riley, Kansas. His vital statistics were 1) weight = 13.6 kgs., 2) height = 37 1/4", 3) B.P. - 94/54, 4) pulse = 100, 5) resp = 30. On admission a complete hematological evaluation was performed to assess the competence of the hemostatic mechanism. The c.b.c. revealed 1) Hbg = 16.7 grm/100 ml, 2) HCT = 49.2 mg percent, 3) R.B.C. = 5.38 million per cmm, 4) platelets = 210,000, 5) W.B.C. = 9,100/mm.^{3} The bleeding time, PT, and PTT were also within normal limits. On the recommendation of the pediatric cardiologist, preoperative prophylaxis for subacute bacterial endocarditis was provided, following the 1977 A.H.A. dosage regimen (300,000 U aqueous penicillin g/kg mixed with 600,000 units procaine penicillin plus streptomycin, 20 mgs/kg 1.M, one hour before the procedure, to be followed by 500 mgs penicillin V, Q 6 hr for 8 doses).[13]

The primary anesthetic considerations in this case were 1) avoidance of extreme agitation preoperatively, which might precipitate a "hypoxic spell", 2) avoidance of hypoxia and hypotension, 3) maintenance of the normal volume status to prevent hemoconcentration and/or thrombosis.

Following successful nasotracheal intubation, the necessary restorative dentistry was performed without complication. Hemostasis was normal, following the extraction of several nonrestorative primary teeth. Careful attention was directed to the possibility of pulp exposures, since routine pulp therapy would not be indicated in patients with severe cyanotic heart disease. The postoperative recovery was normal. Ambulatory follow-up visits revealed no oral discomfort, normal wound healing, and improved oral hygiene. The parents reported that the child was to be reevaluated for definitive corrective surgery within the next few months.

DISCUSSION

In pediatric dentistry, behavior management is a frequently discussed topic and the literature on the subject is voluminous. It is always our goal to treat our patients in a manner as to make dental treatment as stress-free as possible. In patients with tetralogy of Fallot, this is an essential priority. Since these children have a relatively fixed pulmonary blood flow, increased stress tends to

result in increased cyanosis. Patient management on the part of the dentist and staff can reduce the apprehension of the child. In the hospital setting, adequate preoperative sedation is an important consideration, both from a medical as well as a psychological standpoint.

Prevention of bacterial endocarditis is essential in patients with predisposing congenital heart disease. The proper regimen of antibiotics is well publicized by the AHA. It is important to investigate, however, the child's antibiotic experience, since frequent exposures to antibiotics may have resulted in the development of resistant microbial strains and thus the standard antibiotic coverage may not be effective. Medical consultation should be sought, to assure the proper choice and dosage of prophylactic antibiotics.

The sequelae of infection in patients with tetralogy of Fallot are such that the practitioner may have to reevaluate some of the standard and acceptable clinical procedures. It is my opinion that pulpectomies are contraindicated in these patients, since the root canal system is so diverse in primary teeth it may be difficult or impossible to debride an infected tooth totally. This can result in a focus of infection and place the patient at risk. Although the success of vital formocresol pulpotomy is well established, the individual must assess the risk/benefit ratio to determine the efficacy of the procedure. Perhaps extraction and space maintenance are the more appropriate treatment in children with severe congenital heart disease.

Careful attention to the hematological profile is mandatory. The hemoglobin and hematocrit are a physiological mirror to the patient's adaptation to reduced arterial oxygenization and his ability to tolerate his cardiac malformation. Assessment of the hematologic mechanism prior to nasotracheal intubation and oral surgical procedures are of extreme importance.

The above is the opinion of the author and does not reflect the opinions of the Department of Defense or the United States Army.

The importance of home care must be constantly stressed. Since the magnitude of these children's medical problems complicates the most routine dental procedures, prevention of disease must be the common goal of the dentist and parent. The risk of bacterial endocarditis after an episode of low-grade bacteremia caused by vigorous tooth-brushing or chewing is undoubtedly less than the intense bacteremia caused by oral surgical procedures. The cumulative risk of a daily low-grade bacteremia, however, places patients with severe congenital heart defects at risk. Maintaining good oral health will decrease the daily bacteremias and prove extremely important in preventing bacterial endocarditis.

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ABSTRACTS

De Craene, Luc G.D.; Martens, Luc C.; Dermant, Luc R.; Surmont, Paul A.S.: A clinical evaluation of a light-cured fissure sealant (Helioseal®). J Dent Child, 56:97-102, March-April, 1989. The clinical success of pit and fissure sealants has been reported by several authors. In this study a white-shaded, visible-light-cured sealant was used; the results of the clinical evaluation confirmed this finding. Concerning retention rate, marginal adaptation, and the presence of secondary caries and air bubbles, good results were obtained. Data indicate that a visible- light-cured sealant (Helioseal®) appears to be as good as the self-cured sealants and better than the UV-light-cured products. A comparison was also made between the invasive (PFSI) and non- invasive (PFS) application techniques; with respect to the marginal adaptation and the presence of air bubbles, better results were found for fissures that had been enlarged as a preventive measure. More longitudinal studies over a longer period of time are necessary.

Caries, occlusal; Pit and fissure sealants; Retention rates; Visible light-cured products

Doyle, Keri A. and Goepferd, Stephen J.: An allergy to local anesthetics? The consequences of a misdiagnosis. J Dent Child, 56:103-106, March-April, 1989. Adverse reactions to local anesthetics are relatively uncommon and quite variable. Understanding the signs and symptoms of the variety of adverse reactions to local anesthetics is necessary to categorize properly the type of reaction. A wrong diagnosis can have unfortunate consequences. An example of an adverse reaction to a local anesthetic which was improperly diagnosed as an allergic reaction is presented; a seven-year-old girl had suffered a seizure two years earlier, immediately following an intraoral injection of lidocaine. Intravascular injections are the most frequent cause of systemic toxicity; no dentist, however, was willing to treat the child in the interim, assuming an allergy to local anesthetics. The consequences of labeling the patient "allergic to local anesthetics" are discussed.

Allergic reaction; Seizure; Anesthesia, local; Lidocaine

Ben-Bassat, Yocheved; Brin, Ilana; Zilberman, Yerucham: Effects of trauma to the primary incisors on their permanent successors: multidisciplinary treatment. J Dent Child, 56:112-116, March- April, 1989. Dental trauma can often be a factor in developing a malocclusion. Although the prevalence of severely affected permanent teeth following trauma to their predecessors is relatively low, each case may present a variety of sequelae. The purpose of the following report was to present the problems confronting the dentist when treating children after serious injury to their primary incisors. A brief summary of the sequelae of trauma to the primary dentition as found in a longitudinally followed sample, as well as in the representative case of a ten-year-old girl, are presented. The need for prolonged follow-up, originality in

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the solution, and a multidisciplinary treatment approach are stressed.

Trauma, dental; Malocclusion; Tooth alignment; Treatment, multidisciplinary

Myers, David R.; O'Dell, Norris L.; Clark, James W.; Cross, Richard L.: Localized prepubertal periodontitis: literature review and report of case. J Dent Child, 56:107-111, March-April, 1989. There is increasing awareness that periodontitis is a family of related but discrete diseases. This paper reviews literature pertinent to periodontal disease in children and describes an apparent case of early onset of periodontal disease in a 5-year- old girl. The histological features of the prematurely lost primary teeth are described, and the differences between this subject and juvenile periodontitis are stated.

Root resorption, premature; Bone loss, alveolar; Cementum, defective; Periodontitis, prepubertal

Mass, Eliyahu and Zilberman, Uri L.: Endodontic treatment of infected primary teeth, using Maisto's paste. J Dent Child, 56:117-120, March-April, 1989. A method of endodontic treatment, using a modification of Maisto's paste, is suggested for preservation of infected primary teeth. Adding more zinc-oxide reagent and other anti-bacterial materials to the original Walkhoff's paste (Kri 1), for pulp canal medication and final filling, seems to improve the pharmacological effect of the paste by reducing the resorption rate. The literature is reviewed and a case with a follow-up time of three and a half years is described, in which the tooth remained stable.

Primary teeth; Infection, chronic; Endodontics; Zinc-oxide- eugenol cement; Iodoform

Waldman, H. Barry: Pediatric dentistry in a period of decreasing numbers of dentists. J Dent Child, 56:121-124, March-April, 1989. The availability of pediatric dental services is considered in terms of the projected decreases in the numbers of dentists to provide services to the general population. This decrease is further accentuated by the dental practice patterns of an increasing number of female dentists, many of whom demonstrate a particular interest in the care of children. There is an evolving demand for pediatric dental services, and a growing number of pediatric dentists overall.

Pediatric dentistry; Population trends; Practitioners, male (and) female

Waldman, H. Barry: Dental insurance coverage and the use of dental services by children. J Dent Child, 56:125-128, March- April, 1989. The increasing availability of dental insurance for children, and the relationship between insurance and dental visits are detailed. In the changing environment for the delivery of dental services, successful dental practice and general medical practice increasingly require that health providers recognize the variations in the new populations served.

Dental practice; Dental insurance

Warnakulasuriya, K.A.A.S.: Prevalence of selected developmental dental anomalies in children, in Sri Lanka. J Dent Child, 56:137-139, March-April, 1989. Dental anomalies of school children in Kandy, Sri Lanka are described in this report. The sample studied consisted of 683 children, between 13-16 years old, living in a low-fluoride area. In this sample, 42 percent had at least one anomaly, the most prevalent being enamel defects. Anomalies related to hypodontia and tooth form were to a large extent similar to the reports from the Western Hemisphere. Tetracycline staining of teeth found in 13 percent of the sample, however, raises concern. Hypoplasias, perhaps due to local infections or systemic disturbances during childhood illnesses, were expected to be higher than other published reports.

Anomalies, dental; Sri Lanka; Enamel defects; Hypodontia; Teeth, tetracycline-stained

Westover, Kristine M.; DiLoreto, Mary Kay; Shearer, Thomas R.: The relationship of breastfeeding to oral development and dental concerns. J Dent Child, 56:140-143, March-April, 1989. Infants' oral muscles are exercised strenuously in suckling. Breastfeeding contributes an important influence on the thrust and growth of the mandible, in addition to imparting maternal immunological components in the nutritious milk. Infant feeding practices may affect the life-long health of the child. Appropriate, health-promoting practices, such as breastfeeding, should be encouraged by healthcare professionals.

Oral development; Breastfeeding; Tongue-thrusting; Thumb-sucking; Nutrition; Immunology; Nursing caries; Weaning; Beikost

Pilo, Raphael; Littner, Mark M.; Marshak, Barry; Aviv, Israel: Severe infraclusion ankylosis: report of three cases. J Dent child, 56:144-146, March-April, 1989. Tooth ankylosis may occur at any time during eruption and may show varying degrees of infraclusion. Cases of fully erupted teeth subsequently becoming totally embedded in bone are rare. The three reports described here show cases of severe infraclusion ankylosis; the etiology and related problems are discussed. Associated periodontal, prosthetic and orthodontic problems can be avoided with early diagnosis and treatment.

Ankylosis; Infraclusion; Diagnosis, early

McNulty, Judith Ann and Fos, Peter J.: The study of caries prevalence in children in a developing country. J