ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

JANUARY-FEBRUARY 1986

JOURNAL OF DENTISTRY FOR CHILDREN

Beautiful cloud! with folds so soft and fair,
Swimming in the pure quiet air!

WILLIAM CULLEN BRYANT

SEDATION AND THE CHILD

ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

JOURNAL OF DENTISTRY FOR CHILDREN

Volume 53 Number 1 January-February 1986

All copy and manuscripts for the journal should be sent directly to the Editorial Office, 730 Blaney Drive, Dyer, Indiana 46311.

Prospective authors should consult "Information for Authors," which appears in the January and July issues. Reprints may be obtained from the Editorial Office.

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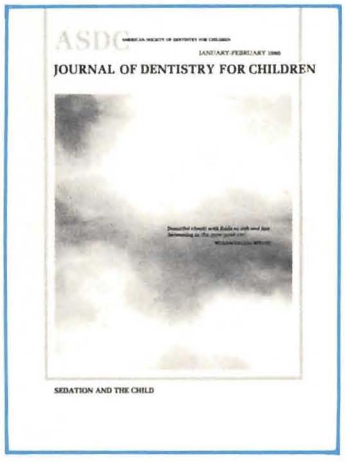
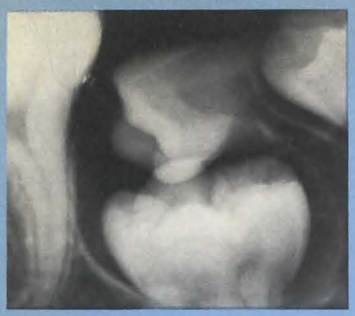


Serenity—an important goal on our way to the achievement of better relationships among people. Design by Sharlene Nowak

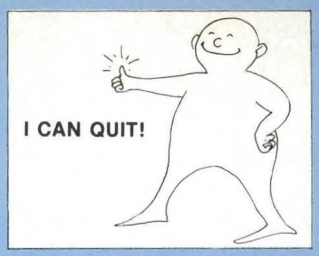
SEDATION

DEVELOPMENT

CLINIC


67


63



48

For the busy reader

Evaluation of the anterograde amnesic effect of rectally administered diazepam in the sedated pedodontic patient—page 17

Randomly, a dosage of 0.6 mg/kg of either diazepam in solution or sodium chloride was dispensed rectally to twelve preschool children. Before the local anesthetic injection, each child was shown a toy and, before dismissal, asked to identify the toy displayed earlier. Amnesia was observed in the majority of children during the diazepam treatment appointment.

Requests for reprints should be directed to Dr. Catherine M. Flaitz, Department of Growth and Development, School of Dentistry, University of Colorado Health Sciences Center, Denver, CO 80262.

IgE in postsecretory ameloblasts suggesting a hypersensitivity reaction at tooth eruption—page 23

The clinical symptoms associated with the eruption of primary teeth resemble a mild hypersensitivity reaction. Light microscopic examination showed that IgE accumulated in postsecretory ameloblasts. The formation of IgE was elicited by enamel matrix proteins, which are chemotactic for mast cells.

Requests for reprints should be directed to Dr. Angela M. Pierce, Department of Oral Pathology, School of Dentistry, Karolinska Institute, Box 4064, S-14104, Huddinge, Sweden.

Dental disease as an indication of nutritional problems—page 27

This study was made of 293 Nigerian children (aged 2-6) to relate height and weight to dental disease. Nigerian children from large families were shorter, lighter, and had a poorer periodontal condition than children from smaller families.

Requests for reprints should be directed to Dr. John Miller, University of Wales College of Medicine, Dental School, Health Park, Cardiff, Wales CF4 4XY, Great Britain.

Hallerman-Streiff syndrome and its oral implications—page 32

A patient with Hallermann-Streiff syndrome was followed from birth to nine years of age. The oral manifestations during the course of the nine years were documented.

Requests for reprints should be directed to Dr. Masamichi Ohishi, Faculty of Dentistry, Kyushu University, 3-1-1 Maidashi, Higashi-Ku, Fukuoka 812, Japan.

Prophylactic dental treatment for a patient with vitamin D-resistant rickets: report of case—page 38

Spontaneous oral dental abscesses in caries-free teeth has been a common sequela in patients with vitamin D-resistant rickets (VDRR). A successful attempt has been made to prevent such abscesses in a 4½-year-old boy with VDRR by covering susceptible teeth with chrome crowns.

Requests for reprints should be directed to Dr. Gary H. Breen, 6 Roberts Avenue, Rutland, VT 05701.

Apical closure in a nonvital permanent tooth using one $Ca(OH)_2$ dressing—page 44

The procedure of apex closure in wide-apexed nonvital teeth usually involves repeated $Ca(OH)_2$ root canal dressings. In this trial of single dressings, only two teeth of twenty-six teeth studied required repeat $Ca(OH)_2$ dressings.

Requests for reprints should be directed to Dr. H.S. Chawla, Department of Dentistry, Postgraduate Institute of Medical Education and Research, Chandigarh - 160012, India.

Monitoring and reinforcement to eliminate thumbsucking—page 48

This pilot study tested the effectiveness of monitoring and positive reinforcement in eliminating thumbsucking, in five to nine-year-old children. Notable declines in thumbsucking were observed after two to four weeks, for the children who used the calendars.

Requests for reprints should be directed to Dr. Monica H. Cipes, Department of Behavioral Sciences and Community Health, University of Connecticut School of Dental Medicine, Farmington, CT 06032.

A comparison of the OHI-S and the PHP in an oral hygiene program—page 53

This study examined two critical measurement properties of the Simplified Oral Hygiene Index (OHI-S) and the Patient Hygiene Performance method (PHP). Both scales proved to be sufficiently sensitive to decreases in plaque.

Requests for reprints should be directed to Dr. Ronald L. Blount, Department of Psychiatry and Behavioral Sciences, Medical University of South Carolina, 171 Ashley Avenue, Charleston, SC 29425.

Dentistry and the technology connection—page 57

In the computerized dental office of the future, high technology will be a cost-effective way of increasing productivity and performance of personnel, if the dentist takes advantage of its inherent capabilities.

Requests for reprints should be directed to Dr. Alvin F. Gardner, 2000 Hidden Valley Lane, Silver Spring, MD 20904.

The problems of treatment of early ankylosis: report of case—page 63

The case report described in this paper, a patient with an early ankylosed second primary mandibular molar, illustrates the importance of patient cooperation in treatment planning. Extraction too early can cause space loss requiring future orthodontic treatment.

Requests for reprints should be directed to Dr. Sabine C. Maréchaux, Pedodontic Clinic, University of Geneva Dental School, Geneva, Switzerland.

Unerupted second primary molar positioned inferior to the second premolar: clinical report—page 67

A case is presented of a ten-year-old boy having a tooth inferior to the right second premolar, which appeared to be the unerupted primary mandibular right second molar. These teeth were extracted.

Requests for reprints should be directed to Dr. Raymond L. Braham, Department of Pediatric Dentistry, University of California, San Francisco, CA 94143.

Facial myiasis: report of case—page 70

A report is described in which a young Indian girl had a large round facial ulcer near the mandible, with maggots observed in four burrows within the ulcer. Turpentine oil was applied to each burrow; debridement and irrigation permitted healing to occur rapidly.

Requests for reprints should be addressed to Dr. H.N. Joshi, 19, Viratnagar Society, Sector-23, Gandhinagar - 382-023, India.

Evaluation of the anterograde amnesic effect of rectally administered diazepam in the sedated pedodontic patient

Sedation

Catherine M. Flaitz, DDS, MS
Arthur J. Nowak, DMD, MA
M. John Hicks, DDS, MS, PhD

Diazepam is a popular sedative agent in dentistry because of its desirable anterograde amnesic property. This amnesic effect is well-documented during various dental procedures, when diazepam is administered intravenously.[1-4] This lack of recall has its peak effect approximately two to ten minutes following the administration of diazepam.[2,3,5] Since the injection of the local anesthetic is considered a noxious procedure in dentistry, memory of this event has been examined in several clinical studies. Amnesia for local anesthetic injection in dental patients varied from total recall to total amnesia.[1,3,4] In general, greater than 60 percent amnesia for local anesthetic injections occurred, when diazepam was administered at dosages that had no significant alteration in the level of consciousness or cardiopulmonary vital functions.[2,3]

Anterograde amnesia has been observed, but not evaluated, when diazepam, in solution, was administered rectally to young pedodontic patients.[6] Since diazepam is highly lipophilic, it is rapidly absorbed

Dr. Flaitz is in practice in pediatric dentistry in Westminster, CO, and is Clinical Assistant Professor, Department of Growth and Development, School of Dentistry, University of Colorado Health Science Center, Denver, CO 80262.

Dr. Nowak is Professor, Department of Pedodontics, College of Dentistry, The University of Iowa, Iowa City, IA 52242.

Dr. Hicks is Assistant Professor, Dental Research Unit, Department of Growth and Development, School of Dentistry, University of Colorado Health Sciences Center, Denver, CO 80262.

through the mucosal membranes of the colon. For this reason, the rectal route is the second most rapidly absorbed method in children.[7-9] Peak serum levels, when administering diazepam rectally, are obtained in five to ten minutes in children, with very small interindividual differences.[7,10] In addition, blood levels as high as 80 percent of that attained for intravenous diazepam have been measured, using the rectal approach.[7] This alternative method of administration is important, because predictable and adequate sedation can occur without using a traumatic route of drug induction in a child.

The purpose of this behavioral study was to investigate the phenomenon of anterograde amnesia in the young child, using rectally administered diazepam. These uncooperative pedodontic patients were selected, because they required sedation for safe and effective management, during restorative dental treatment.

METHODS AND MATERIALS

The patients in this study included twelve children between the ages of two and six, with a mean age of 3.75. Selection of these difficult-to-manage pediatric patients was determined at an initial examination visit by pedodontic faculty. All children were identified as negative or definitely negative toward dental treatment, as defined by the Frankl Scale, ratings 1 and 2.[11] Minimum treatment requirements for the children were two occlusal alloy restorations on primary molars.

The investigation was conducted using a double-blind design in which neither the dentist nor the child were aware of the agent dispensed. Each patient was required to return to the dental clinic for three separate appointments, including the initial examination visit and two treatment visits. Randomly, these uncooperative children were divided into two groups; Group A received the placebo at the first appointment and diazepam at the second appointment; while Group B received diazepam at the first appointment and the placebo at the second appointment.

A sedative dose of 0.6 mg/kg of diazepam, in solution, was administered because of the positive behavioral effects, obtained by Lundgren and co-workers, in young pedodontic patients.[6] This predetermined dosage was dispensed through a soft rubber catheter with the assistance of the parent. In a similar manner, bacteriostatic sodium chloride was administered as the placebo.

The agents were administered to the child by a pedodontist in a standardized operatory, equipped with an overhead camera. The same dentist and dental assistant were responsible for the treatment and management of the young patients. At no time was the dentist aware of the agent given to the child before treatment began.

The restorative procedure was begun ten to fifteen minutes after administering the medication. Every appointment was videotaped and later divided into six one-minute segments for future evaluation. The first three minutes of the film included the local anesthetic injection and the period immediately following. The fourth minute coincided with rubber dam application. The fifth minute started with the cavity preparation and the final minute included the condensation and carving of the amalgam restoration. Blood pressure and pulse were recorded four times during the treatment visit at specific intervals.

Before the local anesthetic injection, each child was shown a colorful toy for thirty seconds. The young patient was encouraged to touch the object and comments about the toy were directed to the child. A stuffed pink panther was displayed at the first treatment appointment and a multicolored rubber clown was shown at the second treatment appointment.

The videotapes were reviewed by two pedodontists and a dental assistant, using the kinesics/vocalization instrument for evaluation of behavioral differences between the two treatment groups.[12,13] Six behavioral categories were evaluated and subdivided into interfering and noninterfering responses. The behavioral categories included:

- ☐ Head and oral movements.
- ☐ Upper extremity movements.
- ☐ Torso movements.
- ☐ Lower extremity movements.
- ☐ Vocalizations by the patients.
- ☐ Requests and commands by the dentists.

Each evaluator reviewed the filmed treatment appointment and independently recorded the behavioral responses of the child and the voice commands of the dentist, during the specified six-minute period. An audible tone was incorporated into ten-second intervals, in order to quantify the duration of the behavioral responses. The minimum number of responses for each behavioral category during the six-minutes of filmed tape was none and the maximum number of recorded responses was thirty-six.

Analysis of Variance (ANOVA) was used to examine the sedative effect of diazepam and placebo on the children's behavior, during the treatment visits. A significance level of $p \leq 0.05$ was considered acceptable. Tables illustrating the means of these treatment groups were constructed for the six categories of behavior, defined by the kinesics/vocalization instrument.

Table 1 ☐ Frequency of the amnesic effect between the treatment groups: Mean values.

Treatment Group	Percent incorrect response
Diazepam (N = 12)	58.3*
Placebo (N = 12)	8.3

*Significant difference between diazepam and placebo treatment at $p \leq 0.005$ - Chi-Square Binomial Population Test.

Table 2 ☐ Total interfering movements: Mean values.[1]

Treatment	Head/oral	Upper extremities	Lower extremities	Torso
Diazepam (N = 12)	1.67*	2.72*	0.33*	0.83*
Placebo (N = 12)	9.50	9.11	5.72	7.33

*Significant difference between diazepam and placebo treatment at $p \leq 0.0001$ ANOVA
[1]-Possible score: minimum = 0; maximum = 36 for each category of movement.

Table 3 ☐ Total vocalizations: Mean values.[1]

Treatment	Patient	Operator
Diazepam (N = 12)	7.39*	5.83*
Placebo (N = 12)	17.08	12.61

*Significant difference between diazepam and placebo treatment at $p \leq 0.0001$ ANOVA
[1]-Possible score: minimum = 0; maximum = 36 for each category of vocalization.

The amnesic property of rectal diazepam was evaluated before the child was dismissed from the treatment appointments. This time-interval was approximately sixty minutes after the drug was administered and when the children were ambulatory. A series of five appealing toys was arranged randomly in another room after treatment. This was done so that positional order would not be a selection factor. These toys included a stuffed panther, a rubber clown, a beach ball, a dump truck and a plastic guitar. The young child was asked to choose the toy that he had been shown at the beginning of the appointment. These results were recorded and analyzed for significance between the treatment groups, using the Chi-Square Binominal Population Test. A significance level of $p \leq 0.05$ was considered acceptable.

RESULTS

Results demonstrated that all but one of the twelve children selected the correct toy, when the placebo had been administered, during the treatment appointment. This one child refused to look at any of the toys in the room, because of uncooperative behavior. In contrast, the patients who had received diazepam during the appointment responded in a varierty of ways and were more hesitant about their decision. Of the twelve children, five were able to choose the appropriate toy, while the remaining children divided their attention among three other toys. When comparing the two treatment groups, a significant difference was observed for the amnesic effect, when diazepam was administered (Table 1).

This amnesic effect was observed, when the children were sedated, but responsive. All interfering bodily movements and vocalizations of the patient and all commands by the dentist were reduced significantly during the diazepam treatment, when compared to the placebo (Tables 2, 3). Of importance, these disruptive behaviors were reduced significantly during the local anesthetic injection period, which immediately followed the display of the toy to the child (Table 4). No significant difference was observed between the two groups, however, when analyzing noninterfering behaviors (Table 5). In addition, there was no clinically significant difference in blood pressure and pulse between the two treatment appointments. These findings aided in evaluating the level of sedation attained, since the children engaged in an acceptable range of bodily movements, and vital signs remained stable, during the treatment appointment.

DISCUSSION

A clinically desirable property of diazepam is its ability to produce anterograde amnesia, during dental treatment. Although this amnesic affect has been studied primarily in adults, it has been observed in children who required sedation during treatment. Healy and coworkers administered intravenous diazepam to apprehensive pedodontic patients who ranged in age from five to sixteen years old.[4] All children were asked whether they recalled the drug induction with the intra-

Table 4 ☐ Interfering movements during local anesthetic injection: Mean values.[1]

	Injection		
Treatment	Pre	During	Post
Diazepam (N = 12)	0.39*	2.17*	1.53*
Placebo (N = 12)	3.67	5.56	4.36

*Significant difference between diazepam and placebo treatment at $p \leq 0.0001$ ANOVA
[1]-Possible score: minimum = 0; maximum = 36 for each 1-minute segment of the injection.

Table 5 ☐ Total noninterfering movements: Mean values.[1]

Treatment	Head/oral	Upper extremities	Lower extremities	Torso
Diazepam (N = 12)	8.50	11.05	2.58	11.89
Placebo (N = 12)	7.64	11.00	2.86	11.75

No significant differences between diazepam and placebo treatment at $p \leq 0.05$ ANOVA
[1]-Possible score: minimum = 0; maximum = 36 for each category of movement.

venous needle and the local anesthetic injection. All the children could recall the sedative administration, but there was no memory of the local anesthetic injection. In addition, all the children expressed willingness to return for future dental treatment.

Lundgren and investigators found rectally administered diazepam to be an acceptable sedative for uncooperative children in an out-patient dental practice.[6] Although they observed amnesia in a number of the young children, there was no attempt to assess the frequency of this side effect. Instead, it was felt that amnesia was not the purpose of sedating a child, since it would be advantageous for the young patient to learn from the previous dental experience.

This present study attempted to evaluate this transient amnesic effect in the young child by using a controlled visual stimulus that the patient would find attractive. The children were requested to select the toy which they had been shown, during the beginning of the appointment. They made this choice at the end of the appointment from a group of five appealing toys, when the children were able to ambulate on their own. The selection of the toy was made approximately sixty minutes after the drug induction. It was found that an average dose of 10 mg of rectally administered diazepam produced amnesia in approximately 60 percent of the children. This lack of recall occurred ten to twelve minutes after administration of the drug.

Anterograde amnesia was observed, when the young children were sedated, but apparetnly alert and cooperative. This was demonstrated by the fact that all interfering bodily movements and vocalizations of the patient were reduced significantly, during the diazepam treatment appointment; while no difference in noninterfering movements was evidenced between the treatment appointments, when measured by the kinesics/vocalization behavioral instrument. This demonstrated that the sedated children were responsive and did engage in an acceptable range of bodily movements, when compared to the placebo. In addition, this side effect occurred without clinically significant deviations in blood pressure and pulse. These findings were similar to those reported by other investigators who were evaluating this amnesic property in adults undergoing oral surgical procedures.[2,3,14]

Although not tested specifically, one might speculate that since the toy was displayed before the local anesthetic injection was made, the children had lack of recall of this noxious dental stimulus. The point is questionable, since some patients undergoing oral surgical procedures with intravenous diazepam recalled, more frequently, the strong operative stimuli rather than the experimental stimuli, although both stimuli were introduced in a narrow time frame.[2] In contrast, Gelfman and others demonstrate a significantly higher recollection for the experimental visual cutaneous-tactile stimuli than for the local anesthetic injection in their patients.[15] This later study may explain why three of the older children, who selected the correct toy during the appointment, postoperatively remarked to their parents that they had not received "a shot" during the diazepam treatment appointment.

CONCLUSION

In this behavioral study, rectally administered diazepam, in solution, was a desirable sedative for effectively and safely managing the young child during dental treatment. A favorable property of this sedative was its ability to produce anterograde amnesia in the majority of these young patients. This amnesic effect occurred, when the sedated children were apparently alert and responsive and vital signs were stable.

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Guidelines for the elective use of conscious sedation, deep sedation, and general anesthesia in pediatric patients*

The goals of sedation and general anesthesia in the ambulatory patient are: (1) patient welfare; (2) control of patient behavior; (3) production of positive psychological response to treatment; and (4) return to pretreatment level of consciousness by time of discharge.

Definition of Terms

Terms used in this document are defined as follows:

Pediatric dental patients: Includes all patients who are infants, children, and adolescents less than age of majority.

Must or shall: Indicates an imperative need and/or duty; as essential or indispensable; mandatory.

Should: Indicates the recommended manner of obtaining the standard; highly desirable.

May or could: Indicates freedom or liberty to follow a suggested or reasonable alternative.

Conscious sedation: Conscious sedation is a minimally depressed level of consciousness that retains the patient's ability to maintain a patent airway independently and continuously, and respond appropriately to physical stimulation and/or verbal command, eg, "Open your eyes." For the very young or handicapped individual, incapable of the usually expected verbal responses, a minimally depressed level of consciousness for that individual should be maintained. The caveat that loss of consciousness should be unlikely is a particularly important part of the definition of conscious sedation, and the drugs and techniques used should carry a margin of safety wide enough to render unintended loss of consciousness unlikely.

Deep sedation: Deep sedation is a controlled state of depressed consciousness or unconsciousness from which the patient is not easily aroused, which may be accompanied by a partial or complete loss of protective reflexes, including the ability to maintain a patent airway independently and respond purposefully to physical stimulation or verbal command.

General anesthesia: General anesthesia is a controlled state of unconsciousness accompanied by a loss of protective reflexes, including the ability to maintain an airway independently and respond purposefully to physical stimulation or verbal command.

Local Anesthesia Considerations

All local anesthetic agents are CNS depressants. Their use is particularly hazardous in smaller children. There is a potential interaction between local anesthetic drugs and other sedatives.

Candidates

Patients who are ASA (American Society of Anesthesiologists) Class I or II are candidates for conscious sedation, deep sedation, or ambulatory general anesthesia (Appendix I). Patients in ASA Class III or IV require special considerations and should be dealt with on an individual basis, probably in a hospital setting.

Facilities and Equipment

Facilities

The practitioner who utilizes any type of sedation medication or general anesthetic agent must have available the proper facilities, personnel, and equipment to manage any reasonably foreseeable emergency situation experienced by the patient and as mandated by state law.

Back-up Emergency Services

Back-up emergency services should be identified with a protocol outlining necessary procedures for their immediate employment. For nonhospital facilities, an emergency-assist system should be established with the nearest hospital emergency facility, and ready access to ambulance service must be assured.

Equipment

A positive-pressure oxygen delivery system that is capable of administering greater than 90% oxygen at a 5 L/min flow for at least 60 min must be available. All equipment must be able to accommodate children of all ages and sizes.

Inhalation sedation equipment must: (1) provide a maximum of 100% and never less than 20% oxygen concentration at a flow rate appropriate to the child's size, and (2) have a fail-safe system that is checked and calibrated annually.

Equipment that is appropriate for the technique being used and that can monitor the physiologic state of the patient before, during, and after the procedure must be present. (See Sections I, II, and III for specific monitoring guidelines).

An emergency cart or kit must be readily accessible and should include the necessary drugs and equipment to resuscitate a nonbreathing and unconscious patient, and provide continuous support while that patient is being transported to a medical facility. There must be documentation that all emergency equipment and drugs are checked and maintained on a scheduled basis. (See Appendix II for recommended drugs.)

Informed Consent

Each family is entitled to be informed and to give consent regarding risks of conscious sedation, deep sedation, and general anesthesia. Written consent should be obtained according to the procedure outlined by individual state laws.

Responsible Adult

The pediatric patient shall be accompanied to and from the office by a parent, legal guardian, or responsible adult who shall be required to remain at the office for the entire treatment period.

Documentation

Prior to Treatment

The practitioner must document each sedation and general anesthetic procedure in the patient's chart. Documentation shall include the following:

1. *Instructions to Parents.* The practitioner shall provide verbal and written instructions to the parents. The instructions must be explicit and shall include an explanation of potential or anticipated postoperative behavior and limitation of activities together with dietary precautions. A 24-hr contact number for the practitioner should be provided to all patients.

2. *Dietary Precautions.* Intake of food and liquids should be as follows: (*a*) no milk or solids after midnight prior to scheduled procedure; (*b*) clear liquids up to 4 hr before procedure, ages 0 to 3 years; clear liquids up to 6 hr before procedure, aged 3 to 6 years; clear liquids up to 8 hr before procedure, age 7 years or greater.

3. *Vital Statistics.* Weight (in pounds or kilograms) and age (in years and months) shall be recorded.

4. *Preoperative Health Evaluation.* Prior to the administration of sedative or general anesthetic drugs, a health evaluation shall be performed.

In the case of conscious sedation, such evaluation should have been accomplished within the past year; for deep sedation or general anesthesia, it shall be accomplished within 2 weeks prior to the procedure, to be reviewed at time of treatment. Such health evaluation should include: (*a*) risk assessment (ASA classification, see Appendix I); (*b*) health history including: (1) allergies and previous allergic reactions; (2) current medications including dose, time, route, and site of administration; (3) diseases, disorders, or abnormalities; (4) previous hospitalization to include the date and for what purpose, together with any history of general anesthesia and hospital courses; and (5) family history of diseases or disorders; (*c*) review of systems, with a statement as to airway patency; (*d*) vital signs, including pulse and blood pressure; and (*e*) physical examination.

5. *Child's Physician.* Name and address of the child's physician or a family physician should be provided.

6. *Rationale for Sedation.* The practitioner shall briefly state the reason for the need for sedation or general anesthesia.

During Treatment

Vital Signs. The patient's chart shall contain documentation that heart rate, respiratory rate, and the responsiveness of the patient were checked and observations of the patient's color, eg, nailbeds, mucosa, etc, were made at specific intervals before and during the procedure, and until the patient was discharged.

Medications Given. The practitioner shall list the route, site, and time of administration together with the type of drug and the dose. The maximum recommended dose per kilogram (or pound) should be calculated, and the actual dose given shall be documented (in milligrams).

When prescriptions are used, a copy or a note describing the content of the prescription should be in the patient's chart along with a description of the instructions given to the parent.

After Treatment

The time and condition of the child upon discharge should be documented in the chart.

Section I: Conscious Sedation

Personnel

The practitioner responsible for the treatment of the patient and/or the administration of drugs for conscious sedation shall be trained appropriately in the use of such techniques.

For conscious sedation, the minimum number of personnel shall be 2; ie, the operator and an assistant trained to monitor appropriate physiologic parameters and to assist in any support or resuscitation measures required. These individuals must have training in basic life support, shall have specific assignments, and shall have current knowledge of the emergency cart inventory. The practitioner and all office personnel should participate in periodic reviews of the office's emergency protocol, including simulated exercises, to assure proper equipment function and staff interaction.

Monitoring Procedures

1. Operative Monitoring. Whenever drugs for conscious sedation are administered, a trained individual should monitor the patient continuously. With the possible exception of very light sedation, the heart and respiratory rates should be monitored and recorded continuously at specific intervals. A precordial stethoscope is considered to be minimum equipment for obtaining continuous information on heart rate and respiratory rate.

The child's color, eg, nailbeds, mucosa, etc, shall be monitored visually on a continuous basis. If a restraint device is used and it covers the patient, a hand or a foot should be kept exposed. Restraining devices should be checked to prevent chest restriction. The child's head position should be checked frequently to ensure a patent airway. At no time shall a sedated person be left unobserved by a trained person.

2. Postoperative Monitoring. When the treatment procedures have been completed and the patient is being readied for discharge, the vital signs should be recorded at specific intervals. The practitioner shall assess the patient's responsiveness and discharge the patient only when the following criteria are met: (*a*) cardiovascular and airway stability are assured; (*b*) patient is alert; (*c*) patient can talk; (*d*) patient can sit up unaided; and (*e*) patient can ambulate with minimal assistance. For the very young or handicapped individual, incapable of the usually expected responses, the presedation level of responsiveness that is as close as possible to the normal level for that individual should be achieved.

Section II: Deep Sedation

Personnel

The technique of deep sedation requires at least 3 individuals; each must be appropriately licensed: (1) a qualified person to direct the sedation; (2) a qualified person whose only responsibilities are observation and monitoring of the patient, and who may administer drugs; and (3) other personnel to assist the operator, if necessary. A person other than the operator may direct and/or administer the drugs and monitor the patient.

Operating Facility

In addition to the facilities and equipment previously cited, the operating facility used for the administration of deep sedation must have the capability of monitoring temperature and blood pressure and have a functioning suction apparatus. An ECG and a defibrillator are desirable. Airway management and breathing equipment must be checked prior to each patient use.

Intravenous Access

Patients receiving deep sedation should have an intravenous line in place or have immediately available a person skilled in establishing intravenous infusion in pediatric patients.

Monitoring Procedures

1. Operative Monitoring. Continuous monitoring of the heart rate, respiratory rate, and blood pressure, and visual monitoring of the patient's color must be carried out and recorded at 5-min intervals. A precordial stethoscope and blood pressure cuff are minimum monitoring devices; ECG and temperature monitoring are desirable. The child's head position must be checked frequently to ensure a patent airway. At no time shall a sedated person be left unobserved by a trained person. A time-based or anesthetic-type record shall be maintained. The practitioner shall list the route, site, and time of administration together with the type of drug and the dose. The maximum recommended dose per kilogram (or pound) should be calculated and the actual dose given shall be documented (in milligrams). When prescriptions are used, a copy or a note describing the content of the prescription should be in the patient's chart along with a description of the instructions given to the parent.

Recovery Care

Following deep sedation, the patient must be observed in a suitably equipped recovery facility. This facility must have functioning suction apparatus, as well as the capacity to deliver greater than 90% oxygen and positive-pressure ventilation. An individual experienced in recovery care must be in attendance at all times in order to assess and record vital signs, observe the patient, and assure a patent airway. The patient must remain in the recovery area until cardiovascular and respiratory stability are assured and the patient is awake and oriented.

Section III: General Anesthesia

Personnel

The technique of general anesthesia requires at least 3 individuals each of whom should be appropriately licensed: (1) a qualified person to direct the anesthesia; (2) a qualified person whose only responsibilities are observation and monitoring of the patient, and who may administer drugs; and (3) other personnel to assist the operator if necessary. A person other than the operator may direct and/or administer the drugs and monitor the patient.

Operating Facility

In addition to the facilities and equipment previously cited, the operating facility used for the administration of general anesthesia must have the capability of monitoring temperature and blood pressure, and have an ECG device and a functioning suction apparatus. A defibrillator is desirable. Airway management and breathing equipment must be checked prior to each patient use. When general anesthesia is being administered, drugs necessary for the treatment of malignant hyperthermia must be readily available. This must include sodium dantrolene.

Intravenous Access

Patients receiving ambulatory general anesthesia shall have an intravenous line in place or have immediately available a person skilled in establishing intravenous infusion in pediatric patients.

Monitoring Procedures

1. Operative Monitoring. Continuous monitoring of the heart rate, respiratory rate, and blood pressure, and visual monitoring of the patient's color must be carried out and recorded at 5-min intervals. A precordial stethoscope and blood pressure cuff are minimum monitoring devices; ECG and temperature monitoring are desirable. The child's head position must be checked frequently to ensure a patent airway. At no time shall an anesthetized person be left unobserved by a trained person. A time-based or anesthetic-type record shall be maintained. The practitioner shall list the route, rate, site, and time of administration together with the type of drug and the dose. The maximum recommended dose per kilogram (or pound) should be calculated and the actual dose given shall be documented (in milligrams).

Recovery Care

Following general anesthesia, the patient must be observed in a suitably equipped recovery facility. This facility must have functioning suction apparatus, as well as the capacity to delivery greater than 90% oxygen and positive-pressure ventilation. An individual experienced in recovery care must be in attendance at all times in order to assess and record vital signs, observe the patient, and assure a patent airway. The patient must remain in the recovery area until cardiovascular and respiratory stability are assured and the patient is awake and oriented.

APPENDIX I
American Society of Anesthesiologists Classification

Class I—There is no organic, physiologic, biochemical, or psychiatric disturbance. The pathologic process for which operation is to be performed is localized and is not a systemic disturbance.

Class II—Mild-to-moderate systemic disturbance caused either by the condition to be treated surgically or by other pathophysiological processes.

Class III—Severe systemic disturbance or disease from whatever cause, even though it may not be possible to define the degree of disability with finality.

Class IV—Indicative of the patient with severe systemic disorder already life-threatening, not always correctable by the operative procedure.

Class V—The moribund patient who has little chance of survival but is submitted to operation in desperation.

APPENDIX II
Recommended Emergency Drugs

Glucose (50%)
Atropine
Epinephrine
Calcium chloride
Sodium bicarbonate
Lidocaine
Naloxone hydrochloride
Diphenhydramine hydrochloride
Hydrocortisone
Intravenous solutions and equipment for administration appropriate to the patient population being treated.
Portable oxygen capable of delivering bag and mask ventilation greater than 90% at 5 L/min flow for at least 60 min (eg, "E" cylinder and resuscitation bag with masks that will accommodate children of all ages and sizes)

* Pedodontic Sedation Medication Committee members were: Drs. Robert L. Creedon, Marshall P. Brownstein, Howard R. Dixon, David L. King, Hugh C. Smith, Kenneth C. Troutman, and Gerald Z. Wright. Special consultants from the American Academy of Pediatrics were: Drs. Theodore W. Striker, Charles Cote, William Wallace, James C. Phero, and Frank C. Woodside, III.

IgE in postsecretory ameloblasts suggesting a hypersensitivity reaction at tooth eruption

Development

Angela M. Pierce, BDS, FRACDS
Sven Lindskog, DDS, Odont. dr.
Lars Hammarström, DDS, Odont. dr.

In recent years, the eruption of primary teeth has been associated with a number of clinical symptoms of varying severity, from a slight erythema at the site of eruption to fever and gastrointestinal symptoms and even convulsions.[1,2] Earlier, tooth eruption was associated with more serious consequences and was considered responsible for half the infant deaths in France during the 18th century.[3] Similarly, it was the assumed cause of death for 7 to 15 percent of all small children who died in Berlin at the end of the last century.[4]

Tooth eruption is no longer considered to endanger the lives of small children, but it is still associated with a number of local and general symptoms. A few days prior to the emergence of the tooth into the oral cavity, there is usually local swelling and erythema of the gingiva ahead of the erupting tooth. At the same time, there can be local irritation and itching in the area and the salivation rate appears to increase.[5]

The most commonly reported general symptoms are irritability, fever, rhinitis and diarrhoea.[5] There does not appear to be general agreement as to whether these symptoms are directly related to tooth eruption, or if their appearance is coincidental and, in fact, caused by infection or dietary changes.

Dr. Pierce is with the Department of Dentistry, The University of Adelaide, Adelaide, Australia.
Dr. Lindskog and Professor Hammarström are with the Department of Oral Pathology, School of Dentistry, Karolinska Institute, Stockholm, Sweden.

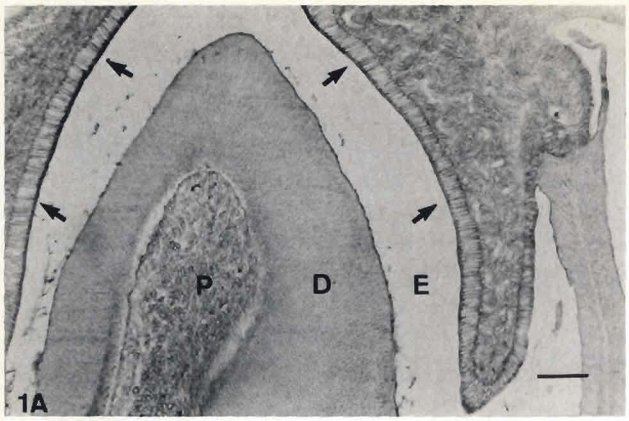

Figure 1A. Developing first molar from a fifteen-day-old mouse, incubated for the presence of IgE, using the ABC immunoperoxidase technique and counterstained with haematoxylin. Note dark deposits (arrows) of IgE in the apical portion of postsecretory ameloblasts. E = enamel space, D = dentin. P = pulp. Bar = 50 μm.

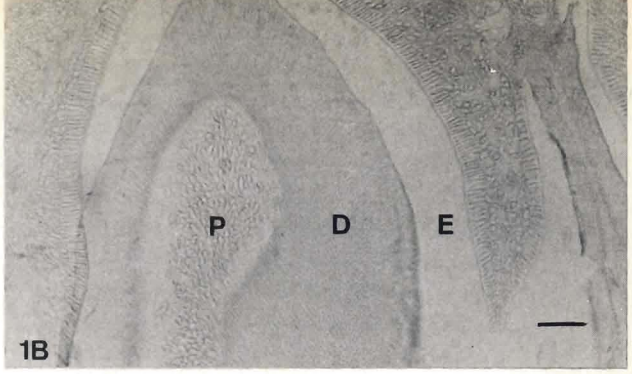

Figure 1B. Control section adjacent to section shown in Figure 1A. No nonspecific peroxidase activity is evident. E = enamel space, D = dentin, P = pulp. Bar = 50 μm.

Histological studies of the tissues surrounding an erupting tooth showed an accumulation of inflammatory cells (mainly lymphocytes) in the area.[6] A "conspicuous" accumulation of mast cells has also been noted.[1]

Enamel matrix, shown to be autoantigenic, is released from the mineralizing enamel during tooth eruption.[7,8] It does not readily attract macrophages, nor does IgG accumulate at sites of enamel formation.[9,10] Enamel matrix, however, is chemotactic for mast cells, whose activation is intimately associated with IgE. The symptoms of tooth eruption may thus be caused by an endogenous immune reaction against the enamel matrix. The purpose of the present investigation was to investigate the presence of IgE in the tissues surrounding the erupting tooth.

MATERIALS AND METHODS

General

Four albino mice, aged five, nine, fifteen days and six weeks, were killed by decapitation. Their maxillae were dissected out, split down the midpalatal suture, and immersion-fixed in 10 percent neutral buffered formalin for one hour. Specimens from nine-day, fifteen-day, and six-week rats were decalcified in 4 percent EDTA and all specimens were processed for light microscopy, using standard paraffin-embedding techniques. Serial sections (5 μm) were prepared of molars at five, nine and fifteen days, and incisors at six weeks.

Immunohistochemistry

After dehydration through a graded series of alcohols, sections were incubated for demonstration of mouse IgE according to the avidin-biotin-peroxidase (ABC) technique, for which the Vectastain TM kit (Vector Laboratories, Inc., Burlington, CA, USA) was used.[11,12] Sections were pretreated in 0.6 percent hydrogen peroxide, rinsed in phosphate buffered saline (PBS) and incubated with Normal Goat Serum for 30 mins. They were further incubated with Rabbit anti-Mouse IgE (US Biochemical Corp., Cleveland, Ohio, USA) at dilutions of 1:300 and 1:400 for 69 mins. Control sections were not incubated with this primary antibody. All further incubations were separated by PBS rinses. Sections were then incubated for 30 mins with biotinylated-Goat anti-Rabbit IgG, and for 60 mins with avidin-biotin-peroxidase complex (ABC). All incubations were carried out in a humidified chamber at room temperature. After the final incubation, sections were rinsed in PBS and exposed to the peroxidase substrate, diaminobenzidine (DAB), and hydrogen peroxide for 5 mins, after which they were rinsed in distilled H_2O, counterstained in haematoxylin and mounted in glyceringelatin, prior to examination in the light microscope.

RESULTS

Molars

No IgE was observed in murine molars at five days; the control and experimental sections were similar in appearance. At nine days, IgE was occasionally noted in experimental sections, but only in association with scanty numbers of postsecretory ameloblasts in the first molar. By fifteen days, IgE was clearly demonstrable in both the apical portion (facing the enamel) of first molar postsecretory ameloblasts (Figure 1A) and within the monolayer of cells lining the developing root surface. Control sections showed no nonspecific peroxidase activity (Figure 1B). In the extrafollicular connective tissue surrounding the teeth, several discrete cell clusters were also noted to contain IgE (Figure 2).

Incisors

IgE was detected in the apical portion of postsecretory ameloblasts in experimental sections of mouse incisors,

Figure 2. Discrete cell clusters (CC) present in the extrafollicular connective tissue between epithelium and tooth germ in a fifteen-day-old mouse. Cells stained strongly for IgE. A = ameloblasts, E = enamel space, D = dentin. Bar = 50 μm.

six weeks of age (Figure 3A). No nonspecific peroxidase activity was noted in control sections (Figure 3B).

DISCUSSION

Ameloblasts present several distinct morphological stages during amelogenesis, all of which have been well documented and are readily detectable using light microscopy.[13-15] They have been classified into zones accordingly: presecretory, secretory, and maturation with a region of transition before maturation.[15] Murine molars do not grow continuously, like their incisal counterparts. Hence a specific zone of molar ameloblasts may be confidently related to the age of the animal. For example, in the present investigation, first molars from five-day-old mice were in the secretory stage; those from nine-day-old mice, in a late-secretory to early-maturation stage; and those from fifteen-day-old mice showed post-secretory ameloblasts in the maturation stage. In contrast, the whole spectrum of enamel formation may be seen in mouse incisors, irrespective of the animal's age; but more clearly demarcated, if the tooth is larger, such as that at six weeks.

In the present study, it is apparent that the principle area of IgE detection in both molars and incisors was in postsecretory ameloblasts. It is, therefore, pertinent to examine this stage more closely. During maturation, enamel matrix proteins and fragments are transported out of the forming enamel.[16] The fate of these proteins has yet to be determined; but it is not unlikely that they are capable of eliciting an immunological reaction in the extrafollicular tissue, their autoantigenicity have been previously established.[7,8] This is supported by the observation, in the present study, that IgE-positive cells accumulated extrafollicularly. This accumulation was only detected in the maturation stage of amelogenesis during which the first exposure of enamel matrix components to cells other than ameloblasts is seen. Furthermore, approximately 25 percent of ameloblasts undergo autolysis during the transition from the secretory to the maturation stage of amelogenesis, thus encouraging further exposure of enamel matrix proteins.[17,18]

It is tempting, therefore, to suggest that enamel matrix proteins elicit an antigenic response in the extrafollicular connective tissue, which results in the production of IgE. Accordingly, the IgE accumulates at the site of highest antigen concentration, that is, the ameloblast-enamel interface, as seen in the present study. It was demonstrated that the tight junctions which render impermeability to the ameloblast layer during the secretory stage may be lost from some cells during the maturation stage of amelogenesis.[19-21] Hence, the ameloblast layer becomes "leaky" during

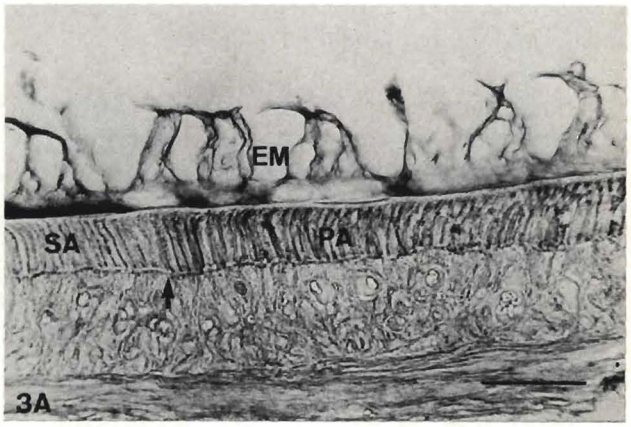

Figure 3A. Mouse incisor, six weeks, incubated for the presence of IgE. Arrow indicates transition from secretory to postsecretory ameloblasts. Note dark deposits in apical portions of postsecretory ameloblasts, indicating the presence of IgE. EM = enamel matrix, SA = secretory ameloblasts, PA = postsecretory ameloblasts. Bar = 50 μm.

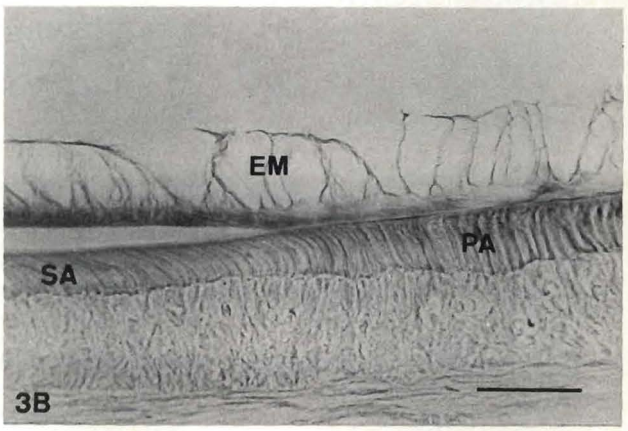

Figure 3B. Control section adjacent to section shown in Figure 3A. No nonspecific peroxidase activity is evident. EM = enamel matrix, SA = secretory ameloblasts, PA = postsecretory ameloblasts. Bar = 50 μm.

this stage, allowing the accumulation of IgE between the postsecretory ameloblasts.

Enamel matrix proteins have been shown to be chemotactic for mast cells and mast cells accumulate around erupting teeth.[1,9] Thus, the interaction of IgE, enamel matrix proteins and mast cells is capable of producing a reaction due to a hypersensitivity within the extrafollicular connective tissue. Such a reaction may be responsible for the clinical signs of tooth eruption. Local symptoms such as erythema, swelling and itching are consistent with a reaction due to a hypersensitivity, which, if severe enough, could also cause some of the more general symptoms. The fact that symptoms vary among children may be due to differences in their immune response.[5]

Of further interest are the observations of Listgarten and Heritier that cementum is formed on the surface of enamel matrix directly exposed to extrafollicular connective tissue. [22,23] In the present study, IgE was detected in the monolayer of cells lining the surface of the developing molar root. Previous studies indicated that an enamel matrix-like material is present on the root surface prior to cementum formation and it is likely that this substance elicits the production of IgE.[24-27] Accordingly, an IgE-related reaction due to a hypersensitivity may be implicated in cementogenesis. Furthermore, an intermittent vascular leakage has been reported to occur in the periapical region during root formation.[28] This could be elicited by release of histamine through the action of IgE on mast cells in the area and may well be responsible for the eruption force.

In conclusion, the presence of IgE in ameloblasts during the maturation stage of amelogenesis is suggested to be a consequence of exposure of enamel matrix proteins to immunocompetent cells in the extrafollicular connective tissue. A local hypersensitivity reaction thus elicited may account for the clinical signs frequently observed during tooth eruption.

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This study was supported by grants from the Faculty of Dentistry, The University of Adelaide, the School of Dentistry, Karolinska Institutet, and the Swedish Medical Research Council, grant/nos. 06001 and 6651.

Clinic

Dental disease as an indication of nutritional problems

John Miller, MDS, DDS, FDS
Frank Etumiwe Okoisor, LDS, FDS, RCPS, FMCDS
Derek Andrew Liddington

A previous study, Miller *et al*, 1982, found that 1,000 children with severe dental caries had significantly lower body weights than 500 control children.[1] The present study was made to explore the extent to which this phenomenon might pertain in other parts of the world and whether altered body weight was associated with forms of dental disease. The object of the study was to ascertain whether oral disease could be a means of identifying the "at-risk" child by correlating the criteria of physical measurement with the prevalence of oral disease. Arrangements were made for studies to be conducted in the Republic of Eire, in Ulster, in the Far East and also in Nigeria. This paper presents the findings of the study conducted in Lagos, Nigeria. The study was carried out on a sample of 293 children, between the ages of two years and six years attending the Maternal and Child Health Centre: The Oguntola Street Clinic in the Shomolu local government area of Lagos. The clinic is run by the Institute of Child Health and Primary Care of the University of Lagos and data on each child's health from conception to oral examination were available.

METHOD

The following information was sought for each child: The height and the weight, the prevalence of dental

Dr. Miller was Dean of the Dental School of the University of Wales College of Medicine, and chairman, Department of Children's Dentistry & Preventive Dentistry, Dental School, Heath Park, Cardiff, DF4 4XY.

caries, the prevalence of periodontal disease, the length of pregnancy, the birth weight, any medical conditions since birth, the ethnic background. The height and weight measurements were made in metric units and presented in centile grouping; as growth and development charts appropriate to Nigeria were not available, those available according to Tanner for height and weight were employed. The child was barefoot while the height and weight were measured.

Dental caries

Dental caries was diagnosed according to WHO Standards 'Oral Health Methods (1971)', using a mirror and sickle probe after having first wiped any debris away with gauze. The lesion recorded as dental caries was one where there was no doubt that caries had penetrated into dentin. The number of either decayed, absent or restored teeth was recorded as right or left of upper or lower jaw.

Periodontal disease

Gingival or periodontal upset was assessed according to the standards developed by Valentine in his study in Burma:

Good The ideal gingival condition exhibiting healthy color (not always pink in all children), firm consistency, smooth margins, stippling and often a health line. The contour of the gingival margins should fit snugly around the tooth. The presence of a small localized area of inflammation associated with an erupting primary molar would not preclude the child from being classified as good, if all other areas were in excellent health.

Poor Red or purplish swollen gingivae exhibiting signs of recent bleeding or from which bleeding occurred on the application of a blunt periodontal probe into the gingival sulcus and no deliberate pressure.

Fair This covered a wide range from the near perfect gingiva, which was not classified as good because of the presence of perhaps one or two swollen or inflammed papillae, to those which had several red and swollen areas and would not be classed as poor because there were no signs of recent bleeding; and bleeding was not induced by the application of a blunt probe in the sulcus. The dividing line between good and fair was the presence of swelling or redness with the resultant loss of stippling; the dividing line between fair and poor was the presence or absence of bleeding.[2]

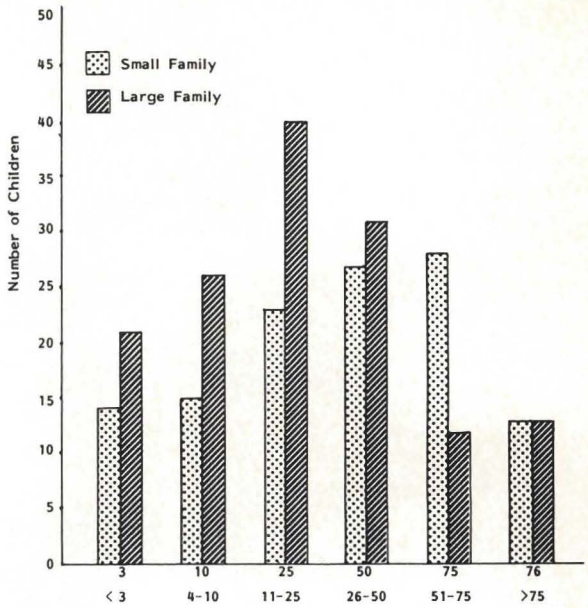

Figure 1A. Total number of children aged 3-5 years in each height group for small and large families.

Special needs

It was conceivable that family conditions might influence the general or dental health of a child; in this context, note was made of any of the following points:

- ☐ *Large family.* This was recorded, if more than four children were in the family unit. The family unit consisted of one father, one mother plus children.
- ☐ *Position in the family.* This was described as first, second, third, fourth child, etc. in the family unit.
- ☐ *Economic conditions of the family.* These were noted, if there was any evidence that economic factors influenced the way in which the family were nurtured. These were related to local conditions and difficult, therefore, to define on a world basis.
- ☐ *Family stress.* This could result from the absence or separation of parents, separation of the family from the tribal family or natural habitat. Death of a sibling might produce family stress.
- ☐ *Bed confinement.* This was noted, if the individual was confined to bed for other than short periods of acute illness.

Statistical methods

The data were entered on an individual data sheet at the time of examination. The record forms can be coded for

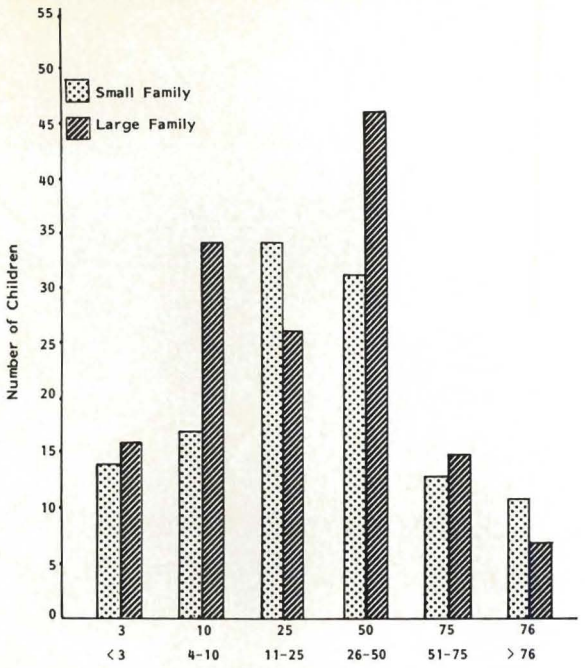

Figure 1B. Total number of children aged 3-5 years in each weight group for small and large families.

computer analysis. The statistical program used for the analysis was Minitab release 81.1 by Pennsylvania State University, 1981. The range of the I.C.D. codes used was expanded to cope with the multiple illnesses.

Minitab has an internal missing value code called asterisk(*). Any missing value was coded with a 9 and by using a Minitab recode command, the 9 could be subsequently recorded as an asterisk and hence be excluded from the analysis on a computer run.

Note on interpretation of chi square test

Two points were born in mind regarding the validity of the chi square test:

- ☐ This test is only valid, if 20 percent of the cells do not have an expected number in a cell of less than five, since this contributes to the total of chi squares possibly being too high.
- ☐ Those results which produce an expected number less than five in more than one cell of a table have been interpreted with caution.

Results

There were only 288 children for whom records of sex, and size of family were available. The number of boys in this sample was slightly greater; but apart from a greater number of boys from large families there was an even balance between boys and girls in age and type of family. The large number of boys from large families was statistically different. Figures 1A and 1B show the distribution of the children in relation to the centiles of height (Figure 1A) and the centiles of weight (Figure 1B), in large or small families. The data from which these graphs were compiled are in Tables 2 and 3. The differences between large and small families in height were significant. Although graphically there appeared to be marked differences in weights between the families, they were not proven to be significant. The periodontal index, when related to height and weight, appeared to be significantly different in relation to weight (Table 4). In relating periodontal condition to

Table 1 ☐ Distribution of children in study.

	Age in Years					
Male						
Small Family	2	20	19	18	3	62
Large Family	4	30	23	26	6	92
Total	6	50	45	44	9	154
Female						
Small Family	2	25	21	18	2	68
Large Family	3	23	18	18	4	66
Total	5	48	39	36	6	134

Table 2 ☐ Height related to family size.

	Percentile for height						
	<3	10	25	50	75	76+	Total
Family Size							
Small	18	17	24	28	28	14	129
Large	24	30	47	33	14	13	161
	42	47	71	61	42	27	290
Percent	14.5	16.2	24.5	21	14.5	9.30	100

$X^2 = 13.652$ d.f. = 5 p = 0.02

Table 3 ☐ Weight related to family size.

	Percentile for weight						
	<3	10	25	50	75	76+	Total
Family Size							
Small	14	20	37	32	15	11	129
Large	17	39	31	52	16	7	162
	31	59	68	84	31	18	291
Percent	10.65	20.27	23.37	28.87	10.65	6.19	100

Table 4 ☐ The relationship between periodontal index and weight.

	<3	10	25	50	75	76+	Total
Periodontium							
Good	5 3	3	8	1	4	24	
Fair	15	44	49	53	19	12	192
Poor	11	9	9	19	7	0	55
	31	56	61	80	27	16	271

$X^2 = 22.140$ d.f. = 10 p = 0.02

family size (Table 5) one was left with the impression that there were significant differences between the periodontal conditions in large and small families; but this imbalance was due to the number of unknown records. When the periodontal condition was related to weight in large families, it appeared that the lighter children had the poorer periodontal condition and this was significant at the 5 percent level (Table 6). Based on an analysis of a possible sex difference, it appeared that underweight girls in larger families had a significantly poorer periodontal condition than those of normal weight.

There was so little dental caries and so few abnormal pregnancies that no relationships were apparent in relation to these aspects; nor were there many 'special needs' recorded.

Table 5 ☐ Periodontal index in large and small families.

	Small	Large	Total
Periodontium			
Good	10	14	24
Fair	84	110	194
Poor	20	35	55
Not known	16	4	20
	130	163	293

$X^2 = 11.876$ d.f. = 3 p = 0.01

Table 6 ☐ Periodontal index and weight in large families.

	Percentile weight						
	<3	10	25	50	75	76+	Total
Periodontium							
Good	2	1	3	5	0	3	14
Fair	8	31	21	34	11	4	109
Poor	7	6	6	12	4	0	35

$X^2 = 19.934$ d.f. = 10 p = 0.05

Table 7 ☐ Periodontal index and weight in girls in large families.

	Percentile weight						
	<3	10	25	50	75	76+	Total
Periodontium							
Good	0	0	2	3	0	2	7
Fair	4	12	11	13	6	0	46
Poor	2	3	0	5	2	0	12
Total							65

$X^2 = 24.642$ d.f. = 10 p = 0.01

DISCUSSION

The results of the height and weight measurements of Nigerian children were interesting, because, when the centiles of large and small families were summated to compare the numbers below and above the 50th centile, it was apparent that the African children were shorter and lighter, i.e. only 23.79 percent of children were above the 50th centile in height (Table 2), and only 17 percent were over the 50th centile in weight (Table 3). This would suggest that either Tanner's charts were inappropriate to indicate height and weight in Nigeria, or these African children were significantly less developed than the children observed by Tanner.

These findings support the view that developed from the previous survey in 1982 that dental disease (this observation could refer to dental caries in 1982 or periodontal disease in 1984) may be associated with the family circumstances of the individual; and they do lead to the conclusion that family economics or family customs may play a greater part in the development of serious dental disease than has previously been conceived. It is established (Davie, R. *et al*) that children from large families tend to be shorter than children from small families.[3] Dental disease was also associated with the family factors by Mansbridge (1960) and Shaw and Murray (1980); but this is probably the first time that this has been reported from Nigeria, following an evaluation of oral health.[4,5] Sawyer and Nwoku (1985) reported the association between malnourishment and gingivitis in Lagos children; periodontal disease, however, has not previously been related to family size.[6] The high prevalence of dental disease in Nigeria and in Cardiff appear to be associated with socioeconomic factors and as such would appear to require a special approach to its prevention—different from that employed to prevent dental disease of lower prevalence in the rest of the population. It would appear that such families will require more of the preventive health services and therapy than would appear at first consideration. It is of interest that 'rampant' or bottlefeeding caries has been considered by some to be a familial disease with researchers exploring possible genetic routes of transmission. It should be remembered that a similar condition of damage to the primary teeth was reported by Hutchinson (1857) in his classic paper on the stigmata of congenital syphilis; he did not attribute the dental appearance of those primary teeth to genetic transmission, but to a familial dietary habit handed down from the distaff side of the family.[7] It may be that preventive methods for these groups of children, whether they be for dental caries in a westernized country or for periodontal disease in African countries, should be directed toward the distaff side of specific families or perhaps in certain societies, toward the child-minding

adult. In either case the identifying feature of the need for such special preventive health advice may be the low physical growth of a child. In the Cardiff study, it was found that these children of low body weight and severe dental caries were first identified by a dental surgeon as the child presented for the relief of dental pain. These children were not recently observed in other health care scrutiny, because the parents did not attend the maternity and Child Welfare Clinics. The presence of dental disease may thus be an alerting factor to more severe nutritional factors. Since 1982, the Child Dental Health Clinic in Cardiff has routinely provided dietary counsel for all patients. Patients whose low body weight does not respond to such counsel are referred for pediatric opinion and a surprisingly large number have received pediatric therapy as a result of such dental observation of the failure to thrive.

Professor Ransome-Kuti, Director of the Institute of Child Health in the University of Lagos; the staff at the Maternal and Child Health Centre; and the recorder, Mrs. John, for their help.
Dr. Okioisor is with the Department of Preventive Dentistry, Dental School, University of Lagos, Nigeria.

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DIETARY EFFECTS ON DRUG ACTIONS

Nutritional considerations in clinical medicine are utilized in genetically based metabolic disorders, in the treatment of some degenerative conditions, in deficiency states seen in developing countries, in the aging population, in chronically ill persons, and in individuals with prolonged syndromes such as alcoholism.

In addition to drug-nutrient interactions, we must consider the chemical additives used to preserve food or to improve its taste and appearance. These additives have the potential to affect sites of drug action, distribution, biotransformation, and excretion. The interactions of these chemical additives with drugs are only now being evaluated and characterized. Scientific interest in drug-nutrient interactions has recently become great enough to warrant the creation (in 1981) of a journal entitled *Drug-Nutrient Interactions* to serve as a forum for scientists engaged in this area of research.

The United States Food and Drug Administration estimates that nearly 40% of the U.S. population that is at least 16 years of age take vitamin and mineral supplements; 11% take five or more supplements daily, up to a daily maximum of 14 supplements.[1]

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Hallermann-Streiff syndrome and its oral implications

Masamichi Ohishi, MD,DDS
Eisuke Murakami, DDS
Tatsuyuki Haita, DDS
Toshihiko Naruse, DDS
Masako Sugino, MD
Hajime Inomata, MD

Hallermann-Streiff syndrome, or oculomandibulodyscephaly, is a rare congenital anomaly, characterized by bilateral congenital cataracts and bird face.[1-5] Because the impaired vision is a serious problem in most cases, the patient usually visits the ophthalmologist first. As the disease, however, always involves oral disturbances, that sometimes precede or predominate over ocular and other symptoms, the patient needs oral examinations and life-long rehabilitation. Accordingly, full knowledge about this condition, especially about the oral manifestations, is required for dentists.

LITERATURE REVIEW

In 1948, Hallermann reported two patients with bilateral congenital cataracts and bird face, stressing the distinctive association of these two disorders.[1] Two years later (1950), Streiff reported a similar case and distinguished this syndrome from mandibulo-facial dysostosis of Franceschetti and Zwahlen.[2] In 1958, François increased reported cases to twenty-one by adding twelve cases from the literature and one seen by himself.[3] Analyzing these cases, François listed the following essential signs: 1) dyscephalia, 2) dental anomalies, 3) proportionate nanism, 4) hypotrichosis, 5) atrophy of the skin localized on the head, 6) bilateral congenital cataracts, and 7) bilateral microphthalmia. In addition, he proposed the following five negative signs to differentiate it from other syndromes such as the mandibulofacial dysostosis: 1) no anomalies of the ear, 2) no palpebral anomalies, 3) no muscular and joint abnormalities, 4) no anomalies of the nails and extremities and 5) no mental backwardness. Then, Falls and Schull (1960) reported six more cases under the heading of "Hallermann-Streiff syndrome" giving the credit to these first two authors.[5]

As far as we investigated, about eighty cases have been reported in the world, including fifteen Japanese cases. It is thought to arise from maldevelopment of the first branchial arch during the fifth to seventh weeks of gestation, although the exact etiology is still uncertain.[4,6,9-12]

As described in the criteria of François, the disease always involves a variety of oral disorders.[4] Most of the reports, however, have been from the fields of ophthalmology and pediatrics. There are only a few reports in the dental literature.[6-8]

CASE HISTORY

Neonatal period

A full-term boy was born on August 25, 1974, with six natal teeth erupted in the maxilla. The teeth subse-

Drs. Ohishi, Murakami and Haita are with the Department of Oral Surgery, Dr. Naruse is with the Department of Pedodontics, and Drs. Sugino and Inomata are with the Department of Ophthalmology, Faculty of Medicine, Kyushu University, Fukuoka, Japan.

quently became mobile. Because the gingival bleeding around his teeth was severe during suckling, the patient was brought to the Clinic of Oral Surgery, Kyushu University Hospital on September 13th, 1974, nineteen days following birth.

The parents were unrelated and the family history was negative. Pregnancy and delivery were normal. Birth weight was 2,800 grams.

Oral examination revealed six natal teeth in the center of the upper alveolus as shown in Figure 1. The surrounding gingiva was swollen and bled easily. All teeth were extremely mobile. In the mandible, the alveolar ridge was normal and unerupted central incisors were palpable. The palate vault, tongue and other parts of the oral mucosa were normal. The nose was depressed at the tip and the mandible was hypoplastic. Nutrition was disturbed and the hair was fair and sparse.

After treatment with local irrigation and antibiotics, all erupted teeth were extracted on September 24th, eleven days after the first visit. Root formation was poor in all extracted teeth. They were the maxillary primary central and lateral incisors and the primary first molars.

The postoperative course was uneventful.

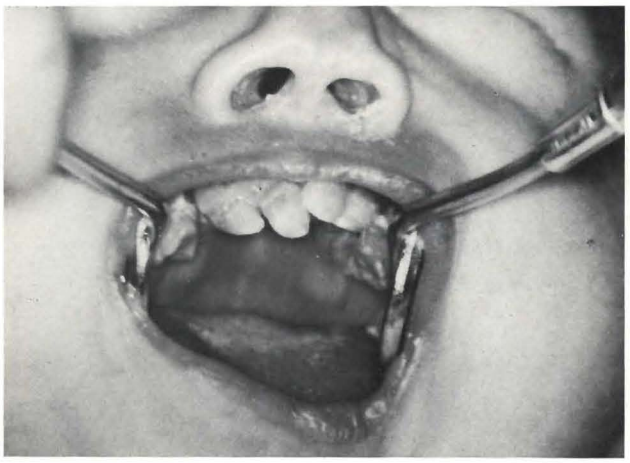

Figure 1. Natal teeth before extraction.

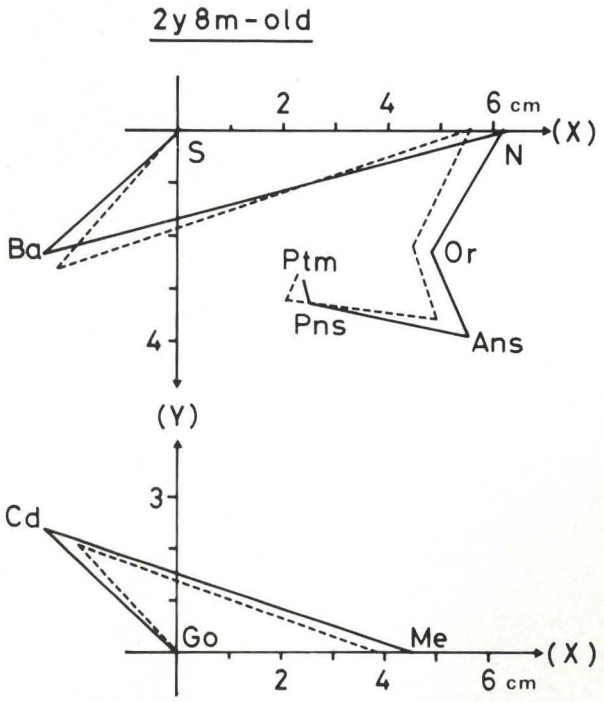

Figure 2. Comparison of profilogram (dotted line) with normal control (solid line) at three years old. S-N line is drawn as X axis and a vertical to S-N through S as Y for midface; Go-Me line is drawn as X and a vertical to Go-Me through Go as Y for mandible.

Two to three-year-old period

All the remaining primary teeth erupted at two years of age. There was a slightly reversed occlusion. Radiographs at the age of three revealed that the tooth-germs of all permanent teeth, except for the four permanent first molars, were absent.

Cephalometric analysis of the patient at age of 2 years, 8 months was compared with the mean of three normal children at the same age (± 1 month). The three normal controls are the patients with tongue-tie (no other abnormalities) operated on under general anesthesia at our clinic of oral surgery. As shown in the table, cranial base length (N-Ba), palatal length (Ans-Pns), mandibular ramal height (Cd-Go), and mandibular length (me-Cd) were smaller by three standard deviations (SD). These results indicated a retardation of forward and downward growth of the maxilla and mandible, as shown in Figure 2.

Physical examinations, at the age of three, revealed that the patient's height was 109.5 cm (av. 111.0 cm) and weight 16.6 Kg (av. 17.8 Kg); circumferences of the head and chest were 49.5 cm (av. 51.1 cm) and 54.6 cm (av. 56.0 cm), respectively. The fontanels were closed. The patient was of normal intelligence and all laboratory findings were within normal limits. Ectodermal dysplasia was diagnosed at the Clinic of Pediatrics, Kyushu University Hospital.

Five to six-year-old period

When the patient was six years old, the four permanent first molars erupted. Because the maxillary alveolus

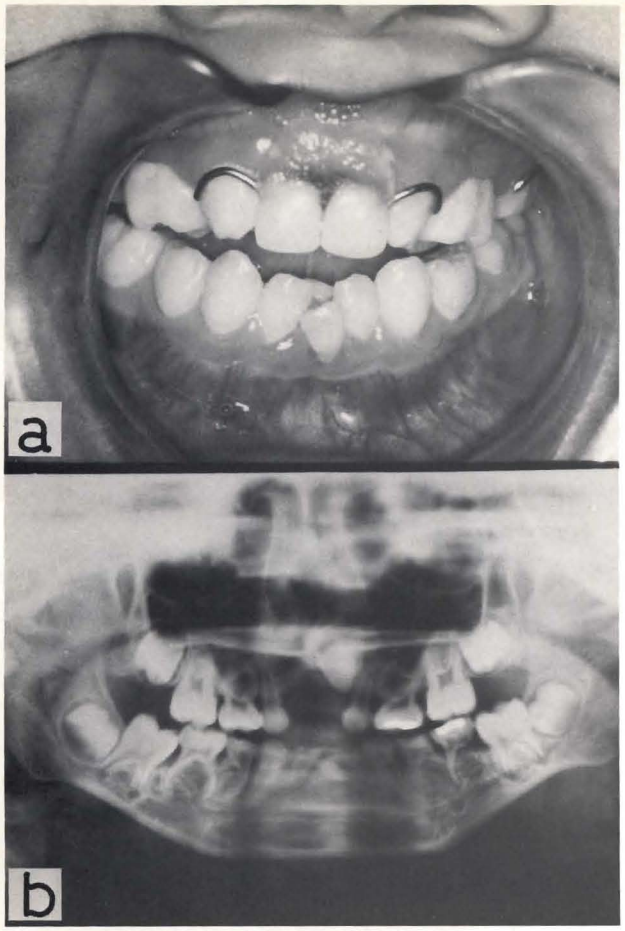

Figure 3. Oral view (a) showing removable maxillary appliance, open bite and crowded lower incisors, and orthopantomograph(b) at six years old.

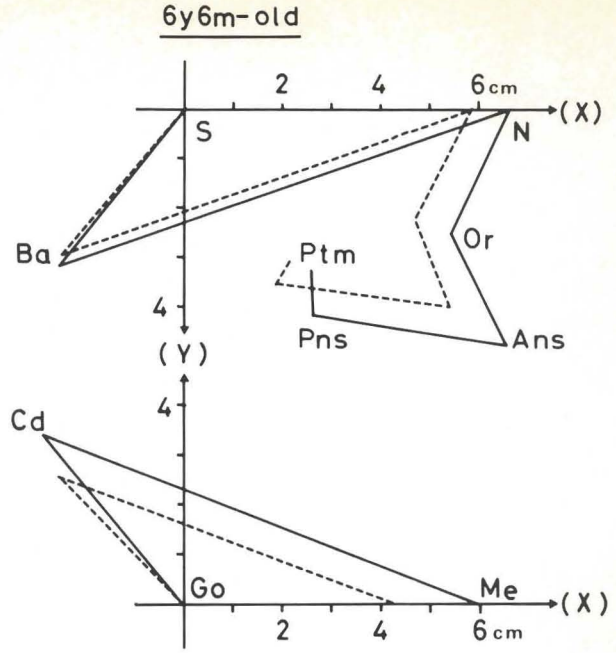

Figure 4. Comparison of profilogram (dotted line) with normal control (solid line) at six years old. S-N line is drawn as X axis and a vertical to S-N through S as Y for midface; Go-Me is drawn as X and a vertical to Go-Me through Go as Y for mandible.

became narrower, a prosthesis was made to replace the central incisor teeth, as shown in Figure 3a. In the mandibular alveolus, the central incisors deviated from the arch. There appeared a slight degree of open bite (Figure 3a); the right intercanine distance was 1.3 mm. Orthopantomography (figure 3b) revealed an unerupted permanent maxillary left incisor and the tooth-germs of four permanent second molars. The distal root of the mandibular primary left second molar was resorbed, probably at the time of eruption of the adjacent permanent first molar.

The patient's cephalometric analysis at the age of 6 years, 6 months was compared with the mean of ten normal children at the same age (±1 month). The ten normal controls were the patients with caries treated at our Clinic of Pedodontics. They had no other abnormalities. More marked retardations of the midface and the mandible were noted (Figure 4); the table indicates that anterior cranial base length (S-N), cranial base length (N-Ba), mandibular body length (Go-Me), mandibular ramal heights (Cd-Go) and mandibular length (Me-Cd) were smaller than the normal averages by 3 SD.

Ocular symptoms became apparent when the patient was five years of age. He was brought to the Clinic of

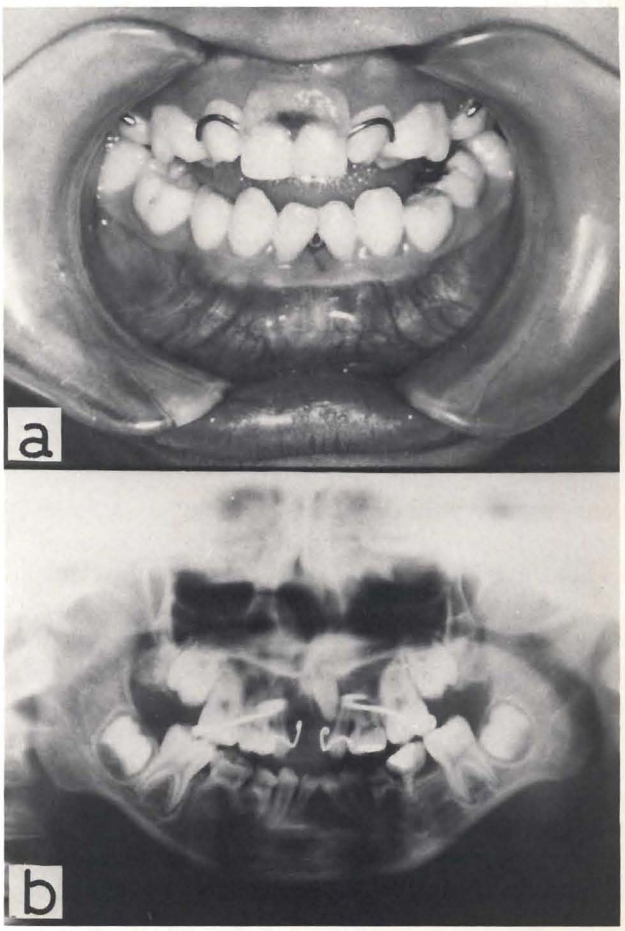

Figure 5. Oral view (a) and orthopantomograph (b) at eight years old.

Table ☐ Comparison of patient's cephalometric, radiographic analysis with that of normal means at 3, 6, and 9 years.

Anatomical structure and angle	Measurement (mm, degree) 3 years(2y 8) Patient	Control (n=3)	6 years(6y 6m) Patient	Control (n=10)	9 years(8y 11m) Patient	Control (n=10)
Cranial length (G-Op)	167.0*	180.1±11.9[a]	171.8	185.3±7.3	172.8*	188.6±8.2
Cranial height (V-Ba)	140.8	142.6± 1.9	144.3**	152.5±3.3	146.3*	154.1±5.4
Anterior cranial base length (S-N)	55.1**	61.1± 2.5	58.5***	66.1±2.3	60.1*	66.9±3.4
Clival length (S-Ba)	35.3	35.1± 2.2	38.7**	41.6±1.3	41.8	43.7±3.1
Cranial base length (N-Ba)	82.7***	90.1± 1.3	88.3***	98.0±2.9	95.3**	101.5±4.5
Upper facial height (N-Ans)	36.4*	39.6± 1.7	40.6**	48.0±3.0	45.4**	52.1±2.4
Palatal length (Ans-Pns)	39.3***	40.9± 0.4	45.4*	49.2±2.1	49.0*	51.7±2.0
Mandibular body length (Go-Me)	38.1*	45.0± 4.3	41.5***	59.3±3.5	45.0***	61.5±1.6
Mandibular ramal height Cd-Go)	29.5***	35.1± 0.9	36.3***	44.3±2.5	40.2**	47.4±2.6
Mandibular length (Me-Cd)	62.4***	74.6± 4.0	72.0***	93.9±3.5	78.5***	99.6±2.6
Cranial base angle <N-S-Ba)	130.7*	137.3± 5.0	129.4	129.4±2.4	126.1*	132.4±5.2
Maxillary protrusiveness (<S-N-Ans)	80.9	81.9± 1.1	83.5*	88.7±3.0	85.9	85.4±3.9
(<S-N-A)	77.3	78.6± 2.2	79.7*	83.4±2.6	82.9	79.8±4.6
Gonial Angle (<Cd-Go-Me)	133.7	136.9± 4.2	135.3	130.0±6.0	134.1	131.7±3.1

[a]: standard deviation
*, **, ***: value is less by 1, 2, 3 standard deviations, respectively.

Ophthalmology, Kyushu University Hospital, on July 23rd, 1980, when he was six years old. Ocular examinations disclosed sparse, almost inapparent eyebrows and scanty eyelashes (Figure 6); the visual acuity was 0.4 in the right eye and 0.1 in the left eye; the intraocular pressure was normal as 20 mm Hg O.D. and 18 mm Hg O.S.; the Hirschberg test showed about 5 degrees of esodeviation of the left eye; the horizontal diameter of the corneae measured 11 mm bilaterally; the sclerae were slightly blue; there were bilateral cataracts showing wedge-shaped opacities as the anterior and posterior cortex. Hallermann-Streiff syndrome was diagnosed.

Eight to nine-year-old period

The deviated primary mandibular incisors were extracted; the open bite was more extensive than it was earlier, and the right intercanine distance was 3.5 mm (Figure 5a); only the distolingual cusp of the maxillary permanent first molar and the distobuccal cusp of the mandibular permanent first molar contacted on each side; the maxillary dental arch was V-shaped but not high-vaulted (Figure 6). The orthopantomography was only slightly different from what it was during the six-year age-period and the tooth germs of the permanent successors to the retained and extracted primary teeth were missing, except for the maxillary left incisor (Figure 5b).

Cephalometric radiographic analysis at the age of 8 years, 11 months was compared with the mean of ten normal chilren at the same age (±1 month). The con-

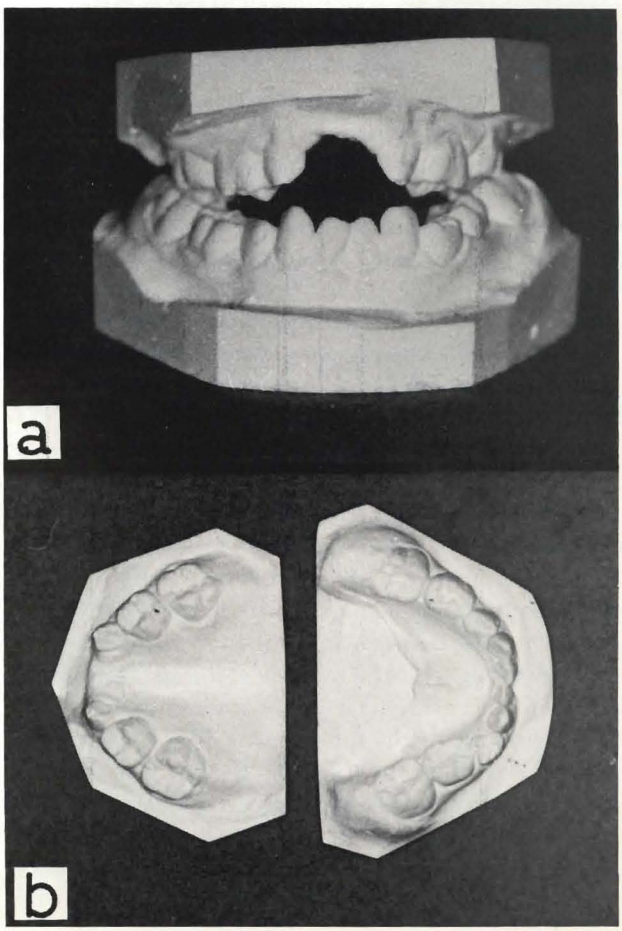

Figure 6. Dental casts at eight years old, showing occlusion (a) and dental arch (b).

trols were the patients with dental caries treated at our Clinic of Pedodontics. The patients had no other abnormalities. The growth of the maxilla and mandible was still retarded (Figure 7). As shown in the table, however, the anterior cranial base length (S-N), the cranial base length (N-Ba), and the mandibular ramal height (Cd-Go), which had been smaller than the normal means by 3 SD at six years, improved to within 2 SD.

DISCUSSION

Hallermann-Streiff syndrome is a rare congenital disorder. For its diagnosis, François' seven positive and five negative signs are most commonly used.[3] Only a few of the reported cases, however, satisfy all of his criteria. In the present case, 1) mandibular hypoplasia, 2) bilateral incomplete cataracts, 3) hypotrichosis, 4) atrophy of the skin of the nose, and 5) dental anomalies were finally demonstrated; but, 6) bilateral microphthalmia and 7) proportionate nanism were absent. As to the negative signs, the patient had 1) no anomalies of the ear, 2) no palpebral anomalies, 3) no muscular and joint abnormalities, 4) no anomalies of the nails and extremities, and 5) no mental backwardness. Thus, a diagnosis of Hallermann-Streiff syndrome appears valid.

When the patient with natal teeth was first seen at our clinic, however, our knowledge of this condition was poor. Several other manifestations, such as sparsity of the scalp hair and eyebrows, thin and atrophic skin over the nose, and micrognathia were observed without recognizing their importance. In the case of Falls and Schull (case 3), six teeth were present at birth, three of which were immediately removed.[5] Ronen *et al* reported that their patient experienced feeding difficulty because of two neonatal teeth; but it is not clear whether they were removed.[13] Premature eruption of primary teeth and congenital absence of successive permanent teeth are common findings in Hallermann-Streiff syndrome.[1,2,5,7,8,13-17] Slootweg and Huber studied the mandible of a two-month-old necropsy case.[8] They found disintegrating dental laminae in the areas where the developiong permanent teeth were normally present. They thought it to be the case of the agenesis of the permanent successors. They also studied prematurely erupted primary teeth. There were no abnormalities in the coronal part but the roots had reached one-third of their normal length and there was no cementum covering or epithelial root sheath.

In the present case, patient's chief complaint was bleeding from the gingiva around the natal teeth. Examination of the extracted teeth showed their root formation to be poor. All primary teeth, except the extracted natal teeth, erupted when the patient was two years old; but the tooth-germs of the permanent successors were found to be absent.

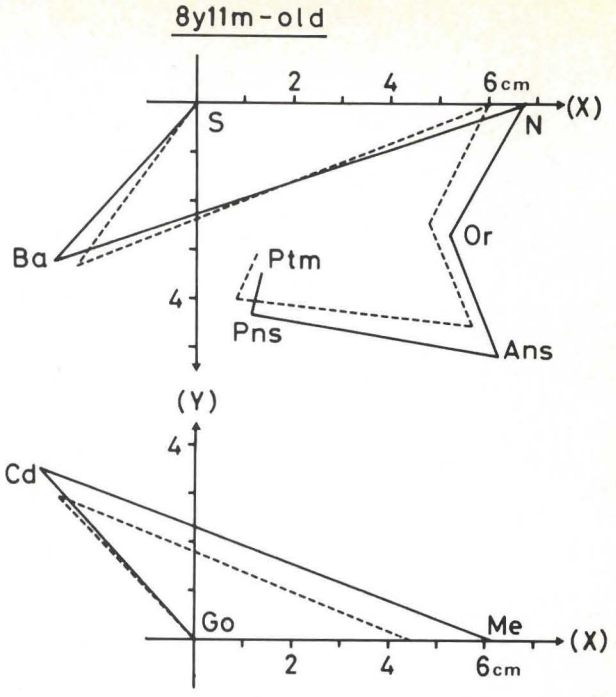

Figure 7. Comparison of profilogram (dotted line) with normal control (solid line) at nine years old. S-N line is drawn as X axis and a vertical to S-N through S as Y for midface; Go-Me is drawn as X and a vertical to Go-Me through Go as Y for mandible.

A V-shaped dental arch with open bite was reported in the case of Patterson *et al*, in which the upper anterior teeth were missing, as in the present case.[7] A V-shaped dental arch or open bite might be intrinsic in this condition; but in the present case, extraction of the natal teeth seemed to have aggravated those disorders: an inherently small maxillary arch seemed to be narrowed more by the lack of the support of anterior teeth; and growth of the mandibular arch, which had had been originally hypoplastic, was further restricted, harmonizing with the smaller maxillary arch. When the permanent first molars began to erupt at the age of six, they caused the former occupants

$$\left(\frac{\underline{E\ C\quad C\ E}}{EDCBA\quad ABCDE}\right)$$

to move mesially, so that the open space in the upper alveolus became smaller and the mandibular central incisors ($\bar{A}|\bar{A}$) became crowded. On the other hand, mesial movement of the primary teeth resulted in the mesiobuccal inclination of $\underline{6}|\underline{6}$ and mesiolingual inclination of $\bar{6}\ |\ \bar{6}$. Only the distolingual cusps of $\underline{6}$ and the distobuccal cusps of $\bar{6}$ contacted on both sides, thus creating an open bite.

Early and multiple caries is frequently reported.[3,5,9] Contributing factors in its development may be enamel dysplasia, malformed teeth, and irregular dentition.[3,5,6,9,10,12,17,19] Fortunately, our patient had no

such abnormalities and by careful maintenance of oral hygiene, the patient is free from active dental caries or periodontitis.

Cephalometric radiographic analysis of the patient was compared with that of the normal at three, six and nine years of age. A retardation of the forward and downward growth of the maxilla and mandible was found at the age of three. The retardation was more evident at six years, but it became less so at nine. Particularly noteworthy, the growth of the maxillary region improved.

CONCLUSION

It is important to observe the patient regularly, because growth of the jaws may accelerate substantially in the circumpubertal period. Patterson *et al* performed orthodontic surgery on a fourteen-year-old boy with this syndrome, to correct the occlusion and esthetics. Such treatment may sometimes be considered for our patient.

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RECURRENT APHTHOUS STOMATITIS

Clinically, the disease has been divided into three types based upon size, distribution, and severity of the ulcerations. Thus the smaller ulcers are referred to as minor aphthae (canker sores); the larger lesions are called major aphthae (also referred to as Sutton's disease or periadenitis mucosa necrotica recurrens), and the third type is herpetiform aphthae. When numerous small ulcerations occur, they must be differentiated from herpes simplex infections. A fourth type, which is often included with the oral aphthae, is Behcet's syndrome, which consists of ulcerations of mucous membranes of the mouth, eyes, and genitalia. Involvement of at least two sites and the presence of arthralgia, skin lesions, or other systemic complaints strongly suggest Behcet's syndrome.

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Prophylactic dental treatment for a patient with vitamin D-resistant rickets: report of case

Gary H. Breen, DMD

Vitamin-D resistant rickets (VDRR), also known as familial hypophosphatemia phosphate diabetes, and refractory rickets, is a form of rickets which is resistant to the usual doses of vitamin D. VDRR is predominantly an X-linked dominant disease, characterized by decreased renal tubular reabsorption of inorganic phosphate, and a diminished gastrointestinal uptake of calcium.[1]

VDRR was first recognized by Albright, who in 1937 described a case of hyperphosphaturia and hypophosphatemia that was refractory to the normal doses of vitamin D.[2] Robertson suggested that the pathogenesis of VDRR was a renal tubular failure of the kidney to reabsorb phosphorous.[3] The first evidence of a familial pattern of inheritance with VDRR, was presented by Christensen in 1941.[4] Winters and Graham both expanded the findings that VDRR was familial, sex linked, clinically more severe in males, and that hypophosphatemia was the primary trait and that rickets was the secondary finding.[5-7] The dental manifestations of VDRR were first described by Hanes and Sullivan.[8]

The X-linked form of VDRR occurs in four clinical entities: 1. asymptomatic hypophosphatemia, the mildest evidence of the metabolic defect, found predominantly in women; 2. hypophosphatemia in adults with inactive postrachitic deformities; 3. hypophosphatemia in adults with deformities and active osteomalacia; 4. the most severe of the four clinical forms is hypophosphatemia with VDRR in children.[9]

Dr. Gary H. Breen practices in Rutland, Vermont.

The majority of the patients with VDRR have an X-linked dominant mode of inheritance. Males tend to be more severely affected, as females carry a normal gene on the X chromosome. The disease is usually first diagnosed shortly after the child begins to walk. Lateral bowing deformities of the legs typically occur, secondary to the stress of the body weight. In addition to short stature, other clinical findings of VDRR include occipital and frontal bossing, scoliosis, rachitic rosary, enlargement of wrists and ankles, pseudofractures and bony protuberances of the sites of major muscle attachments.[10] An important clinical feature of VDRR is normal muscle tone in contrast to the muscular hypotonia prominent in vitamin D-deficient rickets.[10]

The laboratory examination of patients with VDRR generally reveals a normal blood calcium, hypophosphatemia and slightly elevated alkaline phosphatase. The percentage of reabsorbed phosphate is decreased with a resulting elevated urine phosphate. The diagnosis of VDRR in children without a family history of the disease can be missed for eight to ten months after birth, since the bowing of the legs and scoliosis will not be evident until the child is sitting upright and walking. The laboratory data may not be initially clear, because of the low GFR of infancy which inhibits phosphaturia and in turn prevents the characteristic phosphatemia.[11]

The pathogenesis of VDRR is viewed in two ways: The first is a specific defect in the renal tubular reabsorption of phosphate; the second, the classical view, holds that the primary defect in VDRR is the failure in

the conversion of vitamin D to an active metabolite. The inability to convert vitamin D to an active form is responsible for the malabsorption of calcium, which in turn leads to a secondary hyperparathyroidism and rickets.[11]

ROLE OF VITAMIN D

Vitamin D comes from two sources. When an organism is subjected to ultraviolet light, vitamin D is synthesized in the skin. After a series of steps, the vitamin is transferred from the plasma to the liver and eventually the kidney, undergoing a metabolic sequence along the way to an active form.

When vitamin D is taken into the body via diet or supplement, it must also undergo a series of metabolic steps before it can function in the body. After vitamin D is absorbed from the small intestines, the first activation steps occur primarily in the liver, where vitamin D is converted to calcidiol. Calcidiol is then further activated in the mitochondria of the kidney tissue to calcitriol, the active form of vitamin D. Calcitriol is then transported to the small intestine, bone, and possibly the kidneys and parathyroids. The action of vitamin D includes intestinal absorption of calcium and phosphorous, as well as the mobilization of calcium from the bone and the stimulation of renal reabsorption of calcium in the distal tubule of the kidney.[12] In the development of teeth, vitamin D appears to be intimately responsible for normal calcification of the dentin and cementum.[13]

Vitamin D must be metabolically activated in both the liver and kidney, before it is fully active on its target tissue. In VDRR, it is felt there may be a primary defect in the ability of the kidney to convert precursors to the active compound calcitriol. This in turn causes a malabsorption of calcium and phosphorous, which in turn causes a hyperparathyroidism and a resulting rickets.

ORAL FINDINGS

The classical dental finding in patients with VDRR is spontaneous oral abscesses in caries free teeth.[8,9,14-18] Other dental findings include delayed eruption, delayed apical closure, thin and hypoplastic enamel, absent or poorly defined lamina dura, enlarged pulp chambers, numerous accessory canals and pulpal horns that extend up and into the dentinoenamel junction.[8,15,16,19] Histologically, the pulpal horns can extend well into the dentinoenamel junction and into the cusp tips, creating open pathways to the pulp for micro-

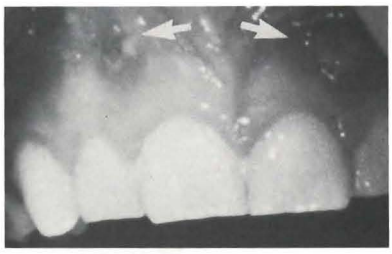

Figure 1. Draining fistulas apical to the maxillary right and left primary central incisors.

organisms and other toxic fluids. Other histologic findings include numerous areas of globular dentin, an increased number of collagenous pulpal elements, a decreased cellular pulpal content, and a widened predentin layer.[14,16,17] Also seen in the pulpal tissue is a dilation and engorgement of the pulpal blood vessels.[14,17,20]

There does not appear to be a correlation between the severity of VDRR and the frequency or severity of dental oral pathology. Severe dental changes may be seen in patients with little clinical or radiographic evidence of rickets. The dental changes may be the first overt symptom of the disease, prompting the patient to seek medical attention.[9]

CASE REPORT

The patient is a 4.5-year-old white male who was diagnosed as having VDRR at twenty-two months of age. There is a long family history of adult onset vitamin D-resistant hypophosphatemic osteomalacia. The patient is a member of the family reported on by Frymoyer and Hodgkin.[21] The patient is short of stature with considerable bowing of the lower extremities and has a rachitic rosary. He is presently well controlled with oral rocatrol 0.25 mcg daily, which is the activated form of vitamin D.

The child was referred by a general dentist for treatment and evaluation of two labial fistulas over the maxillary right and left primary central incisors (Figure 1). Clinical examination revealed a Class I primary dentition in good repair, no macroscopic caries was noted. Fistulas were noted labially over the maxillary right and left primary central incisors. No other soft tissue abnormalities were noted. There was no history of trauma to the abscessed central incisors. A radiographic survey (Figure 2) revealed classical findings consistent with VDRR. Periapical radiolucent lesions were noted over the clinically abscessed teeth in addition to a small mesial incipient lesion on the maxillary right primary central incisor. The right and left central incisors were extracted and sent for histological examination.

Several months later, the patient returned to the

Figure 2. Full-mouth radiographs demonstrating periapical lesions over the right and left maxillary primary central incisors. Large pulp chambers with long pulpal horns are shown.

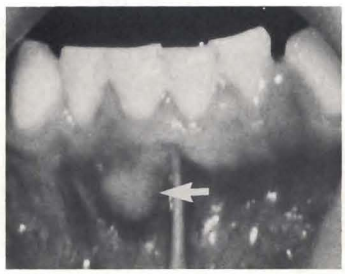

Figure 3. Draining fistulas apical to the mandibular primary right central and lateral incisors.

Figure 4. Radiographic evidence of abscesses found in the mandibular right and left primary central and lateral incisors.

office with several spontaneous abscesses of the mandibular right and left primary central and lateral incisors (Figures 3, 4). These incisors were also extracted. It was evident at this time that some form of prophylactic treatment would be necessary to prevent any further spontaneous abscesses of the posterior teeth.

After a careful review of the literature and the consultation with the patient's attending physician, a decision was made to hospitalize the patient and to cover all remaining canines and molars with chrome steel crowns.

Two medical concerns in treating patients with VDRR under general anesthesia are to avoid immobilizing these children for long periods of time, as they tend to show generalized skeletal decalcification; and secondly, to establish stable blood levels of calcium and phosphorous, preoperatively.

After thorough laboratory and physical examination, the child was admitted and taken to the operating room where all remaining molars and canines were restored with chrome steel crowns. Tooth preparation was modified, as there was absolutely no occlusal or incisal reduction prior to crown placement. The teeth were slightly reduced interproximally to allow the thickness of the crowns. The entire occlusal table and incisal surface were covered with calcium hydroxide prior to crown

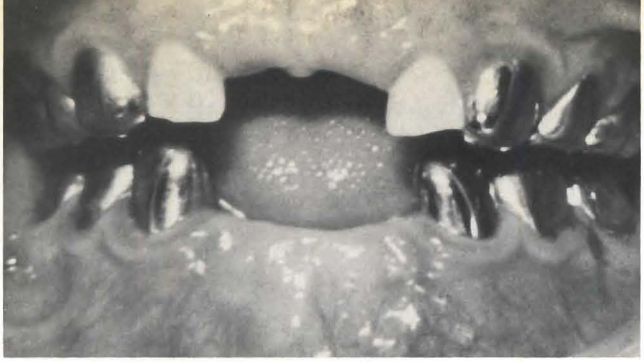

Figure 5. Clinical eighteen months posttreatment with chrome steel crowns.

cementation with glass ionomer cement. The postoperative hospital course was uneventful and after eighteen months of follow-up, the child has not exhibited any clinical or radiographic abscesses (Figures 5,6).

Microscopic report

The right maxillary central incisor was decalcified, and stained with H & E. The pulp horn extends to the dentinoenamel junction in its incisal aspect. There is a sharp demarcation between the neonatal dentin, which is of normal tubular consistency and calcification, and the postnatal dentin, which shows large globules of dentin in a globular pattern throughout the crown (Figures 7, 8), and small globules in the root of the tooth. The predentin lining the pulp chambers shows numerous small calcospherites in a globular pattern (Figure 9),

Figure 6. Radiographs taken eighteen months posttreatment.

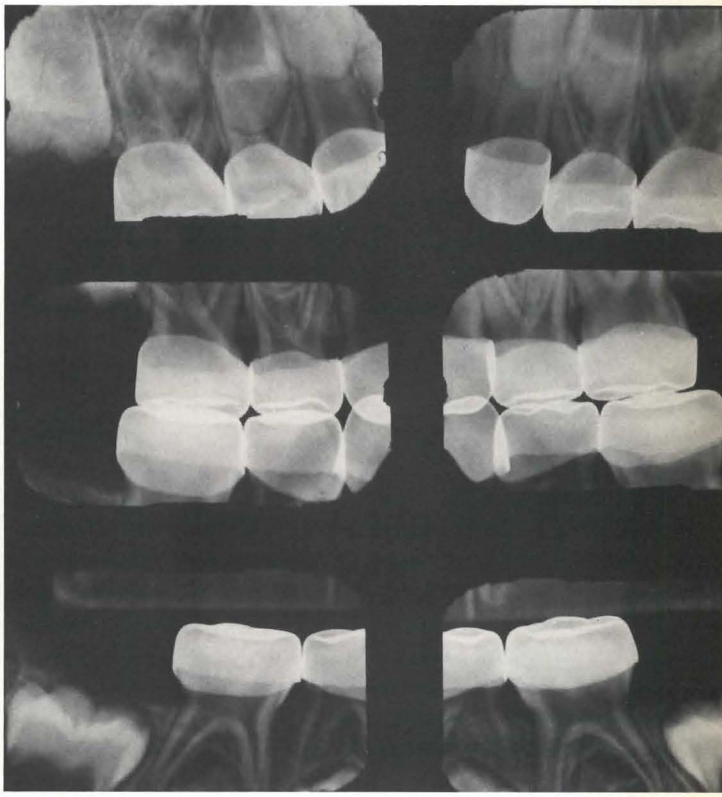

Figure 7. Sectioned maxillary incisor demonstrating globular dentin (original magnification, X25).

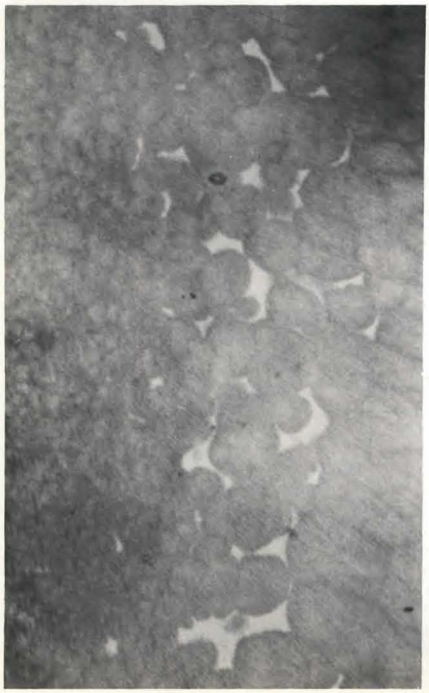

Figure 8. Section of extracted central incisors showing a globular pattern of calcification throughout the crown, and a widened predentin layer (original magnification, X25).

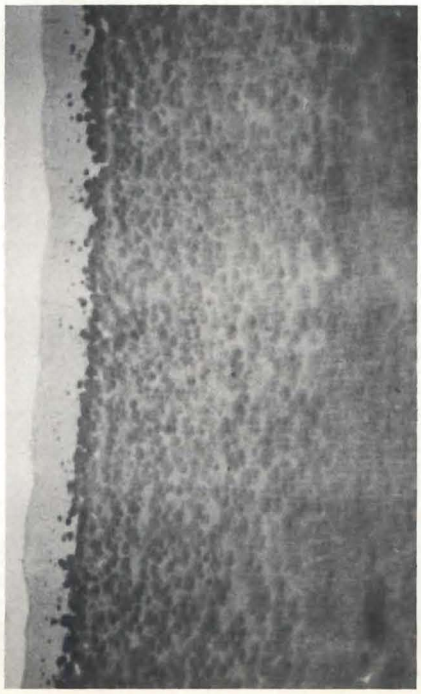

Figure 9. Section of extracted central incisor showing necrotic pulpal debris, as well as globular calcospherites lining the pulpal surface (original magnification, X25).

and a widened predentin zone (Figure 8). There is no disturbance in the course or morphology of the dentinal tubules. The pulp chamber is filled with necrotic remnants of pulp tissue (Figure 9) and microorganisms. There is a normal layer of cementum on the coronal two-thirds of the root of the tooth. On both the labial and lingual aspects of the apical two-thirds of the root are extensive areas of resorption of dentin.

The final diagnosis was extensive globular dentin and necrosis of pulp tissue with resorption of the roots, compatible with hypophosphatemic vitamin D-resistant rickets.

DISCUSSION

Patients with VDRR, as previously described, have abnormal tooth morphology: specifically, thin globular dentin and elongated pulpal horns that extend into the dentinoenamel junction. Invasion of the pulp by microorganisms and toxins is inevitable. The increased fibrotic content of the pulp, along with a reduced number of odontoblasts, decrease the pulp's ability to resist infection.[9] Spontaneous abscesses are therefore common and, unfortunately, extraction is the only treatment of choice for these teeth. So far, regardless of the form of pulpal treatment used, the prognosis for spontaneously abscessed teeth in patients with VDRR has been extremely poor.[8,15,16,17,22,23]

The options for providing prophylactic treatment for those patients with VDRR who are spontaneously developing abscesses on caries free teeth are few, for regardless of the treatment rendered, dental abscesses are a common finding.[24] Occlusal sealants would not prove useful prophylactically, as the pulpal horns in primary molars are found over the cusp tips. In addition, any acid conditioning may endanger the pulpal integrity of the tooth.

Prophylactic full coverage with chrome steel crowns has been reported by several authors. In an excellent article by Rachacz, prophylactic full coverage was performed on the posterior teeth of a patient with VDRR, who previously developed abscesses spontaneously, on caries free incisors.[11] Selected formocresol pulpotomies, and zinc-oxide eugenol pulpectomies were performed on exposed teeth. Rachacz discovered that more predictable results were found in those teeth that received zinc oxide-eugenol pulpectomies.[11] The failure rate in teeth that received formocresol pulpotomies was high. A similar case report by Yosufuku described treatment for a patient with VDRR, where selective pulpotomies were performed during the prophylactic crowning of all remaining incisors, canines and molars.[25] The findings were similar in both case reports.

Lack of reparative dentin formation, and unpredictable reactions to formocresol pulpotomies in patients with VDRR, dictate a highly conservative approach for prophylactic dental treatment. In this case report, an attempt was made to avoid any mechanical exposures by avoiding the reduction of any tooth occlusally or incisally. For pulp protection, a biologically compatible cement was used under a calcium hydroxide base. Every effort was made to keep the prepared teeth vital.

CONCLUSION

There are few reports describing prophylactic treatment for prevention of spontaneous dental abscesses in patients with VDRR. An attempt has been made to prevent spontaneous abscesses by prophylactically covering susceptible teeth with chrome steel crowns. An effort was made to avoid mechanical pulpal exposure and toxic insult to the pulp by avoiding occlusal and incisal tooth reduction and using a biologically compatible medium for cementation. It is hoped by sealing off toxins and oral microbes that the dental pulps in patients with VDRR will be able to stay vital and have the ability to resist whatever toxins and microbes may have already invaded the pulp prior to prophylactic treatment. The patient has been clinically and radiographically free of abscesses for eighteen months.

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INTESTINAL ABSORPTION OF CALCIUM

The intestinal absorption of calcium is mediated by vitamin D and depends on the calcium intake. The absorption of calcium as a percentage of the calcium intake is considerably higher on a low than it is on a high calcium intake, but the actual amount of calcium retained increases during a higher calcium intake. The intestinal absorption of calcium, as determined by tracer doses of radioactive calcium (^{47}Ca), varies a great deal from person to person. It averages 64 ± 15.4% during a low calcium intake of approximately 200 mg per day and averages 31 ± 9.6% during an intake of 2100 mg of calcium per day.

Vitamin D status plays an important role in the intestinal absorption of calcium. When vitamin D_2 is ingested with food or when vitamin D is used as medication, it is hydroxylated in the liver to 25-hydroxycholecalciferol (25-HCC); this vitamin D metabolite is then converted to 1,25-dihydroxy-D_3 in the cortex of the kidney. The latter vitamin D metabolite is primarily responsible for the active transport of calcium across the intestine. The recommended daily dietary allowance for vitamin D is 400 international units (IU). The use of high doses of vitamin D does not improve the intestinal absorption of calcium further and may even be detrimental for persons who are not vitamin D-deficient. High doses of vitamin D, e.g., 10,000-50,000 IU, can lead to excess calcium loss via the kidney in the absence of increased intestinal absorption of calcium. This is due to the fact that the active vitamin D metabolite, 1,25-dihydroxy-D_3, not only acts on the intestinal mucosa to facilitate the absorption of calcium but also acts directly on bone and can thereby cause increased bone resorption and excess removal from the skeleton.

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Apical closure in a nonvital permanent tooth using one $Ca(OH)_2$ dressing

Harpinder Singh Chawla, MDS

The role of $Ca(OH)_2$ in the continued growth of dentin and cementum in effecting the physiological closure of the apices of nonvital young permanent teeth has been discussed in several reports. [1-3]

The present study was undertaken to learn whether a single root-canal dressing of $Ca(OH)_2$, in a bacteria-free environment, would activate the physiological processes required to effect a closure of the apex.

MATERIALS AND METHODS

Thirty-three anterior maxillary teeth (thirty central and three lateral incisors) in twenty-eight children, eight to thirteen years of age, were used in the study. The children were patients in the Department of Pedodontia and Preventive Dentistry, Postgraduate Institute of Medical Education and Research, Chandigarh (India). All teeth in the sample were nonvital and had a wide apex, in accordance with Nolla's stage 8.[4] Thirty teeth had radiographically demonstrable periapical tissue changes. The study was carried out by the author with the help of five residents who were calibrated by the author.

The root canals were opened from the inciso-palatal approach. Only reamers were used to debride the canals. In the teeth with a sinus, blind curretage through the opening was also done. A local anesthetic by infiltration was used to anesthetize the tissues. The root canal during and after debridement was frequently irrigated with 5 percent sodium hypochlorite and 3 percent hydrogen peroxide solutions.

Cleaning the apical segment

Cotton points made from cotton fibers wrapped on a reamer were used to clean and dry the root canal (Figure 1). The cone thus formed on the reamer was inserted half way in the canal; the reamer was rotated counterclockwise so that it released the cotton point; the reamer was pulled out 2 to 3 mm, rotated clockwise to engage the cotton point, then pushed apically and rotated. In this way a sufficient bulk of cotton reached the periapical area and cleaned it (Figure 2).

The root canal dressings consisted of cotton points moistened with a sodium hypochlorite solution. Irrigations with antibiotics were also done, where indicated. The irrigations and dressings were repeated on alternate days until infection was eliminated. The latter

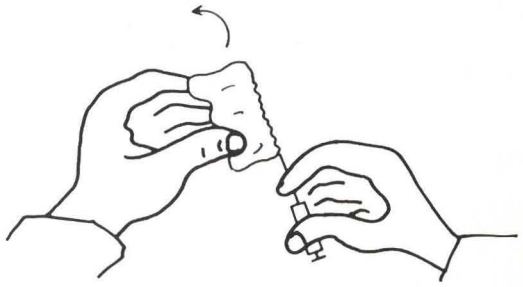

Figure 1. Preparation of cotton point.

Dr. Chawla is Assistant Professor of Pedodontia and Preventive Dentistry, Department of Dentistry, Postgraduate Institute of Medical Education and Research, Chandigarh, India.

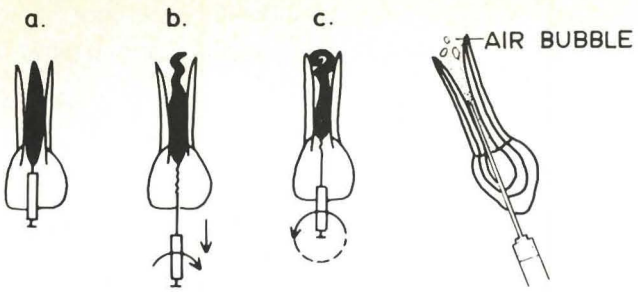

Figure 2. Cleaning of wide apical segment.

condition was determined by the absence of discharge on the cotton points, absence of pain on percussion, and minimal effervescence from the apical half of the cotton point using hydrogen peroxide. That accomplished, the root canal was filled with a premixed commercial preparation of $Ca(OH)_2$ and barium sulphate (Reogan-Rapid, Vivadent Schear).

Insertion of $Ca(OH)_2$

The patient was reclined with chin raised so that the coronal end of the root canal was higher than the apical end, thus facilitating the flow of the $Ca(OH)_2$ to the apex. The $Ca(OH)_2$ was moved along the canal with a hypodermic needle. The latter was moved the entire length of the canal several times. The length of the canal was determined from the radiographs (Figure 3).

The coronal end was sealed with quick setting zinc oxide eugenol followed by zinc phosphate cement. A radiograph was taken to note the level of $Ca(OH)_2$ in the canal. If it did not reach the apex, the procedure was repeated.

Bimonthly clinical and radiographic assessments were made.

- ☐ Radiographically, there should be no evidence of radiolucency and a calcified bridge occluding the apex should be present.
- ☐ The clinical integrity of the dentin bridge was tested by placing a rubber dam, sterilizing the field of operation, removing the zinc oxide cement filling and the dressing. Then a sterile gutta percha point was gently passed toward the apex; obstruction to its movement near the apical end on repeated attempts in different areas without eliciting pain would be indicative of a closed foramen. The tooth also would be free of any clinical symptoms. When the clinical and radiographic findings agreed, a root canal filling was made.

The root canal filling

An atypical technique for filling the canal was used, because the apical foramen was closed and there was no danger of an overextended filling.

A thin gutta percha cone was inserted into the canal as far apically as possible. The portion of it coinciding with the incisal edge was marked. Then, the thickest cone

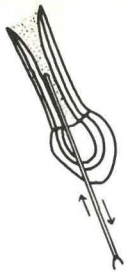

Figure 3. Removal of air bubble from $Ca(OH)_2$ dressing.

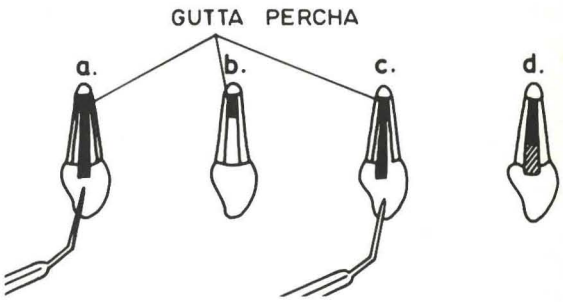

Figure 4. Gutta percha root canal filling.

capable of being inserted the same distance as that of the thin cone was chosen. After covering the cone with zinc oxide-eugenol, it was inserted in the root canal as far apically as possible. With heated root canal pluggers, apical condensation of the cone was achieved. Usually, the cone was only sufficient for packing the apical third. The procedure was repeated until the root canal was completely filled (Figure 4).

RESULTS

The patients were observed for periods of six to twelve months. During the period, three patients were lost from the study, leaving a net of twenty-six teeth for completion of the study (Table 1).

Twenty-six teeth were observed for a year; five of them were observed in conjunction with an intraoral sinus opening on the labial mucosa (Table 2).

Apexification occurred in all cases within a year (Table 3); and maximum apical closure was discernible radi-

Table 1 ☐ Distribution of sample.

Total number of children in the study	28
Total number of teeth in study	33
Number of teeth followed for $> 6 \leq 12$ months	26
Number of teeth followed for $> 0 \leq 6$ months	4
Drop out	3

Table 2 ☐ Teeth with and without associated sinus.

Total teeth in the study	With sinus	No sinus	Total teeth followed for $>6 \leq 12$ months	With sinus	No sinus
33	7	26	26	5	21

Table 3 ☐ Radiographic and clinical evaluation of data with observation period $> 6 \leq 12$ months.

$Ca(OH)_2$ dressing			
Number of children	Number of teeth	Apexification	No apexification
22	26	26	0

Table 4 ☐ Relationship of apexification to time (average time 6.69 months).

Total number of teeth with apexification		Period in months					
		2	4	6	8	10	12
26	Number of teeth	0	3	17	2	2	2
	Percentage	0	11.5	65.4	7.7	7.7	7.7

Table 5 ☐ Split-up of apexifications according to one or two $Ca(OH)_2$ dressings.

Total number of teeth with apexification	Teeth showing apexification with single $Ca(OH)_2$ dressing		Apexification obtained with second $Ca(OH)_2$ dressing	
	Number	Percent	Number	Percent
26	4	92.3	2	7.7

ographically and clinically at six months in 65.4 percent of the cases (Table 4).

The single dressing of $Ca(OH)_2$ sufficed in twenty-four of the twenty-six teeth (Table 5). It was observed in the serial radiographs that the $Ca(OH)_2$ was gradually depleted from the root canals; in two teeth a second $Ca(OH)_2$ dressing was required.

DISCUSSION

Assuming that $Ca(OH)_2$ acts as a catalyst, its continuous depletion from the root canal suggests that it is being used and perhaps required for formation of the bridge.

The amount of $Ca(OH)_2$ in the single root canal dressing was sufficient to initiate and complete the bridge formation in 92.3 percent of the teeth, thus suggesting that multidressing treatment was not essential.

It was found in this study that the majority of apical closures (65.4 percent) occurred within six months. These results are comparable to those of our previous study in which a comparable figure of 70 percent occurred and in which $Ca(OH)_2$ dressings were repeated after 45-60 days.[3]

Generally, in every study, there are some failures that add to the reliability of the experiment. The success rate of the present study is very high. In our previous study using $Ca(OH)_2$ in a multidressing regimen, the success rate was 95 percent.[3] Heithersay (1970) reported successful results in nineteen of twenty-one non-vital immature teeth.[5] Miomir (1972) observed apical closure in 96 percent of fifty-five treated teeth.[6] Goldman (1974) reported that he had only two failures in

Figure 5. Preoperative radiograph of maxillary left central incisor showing wide apex and faulty gutta percha root canal filling.

Figure 6. Postoperative radiograph of the case in figure 5, after six months, showing bridge formation and successful obturation.

Figure 7. Radiograph of upper left central incisor immediately after $Ca(OH)_2$ dressing.

Figure 8. Radiograph of the case in figure 7, after two months, showing $Ca(OH)_2$ depletion from the root canal; also seen is the circumscription of the periapical rarefaction.

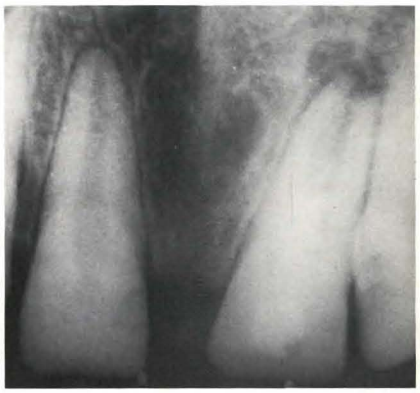

Figure 9. Radiograph of the case in figures 8 and 9, after five months, showing further $Ca(OH)_2$ resorption and healing of the periapical pathology.

seven years, using $Ca(OH)_2$ for young permanent teeth, and these occurred in completely avulsed and replanted teeth.[7] Winter (1977), however, reported favorable results in 74 percent of thirty-six teeth treated with $Ca(OH)_2$.[8]

It is suggested that as a general rule, the decision whether to repeat a $Ca(OH)_2$ dressing should be based on the following observation: When the radiograph shows that the $Ca(OH)_2$ was gone from more than half the length of the canal, and the bridge was not formed, a new dressing of $Ca(OH)_2$ should be placed. A radiographic assessment of those conditions should be made every two months.

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OPEN FLARING APEX

The tooth with the open flaring apex may be endodontically treated and quite successfully. The first approach should be to encourage the continued growth of the root according to its genetic "blueprint"— the so called *apexification* procedure. Fortunately, this procedure leads to a reawakening of root formation that ceased with premature pulpal death. Following the new growth, root canal therapy must be completed, however, to obturate any tiny opening into the canal. Apexification has proved to be successful for youngsters.

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Habits

Monitoring and reinforcement to eliminate thumbsucking

Monica H. Cipes, DMD, MSD
M. Miraglia, MPH
E. Gaulin-Kremer, PhD

Previous research suggested the significance of thumbsucking as both a social and physical problem. Thumbsucking is the earliest and most common habit in children, affecting as many as 46 percent of all children from birth through adolescence.[1,2] Although the frequency of thumbsucking declines with age, the habit has been estimated to occur in about one of every two or three toddlers and preschoolers and about one in every four preadolescents.[3,4]

Thumbsucking, often considered by parents, teachers and health professionals to be socially undesirable, also appears associated with dental problems. The damages reportedly associated with this habit include open-bite, posterior cross-bite, exaggerated overjet and overbite, temporomandibular joint problems, diastema, retrusive position of the mandible, and changes in tongue and lip posture.[5] The relation to malocclusion is particularly evident in children continuing the habit beyond the age of four years.[6]

The most common professional method of treatment has been the use of a palatal crib. This device, which

Dr. Cipes is Assistant Professor and Ms. Miraglia is Research Assistant with the Department of Behavioral Sciences and Community Health, University of Connecticut School of Dental Medicine, Farmington, CT 06032.

Dr. Gaulin-Kremer, formerly of Department of Behavioral Sciences and Community Health, and presently with the Department of Health Services, State of Connecticut, Hartford, CT.

Supported by Connecticut Research Foundation #1115-83.

extends across the palatal arch and is cemented to the upper molars, does prevent thumbsucking; but may also create considerable inconvenience and expense; and it may cause negative emotional reactions and difficulties in speech and eating.[7]

Thumbsucking can be disrupted by wearing a glove or by placing a plastic splint on the child's thumb.[8,9] These interventions seem to derive their effectiveness from reducing the pleasant sensory stimulation attendant on thumbsucking and possibly from increasing the child's awareness of a semiautomatic habit pattern. Although such devices are effective for the duration of their use, the stability of the effects remains unclear.

Behavior modification procedures have been used to reduce or eliminate thumbsucking in your children. The paradigms used have included time-out, habit reversal, overcorrection, and differential reinforcement of other behaviors.[10-15] The majority of these investigations have involved case studies of one to three subjects and have had mixed success. Unfortunately, a too frequent finding has been that the habit rapidly recovers to its preintervention level when experimental conditions are discontinued.

This paper reports the results of a pilot project that tested the effectiveness of monitoring and positive reinforcement by parents in eliminating thumbsucking. Monitoring is a behavioral strategy, which has been shown to be effective in increasing compliance with many health measures and in eliminating harmful health behaviors (such as overeating in adults).[16-18] It has also been shown to be effective in increasing children's compliance with such preventive dental regimens as fluoride mouthrinsing.[19,20] The success of monitoring appears dependent on keeping a record of the behavior that provides positive reinforcement through feedback.

Although contingency contracting is a widely used strategy for involving parents in modifying their children's behavior, this approach has apparently not been applied to the elimination of thumbsucking.[21-24] Contingency contracting consists of a formal agreement between parent and child, in which a behavioral goal is set for the child and a reward for meeting that goal is agreed upon. When the child achieves the behavioral goal the parent rewards the child as agreed. If the goal is not met the child is not rewarded.

Despite thumbsucking's adverse effects on dental health, there apparently has been little effort to develop behavioral intervention strategies that practitioners can offer to parents and children as alternatives to appliance therapy. This paper explores monitoring and contingency contracting as alternative treatments for the persistent thumbsucker.

MATERIALS AND METHODS

Subjects

Eleven children aged five to nine years old who were persistent thumbsuckers were recruited from the first author's private pedodontic practice. The program was offered to evey child over five who was reported as sucking his or her thumb at a dental examination visit. A single subject design was used. Each subject's thumbsucking behavior was monitored for two weeks prior to the program, during the program, and then followed up approximately six months after the program ended.

During a scheduled dental examination, the fact that thumbsucking appeared to be causing a dental problem was briefly discussed with the parent and child. To be eligible to participate, both parent and child had to express a desire to stop the habit. At a private interview, parents completed a written questionnaire, and described their child's thumbsucking behavior, including frequency, associated behaviors and unsuccessful interventions that they had tried. At this interview, parents were introduced to the procedure for baseline data collection, but were asked not to discuss the problem further with their child.

Experimental measure

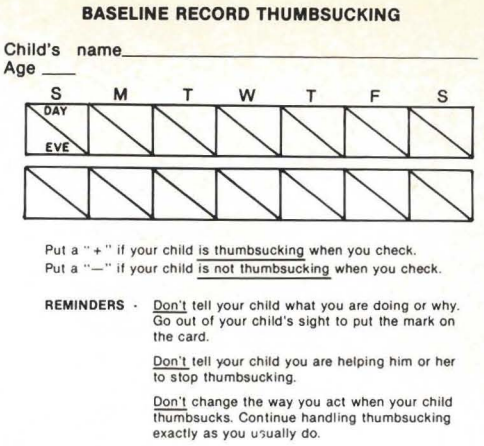
The experimental outcome measure was the frequency of thumbsucking, as monitored by the parent in the child's home environment. The parent was asked to monitor thumbsucking eight times per twenty-four hour period: four times during waking hours and four times during sleeping hours. Each parent was asked to select a standard one-hour waking period, during which the parent and child were at home together and during which the child typically sucked his thumb at a high rate. The parent conducted four observations at fifteen-minute intervals during the hour, and recorded whether thumbsucking was present or absent. For the sleeping observations, the parent recorded the presence or absence of thumbsucking at four standard points: fifteen minutes after the child's bedtime, immediately before the parent retired, immediately after the parent arose in the morning, and immediately before the parent woke the child.

Experimental phases

The experimental phases are outlined as follows:

BASELINE

Data regarding the presence or absence of thumbsucking was collected eight times daily for a consecutive two-week period. Observations were to be collected unobtrusively and recorded on an index card, by the parent. Children were to receive no feedback on the parental observations. The index card and instructions for recording the baseline data are illustrated in Figure 1.


BASELINE RECORD THUMBSUCKING

Child's name_____
Age ___

S M T W T F S

DAY
EVE

Put a "+" if your child is thumbsucking when you check.
Put a "—" if your child is not thumbsucking when you check.

REMINDERS · Don't tell your child what you are doing or why. Go out of your child's sight to put the mark on the card.

Don't tell your child you are helping him or her to stop thumbsucking.

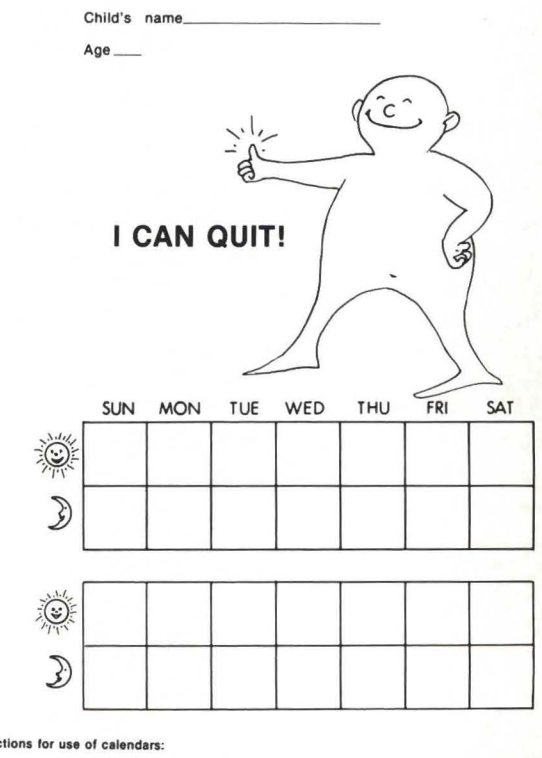
Don't change the way you act when your child thumbsucks. Continue handling thumbsucking exactly as you usually do.

Figure 1.

INTERVENTION

At the end of two weeks, the parent and the child met with the dentist to review baseline data and to explain the use of calendars for monitoring the behavior. During the intervention, the absence of thumbsucking was recorded at each observation using stars on a printed calendar. The calendar was to be posted in a conspicuous place, and the child was to be given feedback and praise, when a star was awarded for not sucking the thumb. No star was to be awarded and no feedback provided for the presence of thumbsucking. The calendar and instructions for recording the absence of thumbsucking are illustrated in Figure 2.

The parents were instructed to make monitoring a joint activity with their child. Three parents also chose to set up contingency contracts with their children and to reward them for reaching a previously agreed upon goal. This activity was neither discouraged nor stressed, but left up to the individual subject pairs.



Directions for use of calendars:

Put a star on the calendar each time you check and your child is *not* sucking his thumb. This only includes the 8 checks you have been making. For example, your child can earn 4 stars during the hour you have decided to check during the day, and 4 stars for not sucking the thumb at the 4 night-time checks.

Figure 2.

FOLLOW-UP

Parents of all children who participated in the project were sent an index card and a letter requesting them to monitor their child's thumbsucking covertly as they did during the baseline period. This material was sent approximately six months after the child had taken part in the program. A follow-up phone call was made to parents who did not return these cards to ascertain the current frequency of their child's thumbsucking.

RESULTS

The parents of two children did not complete the baseline data collection. Three other children did not continue in the project past the baseline period, (KA) displayed low frequencies for both day and night thumbsucking and her parents realized by monitoring that thumbsucking was not as significant a problem as they had thought. The second child (KC) stopped sucking his thumb immediately after the brief mention by the dentist that the habit was causing a dental problem. The third child (AH) was not interested in monitoring, and persisted in sucking her thumb, which had caused an anterior open bite and exaggerated overjet. A traditional palatal crib was placed, which eliminated the habit.

Figure 3 illustrates the notable declines in thumbsucking which occurred at two to four weeks for the six children who used calendars. For the most part, this was well sustained during the following weeks. Three of the children and their parents used monitoring and praise

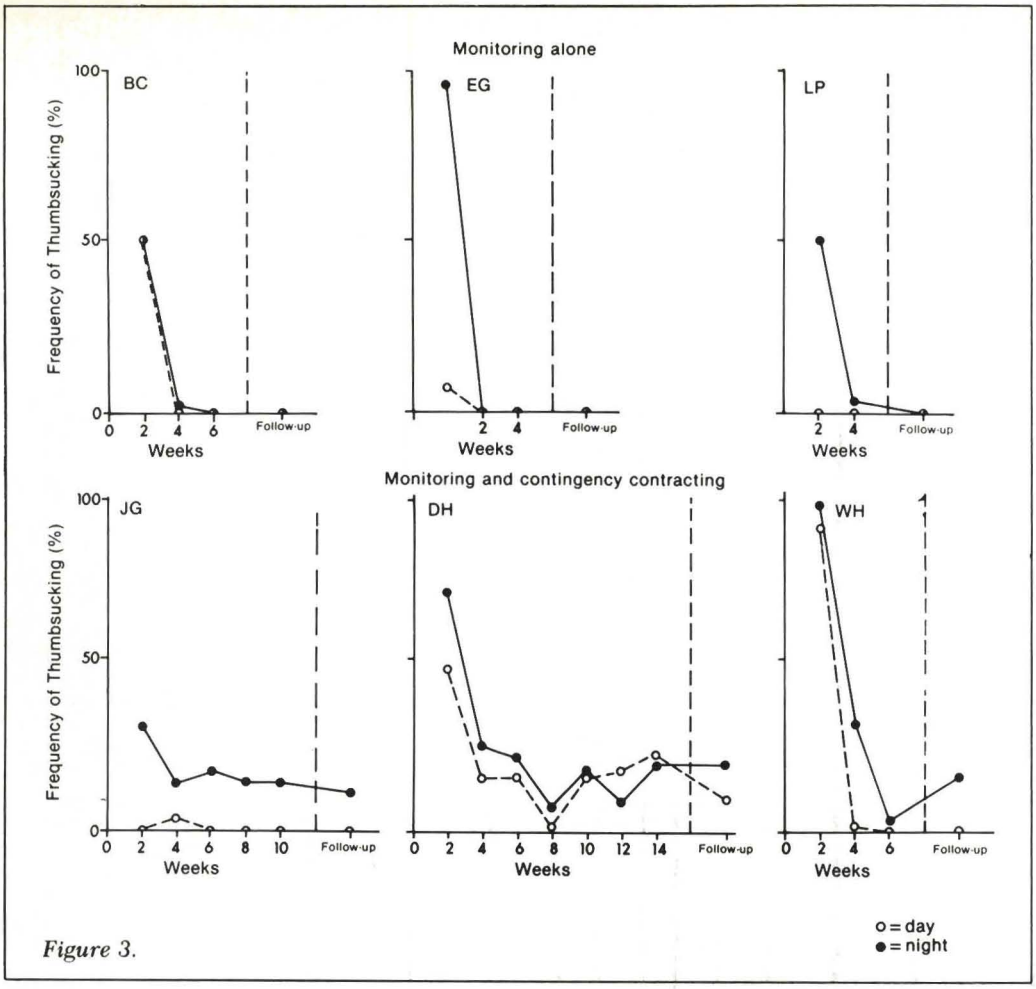


Figure 3.

alone, with great success. The parents of the remaining three children set up formal contingency contracts with their children, setting a specific goal and rewarding their children for meeting the goals.

Follow-up revealed that all nine children whose parents completed recording the baseline data had shown dramatic declines in thumbsucking. Of the three who did not continue past the baseline data collection, two were not sucking their thumbs at all, one of whom had been treated with a traditional habit appliance; and the third child was not sucking at all during the day, and rarely at night. Of the six children who completed the experimental part of the project by using the calendars to monitor their behavior, three were not sucking their thumbs at all, while three had sustained a 57 percent to 88 percent reduction in thumbsucking.

Because frequencies were reported as proportions, arc-sine transformations were done to stabilize the variance. The table presents the results of a paired t-test used to analyze preprogram and postprogram thumbsucking. Results revealed a significant difference ($p<.01$) in nighttime thumbsucking between the preprogram and postprogram measures.

Table ☐ Comparison of preintervention and postintervention thumbsucking.

	Preintervention		Postintervention		
	x	SD	x	SD	t
Daytime	33.0	23.6	14.3	6.0	1.99
Nighttime	55.9	18.3	16.1	5.1	5.39*

*P <.01 df = 5

DISCUSSION AND IMPLICATIONS

This pilot experiment suggests a simple effective treatment alternative for thumbsucking and fingersucking. The fact that nine of the eleven patients and their parents who were offered the program participated, and were able to use the materials effectively, suggests high acceptability of this method to modify this particular behavior. In addition, this program provides a low-cost alternative to traditional dental appliance therapy. Since the monitoring and reinforcement are done by the parent at home, minimal office time is required. The materials and instructions may be presented by auxiliary personnel or paraprofessionals. Of the nine children who participated, only one needed a dental appliance placed for presistent thumbsucking.

Viewing the results cautiously, it appears that monitoring alone may have been more successful than monitoring combined with contingency contracting, in eliminating the behavior. It is possible that the promise

of contingent reward for decreases in thumbsucking frequency may have actually served to prolong the period of extinction. One cannot compare the effectiveness of monitoring alone vs. monitoring and contingency contracting, however, because subjects were not randomly assigned to a condition. Instead, parents chose whether to make rewards contingent on achieving a certain level of success. This self-selection may have resulted in the more difficult cases falling into this category. Alternatively, with such a small sample, the difference observed may have been random and not significant.

SUMMARY

The simplicity and success of this intervention suggest that behavioral strategies such as monitoring and positive reinforcement should be applied to the problem of thumbsucking before the use of traditional dental appliance therapy in the age group studied.

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DIGITAL SUCKING

It should be thoroughly explained to the parents that, while digital sucking causes a proclination of the maxillary anterior teeth involved in habit pressure patterns, the pronounced overjet of the class II malocclusion is skeletal and would exist had there been no habit.

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1985, p 657.

Plaque indexes

A comparison of the OHI-S and the PHP in an oral hygiene program

Ronald L. Blount, PhD
Trevor F. Stokes, PhD

Studies which evaluate the effectiveness of toothbrushing and/or flossing procedures typically do so by measuring the amount of plaque. For many dentists, this would be one of the most important variables in an oral hygiene program. The two most popular indices for measuring plaque are the Simplified Oral Hygiene Index (OHI-S) by Greene and Vermillion and the Patient Hygiene Performance method (PHP) by Podshadley and Haley.[1,2] Both indices examine the same six teeth for plaque. They differ, however, in their scoring methods. The OHI-S assigns a zero to three to each tooth scored, based on how many thirds of the tooth surface are covered. When using the PHP, each of five tooth subsidivisions is assigned a zero or one for the absence or presence of plaque, respectively.

In selecting one of these indices, an investigator should consider both the degree to which the scale can be used reliably, that is, the correlation between two independent observers' scores for the same teeth; and how sensitive the index is to change in plaque levels. Thus far, at least two studies have proven useful in this regard. Their outcomes indicated that the PHP was superior to the OHI-S.[2,3]

In examining the degree to which the two indices could be scored reliably, Podshadley and Haley found that the PHP yielded a higher Pearson correlation be-

Dr. Blount is with the Department of Psychology, University of Alabama, Box 2968, University, AL 35486.
Dr. Stokes is on the faculty of West Virginia University.

tween independent observers that did the OHI-S (.91 and .72 respectively).[2] The authors indicated that the difference was probably due to the use of an erythrosin plaque disclosing solution with the PHP versus the use of an explorer to detect unstained plaque when using the OHI-S. The use of an explorer is consistent with Greene and Vermillion's instructions for scoring plaque. Improved interobserver reliability might be found, however, when using a disclosing solution.

The PHP has also been found to be a more sensitive measure than the OHI-S to plaque reductions that result from flossing. In that study, Anaise concluded that the PHP was sensitive to decreases in plaque found in the interproximal sections of the teeth, while the OHI-S was not.[3] No comparison has been made of the sensitivity of the two indices to a decrease in plaque produced by toothbrushing.

The objective of this study was to extend work in the area of plaque measurement, in several important ways. First, it examined the interobserver reliability of the OHI-S and the PHP, when a disclosing solution was used with both scales. Second, the study looked at the differential sensitvity of the indices to changes in plaque levels produced by toothbrushing. These objectives were addressed in the context of a classroom intervention that was designed to increase the toothbrusing effectiveness of first and second grade children.[4]

METHOD

Subjects and setting

The subjects were fifteen children in a combined first and second grade classroom (Classroom A), and twelve children in a first grade classroom (Classroom B). The children were from lower and middle economic groups. The mean age was 7.4 years. All the procedures were conducted inside the two classrooms, which were at the same school.

Measurement and interobserver reliability

The same six teeth were examined when using either the OHI-S or the PHP. They were the buccal surfaces of the maxillary right and left first molars, the lingual surfaces of the mandibular right and left first molars, and the buccal surfaces of both the maxillary right central incisor and the mandibular left central incisor.

When using the OHI-S, each tooth was scored based on the fraction of the tooth covered with plaque. Zero was assigned, if no plaque was present. One was assigned, if not more than one third of the tooth surface was covered with plaque. A score of two was assigned, if plaque covered more than one third, but not more than two thirds of the tooth surface. A three was assigned, if plaque covered more than two thirds of a tooth surface.

When using the PHP, the tooth was divided into five sections. The tooth was divided longitudinally into mesial, middle, and distal thirds. The middle third was further divided into gingival, middle and occlusal thirds. Each of these five subdivisions was then assigned a zero for the absence or a one for the presence of plaque. With both the OHI-S and the PHP, the scores for each of the teeth were summed, then divided by the number of teeth scored. This resulted in maximum scores of three and five, respectively.

The children's teeth were scored after they swished for ten to fifteen seconds with an erythrosin disclosing solution (six drops of disclosing solution in one tablespoon of water). Scoring was done simultaneously by two auxiliary personnel who had received training in either the PHP or the OHI-S. These personnel examined the teeth using a tongue depressor and a flashlight. A total of 508 measurements were made using each index. In addition, the first author, who received training from a dentist and two dental hygienists, observed as the blind examiner for reliability on thirty-nine of the observations for the PHP and sixty-four of the observations with the OHI-S. At least one reliability check occurred for each child, for each scale. When reliability measures were taken, the first author would score the teeth immediately after the auxiliary personnel, while being blind to their observations. The first author was kept blind by virtue of his not watching the assistants write their scores.

Procedures

A baseline period was conducted over twelve days in Classroom A and twenty-eight days in Classroom B. During this and the subsequent treatment phase, the children's teeth were examined for plaque, shortly after they arrived in the classroom. The interval between these unannounced examinations was one to five days, throughout the study. During baseline, no feedback was provided to the children, regarding the level of plaque found. During the treatment phase, which was initiated on Day 14 in Classroom A, and Day 33 in Classroom B, a photograph of each child whose OHI-S score was 1.0 or lower was placed on a brightly colored poster in front of the class.[5] It remained up for as long as the criterion was met or exceeded. If the score was higher than 1.0, the

photograph remained down until the criterion was attained.

Data analysis

The significance of the changes produced was determined by a visual examination of the data and by statistical test. The statistical significance of the changes in mean plaque scores from the baseline to the treatment phase was determined by use of the directional test, with the level of significance set at $p<0.0005$.

Experimental design

A multiple baseline across classrooms design was used with replication of treatment effects across subjects.[6] This design is widely used in psychology when determining the effects of behavior change programs on health-related dependent variables.[4,7-11] In this design, treatment was initiated sequentially, first in Classroom A and then B, after a different number of baseline days. Experimental control was demonstrated by observing that when treatment produced lower levels of plaque for those children in Classroom A, the plaque levels for the children in Classroom B, who were still in the baseline condition, remained virtually the same as they had been before. Because plaque levels did not decrease in Classroom B at the same point that treatment was initiated in Classroom A, the possibility of extraneous factors producing the changes in Classroom A may be ruled out.

RESULTS

Substantial reductions in the level of plaque from the baseline to the treatment phase were evident, whether using the OHI-S or the PHP. These data are shown in the table. OHI-S scores decreased from 1.73 to 1.15 ($p<.0005$), while PHP scores decreased from 3.56 to 2.54 ($p<.0005$). In addition to obtaining statistically significant reductions, when using either index, the percentages of plaque reduction during treatment were also very similar for the OHI-S and the PHP. The percentages of reduction were 33.4 percent and 28.6 percent, respectively.

Table ☐ Baseline and treatment mean plaque scores obtained using the OHI-S and the PHP.

	Number of children	Baseline means	Treatment means	Obtained t	P
OSHI-S	27	1.73 (.447)*	1.15 (.331)*	9.79	< .0005
PHO	27	3.56 (.718)*	2.54 (.592)*	10.58	< .0005

* = Standard deviations

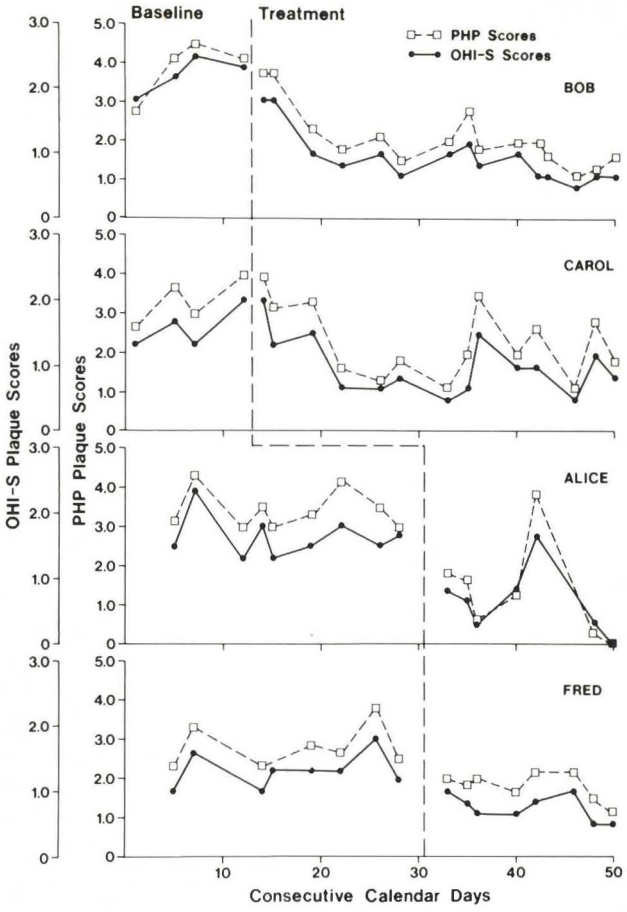

Figure. Simplified Oral Hygiene Index (OHI-S) and Patient Hygiene Performance method (PHP) for two children from Classroom A (Bob and Carol) and two children from Classroom B (Alice and Fred) during Baseline and Treatment periods. The research design is a multiple baseline across subjects design.

The degree of similarity between the two indices may be examined further by inspecting the changes in plaque levels that occurred from the baseline to the treatment phase for each of four subjects (Bob and Carol are from Classroom A, and Alice and Fred are from Classroom B). As can be seen in the figure, there is a high degree of covariance between the two scales. This similarity is reiterated by observing that the mean Pearson correlation between the PHP and the OHI-S for the twenty-seven chldren was 0.92. The lowest correlation for a child was 0.81 while the highest correlation was 0.98. The obtained interobserver Pearson correlations were 0.94 for the OHI-S and 0.97 for the PHP.

Discussion

In this study, the OHI-S and the PHP were determined to have high and nearly identical interobserver reliabilities, as determined by Pearson correlations. These findings agree with those of Podshadley and Haley in that the PHP may be scored reliably.[2] A con-

siderable improvement was found for the OHI-S in this study, however, when compared to Podshadley and Haley's results. The authors are of the opinon that this is directly attributable to the use of an erythrosin disclosing solution.

Also, both indices were found to be sufficiently sensitive to changes in plaque level produced by toothbrushing. This was found both by visually examining the data, which were displayed in a multiple baseline, and by statistical test for significance. It should be indicated that these data do not disagree with Anaise's findings that the PHP was more sensitive than the OHI-S to plaque reductions produced by flossing.[3] Instead, they suggest that when conducting a toothbrushing program, the researcher or clinician may be able to choose between the two indices based on considerations other than reliability or sensitivity.

The decision of which index to use in toothbrushing programs could be guided by the ease with which the indices may be used. Previously, the PHP would have been preferred due to the necessity of using an explorer to conduct examinations with the OHI-S. Podshadley and Haley reported that this resulted in twice as long to conduct examinations with the OHI-S when compared to the PHP. Now, because a dye was used with either index, this is no longer true. These authors prefer the OHI-S over the PHP, finding it easier to decide approximately what fraction of the tooth is covered with plaque rather than mapping out which of the five subdivisions of each tooth contain plaque, as is required with the PHP.

An additional point, relevant to any plaque reduction program, whether using the PHP or the OHI-S, involves the issue of clinical versus statistical significance. In the present study, statistically significant plaque reductions were obtained using both indices. It is equivocal, however, whether these reductions, and the reductions produced by other plaque reduction programs, were clinically significant. To the authors' knowledge, there are no studies in the dental literature that predict that, if X level of plaque is maintained for a certain period of time, Y number of caries lesions will result. Instead, researchers in this area seem to have adopted the philosophy that less is better, without a clear criterion as to how little plaque is good enough. There is also the question of how long plaque levels must remain low in order to be beneficial. Further, because an intervention produces lower plaque levels on one occasion or for a short time, there is no guarantee that a subject will continue to engage in effective oral hygiene behaviors. These authors have just completed a fifteen-month study of toothbrushing effectiveness with Head Start children and their families. They found that unless special procedures were instituted to produce maintenance of effective toothbrushing, maintenance was not attained. Only after implementing special procedures was maintenance of low levels of plaque found for up to twelve months.[12] This suggests that in order to add social validity to studies in this area, i.e. were clinically beneficial results produced by a plaque reduction program, there should be longitudinal investigations of the relationship between plaque levels and the number of caries lesions produced.

In summary, in the current study the OHI-S and the PHP were found to have nearly identical interobserver reliabilities, when an erythrosin disclosing solution was used prior to scoring with each index. Further, both indices were found to be sufficiently sensitive to reductions in plaque levels produced by toothbrushing. These results suggest that future researchers who attempt to improve toothbrushing effectiveness may choose either the OHI-S or the PHP. A clarification of the relationship between dental plaque and caries was proposed for future researchers.

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Dentistry and the technology connection

Computers

Alvin F. Gardner, DDS, PhD

Academic-based programs provide the best available approach to the education and training of auxiliary dental health professionals in the computerized dental office of the future. The employment of dental auxiliary professionals who have not had the advantage of such training would run counter to the developing trend within the dental profession to increase the use of computer technology.

Auxiliary dental personnel will grow in importance as dentists increase the use of computer technology. The accuracy of dental records, including diagnoses, treatment procedures and statistical and billing information, will be crucial and must be verified early by the auxiliaries. Auxiliaries will be required to use a computerized online billing system, and to provide information that is critical to skillful management and planning. The dental receptionist, for instance, will require a knowledge of dental record administration, because of the new significance that will be attached to the dental record in insurance and hospital reimbursements. A merging of the dental record with the financial information will be required of any future dental billing system.

In the future, the ability to provide dental treatment in conjunction with a computerized management system will not be sufficient to assure success in dental practice. The profession will be required to raise the dental awareness of children, adults, senior citizens, the handicapped, and homebound—in essence, all of so-

Dr. Gardner has been a dental officer, Bureau of Medicine, FDA, HHS, since 1963.

ciety—to help solve the busyness problem that plagues dentists, today.

DENTAL AUXILIARY UTILIZATION

Optimum dental auxiliary utilization is an important aspect of augmenting a dental practice in the electronic age and workplace. As advancements occur in dental science and in technology, auxiliaries must keep abreast of these developments or be left behind. It is well established that optimum dental auxiliary utilization enables the dentist to enhance and expand his treatment potential and patient load. In the practice that uses advanced computer technology, income will be directly tied to whether or not the dentist enjoys optimum utilization of auxiliary services, assuring a saving of at least 75 percent of his time. Based on this premise, the education of a dental auxiliary should encompass the following areas: four-handed dentistry, operating team and patient position, high velocity oral evacuation, single-handed instrument transfer technique, and the use of pre-set trays.

Four-handed dentistry includes work simplification, maximization of efficacy, and emphasis on team comfort and elimination of stress. The positioning of the operating team and patient encompasses convenient access, strategic arrangements, and a balanced posture. High velocity oral evacuation includes the washed field, effective rinsing and evacuations. Single-handed instrument transfer technique means the movement of materials and instruments, expediting procedures, reduction of stress, efficient transfer methodology, and maintaining retraction and oral evacuation. The use of color-coded pre-set trays saves time in accomplishing specific treatment procedures. The optimum use of the services of clinical dental assistants will depend upon the availability of adequately trained personnel, and on the availability of training in dental offices and in institutions that offer formal educational programs in clinical assisting.

PERSONNEL COSTS

The rapid turnover of dental auxiliaries is a problem that must be solved, if dental assistants are to play an optimal role in the delivery of dental treatment services. Tests will be developed to help in the selection of people who will be enrolled in formal educational programs. These tests should examine the following areas: eye-hand coordinations, personality, cognitive skills, and a host of areas that are especially relevant. The successful dental auxiliary possesses excellent dexterity and ability to make decisions; and is able, furthermore, to reason and think logically. The cost of acquiring a dental auxiliary, including advertising and training, will be $5,000 to $6,000, much too expensive for the modern day dental practice, where a turnover rate of approximately two and a half years exists.

Successful dental auxiliaries probably have a unique profile. A dental-record-coordinator training program will be required, because the coordinator will require a range of knowledge and skills related to insurance payment systems. The present-day dental receptionist could be trained to become the future dental-record coordinator, although at present there does not appear to be a need for the development of new special auxiliary programs for this purpose.

The demand for dental auxiliary professionals will continue to rise in the computerized dental office for the following reasons: increased awareness of personal responsibility of self-care and personal dental health enhancement; growing complexity of management caused by new technology; increase in the demand for dental health services and greater public acceptance of the role of dental auxiliary professionals in providing them; and increasing numbers of older persons, children, and adults with disabling conditions, who require non-institutional as well as institutional dental care and rehabilitation.

Ninety-five percent of Americans over sixty-five years of age continue to live at home and prefer that arrangement. Although they require dental health services in the dental office, there is a trend toward home health care as an alternative to institutional care. Dentists and dental auxiliaries should find home care an acceptable alternative for providing some types of treatment. It will become necessary, however, to be able to provide whatever services the patient requires, such as medical, dental, and rehabilitation services that have a higher-than-average profit margin. The major question, still unanswered, is: "Who should pay for promoting home dental health care for the geriatric patient?" Regardless of the answer, the dental profession should be cognizant of the needs of the homebound dental patient.

UNMET DEMAND

Future high technology will require emphasis on marketing concepts. Public need must become a public demand for dental services. This can be accomplished by extending needed dental care to additional segments of the population through education of more segments of the population. The newly educated people must be

motivated, however, to come to the dental office. To accomplish this objective, however, institutional efforts are much preferred to individual efforts of the dentist who chooses to market his own services.

Dental care for the handicapped and for those with special needs should be included in any marketing program directed at new segments of the population. Future dentists should be taught to be patient/market oriented while they are in dental school.

The dental profession should increase public awareness of the need for dental services through the use of advanced technology. For instance, increased use of the media, public service programs, high visibility and national promotions via satellite communications should be utilized in the future, not only to inform the public, but other health professionals as well.

The increased use of dental prepayment plans should enhance the marketing of dental services. Health insurance, however, should not be taxed, as is currently proposed. If health insurance is taxed, dental health coverage will probably be among the first of the health benefits to be dropped by large numbers of people, and thus add to the more than 118 million individuals in the United States who do not visit a dentist regularly.

Only 25 percent of Americans, out of a population of approximately 236 million, obtain dental care on a regular basis and feel that dental care is a necessity. Another 25 percent visit a dentist episodically. Fifty percent either do not feel that dental care is a necessity or have a fear of dental treatment.

COMPUTERS IN DENTISTRY

The technology connection will force the future dentist to become a computer consumer. The dentist should ask: "Can the computer hardware and software programs help me to do a better job of managing my dental practice?" The following information should provide a useful framework for the evaluation of computer needs and avoidance of expensive mistakes. First, the dentist must know why he is buying a computer. Computers should provide solutions to specific problems. Before the dental practitioner enters a computer store, therefore, he should ask the following questions:

- ☐ Am I spending excessive time on routine paperwork and insufficient time on proper planning for my practice?
- ☐ Am I unable to control the costs of my practice?
- ☐ Do I lack an organized approach to attracting new patients?
- ☐ Are my accounting and bookkeeping methods less efficient than I would like?

If the answers to these questions are "yes," it is time then to consider the purchase of a computer.

The dentist must understand what effect the computer will have on the needs of the practice and in what specific areas it can be helpful: For example, word processing, accounting and bookkeeping, data and information management, forecasting and financial projections of dental practice, and recall of patients.

In selecting the hardware and software that are right for the dental practice, one should avoid being oversold on very expensive and unneeded hardware and software that do not meet specific needs. If the dentist requires a small business computer, however, he should be prepared to pay approximately $5,000 for hardware and software that will produce meaningful results.[1,2] Generally, a good rule to follow is that less money means less computing power. Each software package requires a certain amount of working memory. The dentist should be certain that the computer has the working memory required for the application of the selected software. The dentist may utilize either a floppy disc drive or a hard disc system. The hard disc systems are more expensive; they have the advantage, however, of requiring less handling, providing the storage requirements are small.[3] The floppy disc drive system will, however, do the same job.[4,5] If the dentist determines that a floppy disc drive system will be purchased, more than a single drive will be needed, since a one-disc drive requires greater handling of program and storage discs. Greater handling increases the risk, such as a damaged disc or loss of valuable data.[6,7] Some practices may require more than one computer workstation with the computers capable of talking to each other. Multiple computer workstations are required, when operators must use the computer power concurrently. Separate workstations can be utilized to communicate with each other, thus sharing expensive resources such as printers and important databases stored on a hard disc. With respect to the need for a quality printer, the less expensive dot matrix printer will suffice, when a large part of the computer output is for internal use. When computer-generated documents are directed, however, to patients and a professional image should be maintained, a correspondence quality printer is a necessity. If color graphics are needed for marketing materials, charts, and tables, color is then a nice enhancement of the system. For the majority of dental practices, however, a monochrome display monitor is adequate.[8] Do not be oversold. Hundreds of software packages are available on the market at the present time. Choosing the correct software packages for the dental office is just as important as choosing the correct hardware. Generally, it is

best to seek the advice of a knowledgeable professional, because a substantial investment is involved. Some individuals start by selecting the software packages first and then selecting a hardware system capable of using them.[9,10]

The dentist must determine whether his practice requires an integrated accounting package. If detail in such aspects as accounts receivable, accounts payable, inventory and payroll are required, the dentist should invest in an accounting software package that will effectively integrate these accounts into a general ledger.

Will a database management program help the dental practice? Generally, yes; the dentist must select, however, the correct database management program for his practice. If the dentist desires to maintain a patient list, the less expensive file systems (Rolodex card file or index card file) are satisfactory. If the practice requires, however, greater correlation capacity, such as an inventory control and payroll, the power of the more expensive and more complex database managers will be required.[11]

It is necessary that the following criteria be kept in mind, when selecting a computer:

- ☐ To assure the greatest return on investment, purchase the hardware that meets the needs of the practice.
- ☐ To assure adequate solution to the problems of the practice, purchase the correct software.
- ☐ To assure early benefits from the investment in the system, make the total system operational as quickly as possible.

The dentist has the following options for acquiring a computer: purchase, lease, or lease with an option to buy—all viable choices, dependent on cash flow, consequences related to taxes and financial statement, and the relative merits of equity versus flexibility.[12] The selection should be compatible with the nature of the practice.

The computer can be helpful in the following areas: adjustments; contract payments; daily transactions; payment processing; patient scheduling; treatment planning; insurance assignments; insurance companies; contract-payment, coupon, insurance, and monthly billings; posting of office charges; ledger cards; patient categories; patient information and selection; billing, personnel, procedural and referral information; word processing; and a dental insurance directory.[13,14] The computer is also capable of providing the following report and label programs for the practice: adjustment summary, aging report, bulk payment, contract payment, credit summary, day sheet, deposit slip, delinquent payments, delinquent-payment letters, payment distributions, treatment plan reports, insurance aging, insurance assignments, insurance billing queue, insurance company listing, doctor production, dental hygienist production, procedure production, production bar graphs, referral production, patient categories, patient recalls, patient listing, personnel listings, procedure listings, referral listing, patient name labels, patient address labels, label and index card generators (Rolodex type).

High technology electronic computers will become a vital part of many dental practices, and will become cost-effective, if the dentist takes advantage of their capabilities.[15,16] A cost-effective computer must be capable of performing simultaneous functions. It should also be capable of expandibility to meet a future increased flow of data.[17,18] If the required computer is not affordable at the time, it is best to postpone the acquisition of a computer until an adequate system is affordable.[19] At any rate, be reminded that the home personal computer does not have the power and speed required for a busy practice.

Electronic trespassing is a problem of which most users of computers should be aware. Despite serious financial losses and invasion of privacy, related legal questions have not been adequately answered. Although insurance is available to cover losses, it is not proving popular, even in the face of worsening circumstances.

IMPROVED PRODUCTIVITY

The function of the electronic dental office will be to improve productivity. In order to fulfill the potential of this function, dentists will have to be trained in the impact of advanced communications on the management and productivity of their practices; and dental schools will be required to develop courses in the use of computers and word processors, to prepare students in the new management techniques.

THE ROBOT AUXILIARY

Inventing the electronic dental auxiliaries for the next century will involve production of the robotic dental auxiliary (Dentobot). It is conceivable that a dental robotic auxiliary will someday be invented to accomplish its own work, and obey and anticipate the will of the dental practitioner. The usual sounds and voices of the office will be interrupted by the stilted, computer-generated speech of the dentobot. Dentobot is also a

quiet, studious robot who can back off from the dentist, wiggle a little and talk to both dentist and patient. The dental patient exclaims, "What is going on here?" What is going on in this next-century dental office is the use of Dentobot to serve as a dental auxiliary.

Dentobot is a programmable, multilingual robot that is capable of telling time, acting as a sentry, performing housekeeping chores, and serving as the chairside assistant. Dentobot greets every patient entering the dental operatory with a, "Hello, please be seated in the dental chair." Dentobot says, "My name is Dentobot. I can talk; I can move my arms one at a time, and I am a chairside dental assistant." Dentobot will be invented as a long-armed robot capable of functioning in four-handed dentistry. Dentobot reacts to the dentist's voice, to light and heat, and is capable of traveling around the dental operatory, moving its arms and lifting instruments and dental supplies with clawlike hands. Dentobot, looking like an Erector set, will possess educational/industrial robotic arms that follow voice commands. Dentobot will be a tone-activated and program-controlled automatic robot comprised of a rolling-spaghetti bowl of electronic wiring with numerous movement programs. Dentobot will be manufactured by industrial robots and will come in a number of designs and programs. Dentobot requires no food, no rest periods or coffee breaks and is never tardy for work. Dentobot learns his dentist's interests and may have a cup of coffee waiting on a tray when the dental practitioner arrives at the office each morning. If the dentist desires to be left alone, he simply commands Dentobot to go away, whereby the robot promptly enters the nearby closet.

Robots similar to Dentobot may be built in factories in the next generation, by utilizing the ingenious recycling of electronic and other materials. Dentobot will be demonstrated at dental conventions and may be manufactured to come apart in order to reveal a pulsing pink heart. Dentobot will be capable of producing computer sculptures of dental restorations and dentures to demonstrate to the patient how the finished dental treatment will appear.

Mankind has been producing mechanical life in many places for the past 5,000 years. Robots were initially introduced in 1921 in Prague, Czechoslovakia, in a play by Karel Capek entitled, "Rossum's Universal Robots." The word "robot" was derived from the Czech word, robata, meaning forced labor. In the 1940's, Isaac Asimov formulated the Laws of Robotics and demonstrated that robots had to be programmed by humans. Today, industrial robots can lift larger loads than any human, stay at work for years continuously with only very brief periods of time for maintenance and repair. Robots currently work with molten metals and operate in polluted environments where humans would be destroyed. Robots do not become bored, or care if the work is very difficult or highly frustrating. In the Fujitsu-Fanuc factory of Tokyo, Japan, robots are currently manufacturing other robots.

In the next century, dentistry may very well utilize the Dentobot as part of and parcel of the high technology connection in order to improve productivity and stay competitive with dental offices of the future. Dental office automation may sound a bit crazy today and simply represent one's fantasy. History will reveal, however, whether today's fantasy will become tomorrow's reality. The immediate effects of Dentobot on jobs for auxiliaries may be negative. The long-term effects, however, will be to create more jobs. The history of the United States reveals that the creation of more jobs has always been the aftermath of advancements in high technology industries. The invention of the electric motor replaced human muscle power; but what dental practitioner feels guilty about using an electric handpiece? The dental industry and dental profession will be moving into a whole new involvement with electronic machinery in the next generation, because machines with some intelligence will be produced. In order for the Dentobot to improve productivity in the dental office, it will have to achieve a high level of intelligence. Dentobot may say "hello" to the patient in English, Spanish, French, Japanese and many other languages for which it is programmed.

EPILOGUE

The future dental office may be operated on the premise that high technology will be responsible for improving productivity. The electronic computer is a small, fast and powerful desktop electronic organizer capable of solving many dental practice problems; and thus assure greater productivity and income.[20]

Handicapped patients should receive comprehensive dental care in the least restrictive, most dignified setting possible, utilizing the team approach. Realistic preventive programs for handicapped patients should be developed, emphasizing the highest feasible level of independence for personal oral hygiene.

One problem resulting from the development of the dental electronic workplace and the expansion of dentistry into a high-technology field is finding that the workplace does not match the low skills of many individuals

employed in the dental office. Educational advancements will be needed to correct this problem.

A new concept in communications, termed the multimedia document or compound document, is being developed in conjunction with computeried documents that allow voice and text, as well as images, computer data and graphs, to be combined into one electronic message.[21] The multimedia documents face major hurdles (storing, displaying, and transmitting voice and images requires far more memory, power and screen resolution than most personal computers possess). The multimedia document can be used in the voice-annotated text. The future is boundless. Caution should be exercised to avoid computer piracy.[21-25]

I wish to state, in conclusion, that I do not personally desire to see the computer put an end to individual initiative, charity, or the conventional forms of dental practice. The dental profession need not fear depersonalization of the dentist or of our dental care because of the use of computers. Computers will do only what humans arrange them to do. For the majority of dentists, help from computers will be rendered via the dental practitioner.

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BIRTHWEIGHT AND INFANT MORTALITY

The relationship between birthweight and infant mortality has been documented repeatedly in a variety of settings. The lowest mortality rates are experienced by infants weighing 3,000 to 3,500 grams. For infants weighing 2,500 grams or less, the mortality rate increases rapidly with decreasing birthweight. Most of the infants weighing 1,000 grams or less die.

Institute of Medicine: Preventing low birthweight, Washington, D.C.: National Academy Press, 1985, p 27

Case reports

The problems of treatment of early ankylosis: report of case

Sabine C. Maréchaux, DDS

Normally, teeth are in a continual stage of eruption. Any discontinuation of this physiological movement is abnormal and may be caused by three factors:

- ☐ Impaction: an obstruction interferes with the eruptive potential, e.g. another tooth.
- ☐ An accident or infection: whereby the dental papilla is destroyed (very rare).
- ☐ An ankylosis: a situation in which there is a fusion of cementum with alveolar bone.

It has been suggested that the etiology of tooth ankylosis could be of genetic origin or due to a congenital gap in the periodontal membrance; due in other cases to localized trauma or to a locally disturbed arrythmic metabolisn.[1]

The mechanism of tooth ankylosis can be studied by histological methods, radiographs, charts and casts. There appears to be an increased osteoclastic and osteoblastic activity with irregular resorption and repair by alveolar bone. In primary teeth with permanent successors, there is a wider dispersion of ankylosis, while it appears to be concentrated on the apices of primary teeth without permanent successors. The repair by bone is progressive, until there is a complete bony union.[2]

Ankylosis seems to be nearly always located in the primary molar region during the mixed dentition stage. The permanent molars are less often affected. The reimplantation of incisors following traumatic injury, may

Dr. Maréchaux is head of the Pedodontic Clinic of the University of Geneva Dental School, Geneva, Switzerland.

result in ankylosis of the incisors. Biederman tried to initiate a similar situation with primary molars in order to study the mechanism of ankylosis, but his results were not conclusive.[1]

Obersztyn did an experimental investigation with dogs to study the factors causing the resorption of primary teeth.[3] His results indicate that there is a delayed resorption of primary teeth without permanent successors; on the other hand, however, an inflammatory reaction accelerates resorption.

Alexander *et al* suggest that a component of the resorptive process is the mucopolysaccharidose activity within the periodontal tissue of the primary teeth and that this enzyme activity is absent in the periodontal ligament of ankylosed teeth.[4]

REVIEW OF LITERATURE

The first clinical study was made in 1861. Since then, numerous studies have been made concerning the prevalence, cause, treatment and clinical sequelae of tooth ankylosis.[2,5-7] There appears to be no relationship to age, sex, family, caries, systemic disease, occlusal stress and gingivitis.[2] In 1964, however, Via did a study of 2,342 non-siblings and found that there was a family tendency among those who had ankylosed teeth.

A tooth is considered ankylosed if:

- ☐ It had been in occlusal contact at one time and is now 1 mm or more below the level of the occlusal plane.
- ☐ Subsequently, it lost this contact.
- ☐ A sharp clear sound is produced on percussion with a dental instrument.

Ankylosis occurs first and then, with increasing age, the ankylosed tooth may become submerged, due to the continual growth of the surrounding alveolar bone.[2]

The prevalence of ankylosed teeth, depends on the age group with which the study was made. It has been reported as low as 1.9 percent with twelve-year-olds up to 14.3 percent with eight- to nine-year-olds.[9-16] The ratio of primary teeth to permanent teeth is 10:1. Mandibular teeth are ankylosed twice as often as maxillary teeth. The primary tooth which is most frequently ankylosed is the lower first molar. The earlier the onset of ankylosis, the greater the growth interference. It is not uncommon to find more than one ankylosed tooth with the same patient.[1]

The problems arising from ankylosed teeth, due to their submerged positions, are as follows:

- ☐ Initiation of occlusal and periodontal problems for adjacent and antagonistic teeth.
- ☐ Loss of contact point relationship, which permits tipping of the adjacent teeth into an abnormal axial inclination and elongation of the antagonist.
- ☐ Occlusal disharmony, food impaction and subsequent restorative problems.[17]

Figure 1. Ankylosed left mandibular second primary molar of a seven-year-old female patient. Note the abnormal tooth-like structure at the crest of the alveolar border.

Messer *et al* made the following observations on premolars that succeed ankylosed primary teeth: Variations in coronal and radicular morphology, hypoplasia, hypomineralization, coronal malposition, periodontal pocket formation, thickening of the lamina dura and alveolar bone loss.[14]

No precise and explicit treatment of ankylosis has appeared in the literature. Biederman suggests: observation, extraction, luxation to disrupt the bony union or rebuilding the tooth to the level of the occlusal plane and finally space maintenance where indicated.[1] The type of treatment depends on the time and the situation of the ankylosis. Several authors present different methods for restoring the ankylosed teeth to the occlusal surface with the use of composite resins, amalgam, or prefabricated stainless steel crowns.[17-20]

There are numerous case reports of submerged primary molars, which were discovered subsequently with panoramic radiographs, because of routine check-up or because the patient complained of pain in that area.[8,21-27]

CLINICAL PRESENTATION

In September 1981, a family dentist referred a girl, age seven, to the Pedodontic Clinic of the University of Geneva Dental School. He sent along an apical radiograph of the left mandibular region, taken on the 10th

Figure 2. The crown of the left mandibular second premolar is developing lingually to the ankylosed second primary molar, one year later.

Figure 3. Two months postoperative radiograph indicating the continued development of the second premolar. There is no significant space loss.

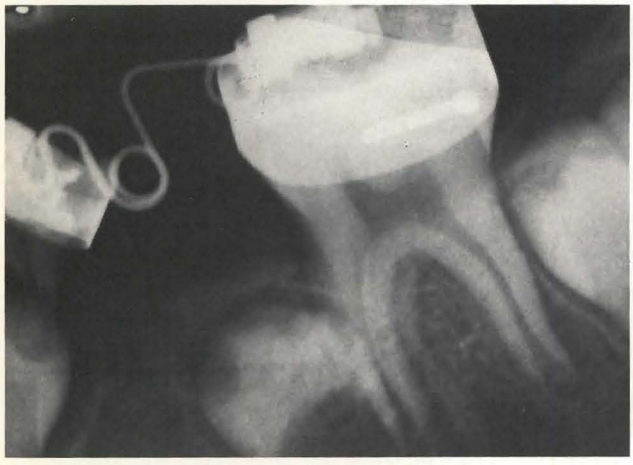

Figure 4. Apical radiograph in February, 1983, presenting the space maintainer. Note the resorption of the distal root of the left primary first molar.

of July 1980 (Figure 1). The radiograph indicated the presence of an unerupted left mandibular second primary molar with only slight root formation and a small supernumerary toothlike formation at the crest of the alveolar bone. The left mandibular first permanent molar had not yet erupted. Because the girl refused to cooperate with the family dentist, he thought it would be wiser to refer the patient to the University Clinic.

While family and medical histories were noncontributory, the patient displayed an immature emotional attitude. Oral examination and bitewing radiographs presented a caries-free dentition, except for a hypoplastic lesion on the occlusal surface of her right maxillary first permanent molar. Both the left maxillary and mandibular first permanent molars had not yet erupted and the left mandibular primary second molar appeared to be ankylosed. She had an Angle Class I occlusal relationship with a tendency toward deep bite. The parents did not wish their daughter to be treated under general anesthesia. With the routine patient explanatory conditioning used in the clinic, it was possible to treat the hypoplastic lesion on the right maxillary first permanent molar. Consequently, the patient and her mother were instructed as to the importance of a prophylactic program and were asked for active participation.

The patient was observed after an interval of six months, to assess her progress in home prophylaxis and patient cooperation. The apical radiograph taken on the 30th of September 1982 (Figure 2) indicated that one third of the crown of the left mandibular second permanent premolar had formed, while the position of the ankylosed second primary molar had remained stationary in relation to the unerupted first premolar. The left first permanent molars were now fully erupted and in occlusion. At this date, with adequate patient cooperation, the ankylosed left mandibular second primary molar was removed under local anesthesia. Healing and postoperative care were uneventful.

An apical radiograph taken on the 25th of November, 1982, indicated that the crown formation of the second premolar had continued normally (Figure 3). In January, 1983, bands were placed on the left mandibular first permanent molar and first primary molar with a sectional arch for space maintenance. The procedure was extremely trying for both the operator and the uncooperative patient. The apical radiograph taken on the 23rd of February 1982 (Figure 4) showed physiological root resorption of the first primary molar. In addition, the oral hygiene of the patient was extremely negligent. In June of 1983 it was decided to remove the bands and place a lingual arch space maintainer, once oral hygiene had improved.

The patient did not show up for her recall appointments until April, 1984, at which time the apical radi-

Figure 5. In April, 1984, there has been mesial drifting of the first permanent molar.

Figure 6. The radiographic situation in February, 1985, with only 3 mm of space available for the erupting second premolar.

ograph (Figure 5) showed continued root formation of the second premolar, but also, a more mesial position of the first permanent molar, with subsequent space loss for the second premolar. She refused to consider any type of space regaining procedure proposed to her.

The apical radiograph taken in February, 1985 (Figure 6), presented a continued mesial drift of the first permanent molar followed by the unerupted second permanent molar, so that the future available space for the as yet unerupted second premolar was reduced to about 3 mm. As she seemed more reasonable at this age and her oral hygience had remarkably improved, she was referred to the orthodontic department for further treatment.

DISCUSSION

The preceding case report of an early ankylosed second primary mandibular molar illustrates the importance of patient cooperation in treatment planning. While extraction seems indicated, to avoid the displacement and malformation of the permanent premolar, the early removal causes space loss, which requires future orthodontic treatment. It might have been advisable to have observed the development of the permanent premolar and delayed the extraction of the ankylosed primary molar until such a time that space loss would be minimal, since patient cooperation was not totally assured.

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Unerupted second primary molar positioned inferior to the second premolar: clinical report

Suehiro Tsukamoto, DDS, DDSc
Raymond L. Braham, BDS, LDSRCS, MScD

A review of the literature of the past ten years revealed only two case reports of an unerupted primary molar in a position inferior to the premolar. Both these cases were in the mandibular right primary second molar region (Table).

Bateman *et al* presented a case of a fourteen-year-old girl with an unerupted mandibular right primary second molar in a position inferior to that of the second premolar. The tooth was covered with bone, although the follicles around the second primary molar and the second premolar were apparently continuous.[1]

Park reported a case of a twenty-year-old female with an unerupted mandibular right primary second molar in a position inferior to that of the second premolar. The patient was not aware of the presence of the unerupted teeth.[2]

CLINICAL REPORT

A ten-year-old Japanese male came to the Pedodontic Clinic at the Fukuoka Dental College complaining of dull pain in the right mandibular area.

The patient's medical history consisted of a record of hydrocephalus with a shunt and mental retardation. No history of intraoral infection or trauma was reported by the mother.

The intraoral examination revealed that the right mandibular primary second molar had not erupted. A depression of the mandibular alveolus in the area of the missing tooth was noted (Figure 1).

Periapical and panoramic radiographs (Figures 2, 3) were taken. They revealed an unerupted right primary second molar, deeply impacted. Above this molar was the second premolar, with a well-developed crown, distally inclined. The crowns of the two teeth were covered continuously with follicles. The left mandibular

Figure 1. Intraoral view of the depression in the missing tooth area.

Dr. Tsukamoto is Assistant Professor of Pedodontics at Fukuoka Dental College, Japan, and was Visiting Associate Professor of Pediatric Dentistry, University of California, San Francisco.
Dr. Braham is Associate Clinical Professor of Pediatric Dentistry and Pediatrics, University of California, San Francisco.

Table ☐ Tabulation of cases of unerupted primary molar in a position inferior to that of the premolar.

Author	Patient Sex	Age	Tooth	Condition	Result	Medical history
Bateman and Emmering	F	14	Mandibular primary second molar and second premolar	Follicles appeared continuous	Not reported	Unremarkable
Park	F	20	Mandibular primary second molar and second premolar	Not reported	Not reported	Unremarkable
Tsukamoto and Braham	M	10	Mandibular primary second molar and second premolar	Ankylosed, Follicles appeared continous	Extracted	Hydrocephalus

second premolar was impacted against the first permanent molar, which was inclined mesially.

Examination showed the following permanent teeth erupted: eight incisors; mandibular canines, first molars and left second molar; maxillary first molars, and first premolars; also the primary maxillary right canine and second molars.

A panoramic radiograph showed the following teeth to be unerupted: the remaining teeth of a dentition of thirty-two teeth plus the right mandibular second primary molar.

Treatment

The following teeth were removed under general anesthesia: the maxillary primary second molars, right primary canine, and first premolars; and the mandibular second premolars and the right primary second premolar.

The mesial root of the mandibular right second primary molar was fractured during the extraction. The roots appeared to be ankylosed. The root fragments were removed (Figure 4).

Both maxillary first premolars and the mandibular second premolars were removed to relieve crowding. The mandibular right premolar appeared to have less root development than the left premolar (Figure 5).

DISCUSSION

The premolars begin their development lingual to, and at the level of, the occlusal plane of the primary molars. Later, they are found between the divergent roots and, at the end of the preeruptive phase, below the roots of the primary molars.[3,4]

The true succedaneous teeth (incisors, canines and premolars in mammals) develop, not directly from the dental lamina, but as epithelial buds from the lingual side of the primary enamel organs, so a primary tooth must develop, if there is to be a successor.[5]

The etiology of the impaction of a second primary molar would appear to be:

- ☐ Abnormal development of the primary molar-germ before one year.
- ☐ Malposition of the second premolar-anlage before one year.

Figure 2. Periapical radiograph showing the unerupted mandibular right primary second molar inferior to the second premolar.

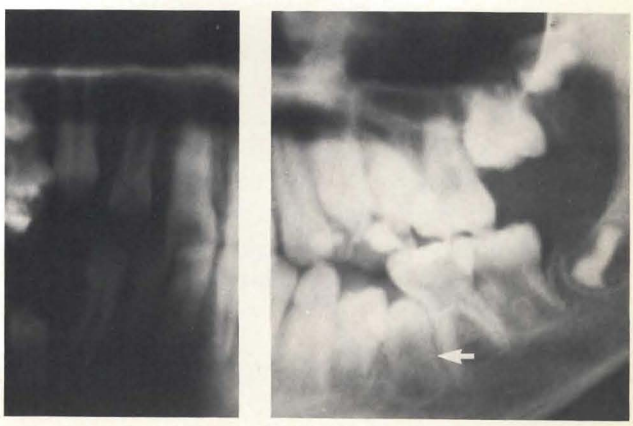

Figure 3. A panoramic radiograph showing the unerupted left premolars and right premolars.

Figure 4. Lateral view of extracted mandibular right second primary molar and second premolar.

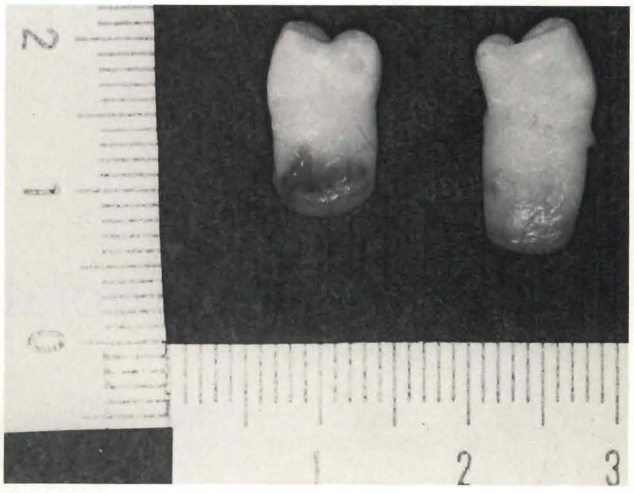

Figure 5. Lateral view of extracted mandibular right and left premolar.

- ☐ Amir and Duperon suggested that "a local traumatic or developmental event could have contributed to ankylosis of the primary tooth and disturbed the development of the permanent tooth."[6]

For the reasons stated, it was concluded that the tooth germ of the second premolar remained above the second primary molar.

In this case, the teeth were extracted for the following reasons:

- ☐ It appeared that normal eruption of the teeth could not occur.
- ☐ The patient was complaining of pain in the specific area.
- ☐ The dentition presented insufficient space for the permanent teeth.

We thank Professor Yutaka Yoshida, Chairman, Department of Pedodontics, Fukuoka Dental College, Japan, for allowing us to publish this case history, also Dr. Merle E. Morris, Clinical Professor Pediatric Dentistry and Pediatrics, University of California, San Francisco, for reviewing the manuscript.

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BEHAVIORAL AND ENVIRONMENTAL RISKS: SMOKING

Smoking is one of the most important preventable determinants of low birthweight in the United States. In 1979, the Surgeon General of the United States warned clearly of the risks to infants of mothers who smoke cigarettes: "Smoking slows fetal growth, doubles the chance of low birthweight and increases the risk of stillbirth. Recent studies suggest that smoking may be a significant contributing factor in 20 to 40 percent of low weight infants born in the United States and Canada.:

Institute of Medicine: Preventing low birthweight, Washington, D.C.: National Academy Press, 1985, pp 67-68.

Facial myiasis: report of case

Hemant Narendra Joshi, BDS
Parimal Jinabhai Kansagra, MDS
Promod Kumar Dayal, BDS, MDS

Hope first introduced the term 'myiasis' in 1840, derived from the Greek word 'myia' meaning fly.[1] Dipterous flies have been known to invade man through their eggs or larvae (maggots).[1,2] Any part of the human body can be affected by myiasis.[2]

In facial myiasis, maggots invade the facial skin and burrow into its deeper tissues, causing perforation. Infected lesions may attract the flies which then deposit their eggs. Such process of invasion by the flies is easier among helpless children and adults especially during sleep. The eggs are hatched within a week and develop rapidly into larvae. Conditions in the tropics are particularly favorable for myiasis.[3]

Although myiasis almost never occurs in Western and other developed countries, because of fly-control measures, it is still found in most of the developing countries, although rarely.

CASE REPORT

A two-year old female child, belonging to a lower socio-economic class family, was referred from a general hospital to the Government Dental College and Hospital, Ahmedabad, India. The child had a complaint of white germs coming out of a facial wound in the left mandibular region. According to the patient's father, a small boil developed on the left side of the child's face, approximately fifteen days earlier. Because it was neglected by her parents, after a few days the boil increased in size and ultimately ruptured, draining pus. The parents took no further care, thinking the wound would heal. Observing moving organisms in the wound, the father attempted to remove them with camphor, unsuccessfully, however. He then brought the child to us.

Present was a large round ulcer, measuring about 3 cm in diameter, on the left side of the face near the body of the mandible, surrounded by a diffuse swelling with inflammation (Figure). Larvae (maggots) were observed

Figure. Clinical photograph of the child showing a round ulcerated cavity containing maggots on the left side of the face near the mandibular body.

Dr. Joshi is Tutor in Oral Diagnosis and Dental Radiology Department, Government Dental College and Hospital, Ahmedabad - 380016, India.
Dr. Kansagra is Clinical Assistant in Oral and Maxillofacial and Plastic Surgery Department, Government Dental College and Hospital, Ahmedabad - 380016, India.
Dr. Dayal is Assistant Professor in Oral Diagnosis and Dental Radiology Department, Government Dental College and Hospital, Ahmedabad - 380016, India.

in four burrows within the ulcer. The patient was uncooperative because of the discomfort. The condition of the teeth and soft tissues including those on the affected side was normal. Radiographic examination, comprised of a lateral oblique view of the left mandibular body and an occlusal film, revealed no periapical or other patholigical lesion in the bone.

The child was malnourished and suffering from fever with 102°F temperature. A clinical diagnosis of facial myiasis was made.

TREATMENT

The patient was admitted to the hospital ward; treatment was done in the dental clinic. Turpentine oil was applied to each burrow of the lesion with a cotton pellet, to force the maggots out of the burrow. As the larvae came, they were grasped with tweezers and placed in a bottle containing formalin, and kept there for preservation and examination. In a period of a few hours, only seven larvae could be removed on the first day. On the second day, again a few larvae were removed. Debridement of the burrows was carried out by irrigation with saline solution. Healing occurred rapidly. The patient was discharged and instructed to return in a week. Unfortunately, the patient was not seen again.

Chrysoma bazina

On examination, the larvae were alive and active. Each larvae has a cork-screw appearance. They were yellow in color, with dark capsular heads, and varied in size, 10 to 12 mm in length and 2 to 3 mm in diameter. The larvae were sent to a pathology laboratory for examination, where they were identified as chrysoma bazina.

DISCUSSION

The larvae of diptera usually develop in decaying tissues.[1] The female diptera flies deposit eggs or larvae on open wounds or in the natural body cavities of helpless, unprotected sleeping persons.[4,5] In the present case, since the child initially had a large boil which later ruptured, the flies may have been attracted to it. Myiasis is quite uncommon in children, except when there are some predisposing lesions that attract flies.[1] As the maggots matured, they caused considerable tissue destruction that was further aggravated by the secondary infection, resulting in intense pyrexia and discomfort.

Siddhu, after reviewing the literature on dental myiasis, stated that the reported cases were also rare in the tropical countries.[2] According to the literature, however, the occurrence of myiasis involving nose and ear is common.[3] This case appears to be the first reported case of facial myiasis from India.

Although the treatment of myiasis is simple, time and patience are required in removing the maggots. The purpose of applying turpentine oil is to suffocate the maggots, to bring them to the surface, where they can be easily grasped with tweezers. Affected areas should never be curetted until all the larvae are removed, to prevent secondary infection from retained larvae. Cutaneous myiasis causes extreme discomfort.[1] In the present case, rapid healing of the wound was assured, although the patient was not seen postoperatively.

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ALCOHOL

The data on maternal alcohol consumption and its association with low birthweight are not as uniform as for smoking. It is reasonably certain that pregnant women who drink heavily are at risk of delivering a baby with fetal alcohol syndrome—characterized by intrauterine growth retardation and a variety of congenital abnormalities.

Institute of Medicine: Preventing low birthweight, Washington, D.C.: National Academy Press, 1985, p 69.
