ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

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Oh, the Comfort, the inexpressible Comfort of feeling safe with a person, having neither to weigh thoughts nor measure words, but pouring them all right out, just as they are, chaff and grain together; certain that a faithful hand will take and sift them, keep what is worth keeping, and then with breath of kindness blow the rest away.

Dinah Maria Mulock Craik
1826–1887

THOSE WHO DO NOT FEEL PAIN SELDOM THINK THAT IT IS FELT.
—Samuel Johnson

60 YEARS OF SERVICE

ASDC AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

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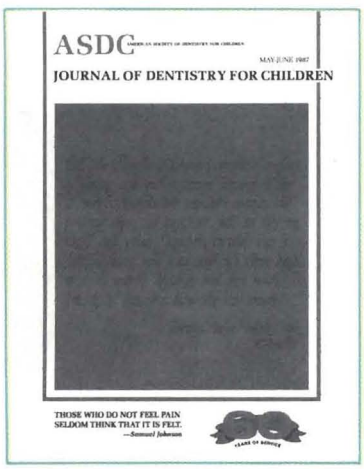


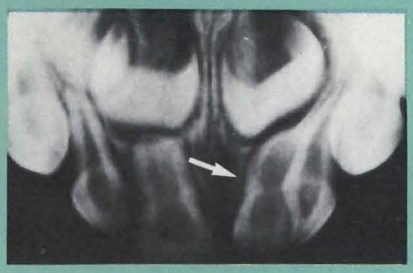
All patients need a clinician who can comfort them and in whom they can have confidence. These are essential to successful treatment, regardless of whether a form of sedation or anesthesia is to be used.

Design and art by Sharlene Nowak.

BURNS

CLINIC

179



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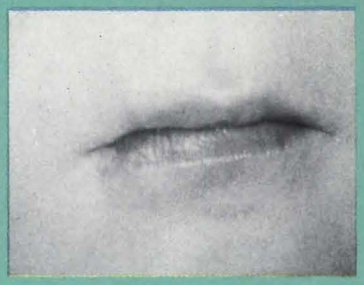

For the busy reader

Splint therapy for electrical burns of the oral commissure in children—page 161

Electrical burns of the oral cavity are relatively rare; a case is reported here. An acrylic splint fabricated for the patient helped prevent microstomia and the subsequent development of a deformity.

Requests for reprints should be directed to Dr. Richard Salman, Department of Oral and Maxillofacial Surgery, Bellevue Hospital Center, 27th Street and First Avenue, New York, NY 10016.

Direct bonded glass ionomer crowns—page 165.

After one year in function, the crowns appear to wear well, are well-retained, and remain esthetically pleasing. The glass ionomer filling materials show a great potential in restoring severely carious incisors with direct bond crowns.

Requests for reprints should be directed to Dr. Frank J. Foreman, Department of General Dentistry, Wilford Hall, USAF Medical Center, Lackland AFB, TX 78236-5300.

Clinical appearance of permanent successors after nonextraction treatment of grossly carious primary molars in highly anxious children—page 170.

After taking into account the local constraints, a treatment plan was devised to introduce children to dental procedures in gradual stages. An alternative nonextraction approach was adopted. Children between the ages of five and ten years were chosen for the acclimatization program; and 65 percent of their permanent successors to treated primary molars showed no defects.

Requests for reprints should be directed to Dr. Graham G. Craig, Department of Preventive Dentistry, University of Sydney, 2 Chalmers Street, Sydney, N.S.W. 2010, Australia.

A new feeding device for treatment of glycogen storage disease—page 176.

To facilitate nighttime management of patients with glycogen storage disease, intragastric drip infusions of concentrated solutions of either glucose or dextrins has been recommended. This paper reports a removable maxillary acrylic appliance used successfully as a feeding device.

Requests for reprints should be directed to Dr. Curt S. Ralstrom, NE Professional Bldg., 39400 Garfield Road, Mt. Clemens, MI 48044.

Double teeth with hypodontia in identical twins—page 179.

There is now considerable evidence to support the theory that heredity is the origin of this anomaly. The condition in one of the twins described here was the mirror image of the condition of the other.

Requests for reprints should be directed to Dr. Nik-Noriah Nik-Hussein, Department of Children's Dentistry, Faculty of Dentistry, University of Malaya, Kuala Lumpur 22-11, Malaysia.

Who uses the services of pediatric dentists?—page 182.

Parents and guardians reported almost 120 million dental visits in 1983 for children between two and seventeen years of age. Pediatric dentists provided nearly 19 percent of visits for two-to four-year-olds; 9 percent for children between five and eleven years; and 1.4 percent for children between twelve and seventeen years of age.

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

An evaluation of a preschool dental health program—page 186.

The ADA Preschool Curriculum provided an excellent opportunity to evaluate dental health education as it relates to very young children. Data were collected at four schools. Overwhelmingly, parents believed the program to be very valuable.

Requests for reprints should be directed to Dr. Laurna Rubinson, Department of Health and Safety Studies, University of Illinois at Urbana-Champaign, 1206 South Fourth Street, Champaign, IL 61820.

Nutrition and immunity—page 193
Part I Basic considerations
Part II Practical applications

It is now recognized that nutrition modulates immune responses and influences the incidence and severity of infectious complications. This selective review summarizes the present state of knowledge of nutrition-immunity interactions.

Reprints are not available.

Pulpal necrosis of an unknown etiology in a newly erupted premolar: report of case—page 198.

A case of pulpal necrosis of unknown etiology in a newly erupted premolar is presented. The cause of the lesion and the pulpal involvement are open to conjecture.

Requests for reprints should be directed to George M. Rakes, BS, DDS, MS, Assistant Professor, Department of Pediatric Dentistry and Orthodontics, Creighton University, Boyne School of Dentistry, California Street at 24th, Omaha, NE 68178.

Russell-Silver syndrome: microdontia and other pertinent oral findings—page 201

Oral findings included microdontia in the primary dentition, absence of second premolars, blunted condyles, decreased cranial base lengths, a hypoplastic mandible, and decreased facial height.

Requests for reprints should be directed to Dr. Claire L. Cullen, Department of Pediatric Dentistry, University of Detroit, School of Dentistry, 2985 East Jefferson Avenue, Detroit, MI 48207.

Delayed eruption associated with an odontoma—page 205

The formation of ghost-like cells complicated the diagnosis of this case. Although treatment should have begun several months earlier, active orthodontic and surgical intervention led to a satisfactory result.

Requestsfor reprints should be directed to Dr. Elliot R. Shulman, Chairman, Department of Pediatric Dentistry, USAF Medical Center Keesler AFB, MS 39534.

Multiple dental extractions in a child with Glanzmann's thrombasthenia: report of case—page 208

Patients with Glanzmann's thrombasthenia have a tendency to hemorrhage. This report shows evidence, however, that extractions in children with the disease can be accomplished without supplemental therapy.

Requests for reprints should be directed to Dr. Jean R. Jasmin, Director, Pedodontics Department, Lenval Children's Hospital, 57 Avenue de la Californie, 06200 Nice, France.

Splint therapy for electrical burns of the oral commissure in children

Burns

Richard A. Salman, DDS
Robert S. Glickman, DMD
Stuart Super, DMD

Electrical burns of the oral cavity are relatively rare occurrences.[1-3] They are most often caused when preschool age children suck or bite the free end of a "live" extension cord.[3-8] The most common site of injury is the commissure and the adjacent upper or lower lip. The electrical trauma can cause severe scarring and constriction which, if left untreated, may result in a disfiguring microstomia. A case is reported in which the fabrication of an acrylic splint helped prevent microstomia and the subsequent development of a deformity. The nature and characteristics of electrical burn injuries to the lips of children and their management are discussed.

ETIOLOGY

Electrical burns have been divided into two types, arc and contact. In an arc burn the saliva completes the circuit between the live wire and the tissues. The destruction is the result of the heat of the arc generating temperatures of 2500-3000°C.[9] In a contact burn the

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electrical current passes through the body along the path of least resistance from the point of contact to the ground or exit site. The degree of damage caused by both types of electrical burns is dependent upon the voltage, amperage, type of current, resistance of the tissues, path of current, and duration of contact.[8-10] Both arc and contact burns occurring to the mouth can be fatal.[4,6]

CLINICAL CHARACTERISTICS

Electrical burns to the commissure initially appear as a grayish-white, coagulated lesion which is outlined by a narrow rim of erythematous tissue.[11] Several hours following the injury the region becomes edematous, and the lips become protuberant. Two to four weeks following the injury the eschar sloughs leaving an ulceration.[12,13] The wound heals slowly and the delayed rate of epithelialization may result in extensive scar formation.[10] It takes up to one year for the post-burn scar to become stable.[12,14] The subsequent contracture, increased by the pull of the orbicularis oris, results in the microstomia often seen following electrical burns.

Electrical injury to the alveolar process can result in sequestration.[4,10] Dental dysplasia following an electrical burn has been reported.[15] The microstomia and the loss of function of the circumoral musculature may result in the abnormal development of the dental arches.[3,6,16] The type of malocclusion is dependent upon the site of electrical injury. In burns of the upper lip, the scar contracture results in a deficient maxillary alveolus with a decreased inclination of the maxillary incisors causing an anterior crossbite.[16] With burns of the lower lip, there commonly occur lingual inclination and crowding of the mandibular incisors. A retrognathia develops from the constant pressure of the contracted lower lip, resulting in an overbite.[3]

TREATMENT

The child with an electrical burn of the oral tissues should initially undergo a complete physical examination. The airway, though seldom compromised, must be evaluated for signs of respiratory distress. An electrocardiogram should be performed, because cardiac arrhythmias, including ventricular fibrillation, have been reported, following electrical burns of the lips.[6] Prophylactic antibiotic coverage against S. aureus and P. aeruginosa should be instituted with extensive burns.[8,17] A recommended regimen consists of intravenous penicillin G, 25,000 u/kg q6h; and oxacillin, 40 mg/kg q6h; changing to oral penicillin V, 10 mg/kg q6h; and dicloxacillin, 10 mg/kg q6h, once fluids are tolerated.[18] Tetanus prophylaxis should be administered, dependent upon the child's immunization status.[6,8,12,13,19]

Figure 1. Sixteen-month-old child who sustained an electrical burn of the right commissure, after biting through an electrical cord.

While electrical burns of the lips are usually painless, because of the destruction of sensory innervation, there is a loss of labial competency, resulting in the drooling of food and saliva. Proper nutrition must be assured for normal healing to occur. The child should be placed on a clear liquid diet, which is advanced as tolerated. A catheter-tipped bulb syringe can be used to assist feeding.[7] If oral intake is inadequate, intravenous supplementation may be necessary.

Secondary hemorrhage from the labial artery is a complication of electrical burns, caused by a weakening of the vessel wall.[9,13] Delayed hemorrhage has been reported in up to 24 percent of oral electrical burns and as long as twenty-one days after the injury.[6,7] The parents and nursing staff should be aware of the possibility of spontaneous bleeding. If bleeding occurs, it is usually controlled by direct pressure on the lip, followed by ligation, if necessary.[7,12,19]

Local wound care, consisting of gentle cleansing with a mild surgical soap, followed by irrigation with hydrogen peroxide, is necessary to remove necrotic tissue. Topical antibiotics such as mafenide acetate (Sulfamylon) controls burn-wound sepsis and allows for the adherence of the eschar to the wound.[17] Once the formation of granulation tissue has begun, the injured area should be massaged daily, to increase the blood supply and keep the tissue soft and pliable.[3,18,20] Follow-up of the child should include an ophthalmological examination, because traumatic cataracts may occur as late as two years after electrical injuries.[13]

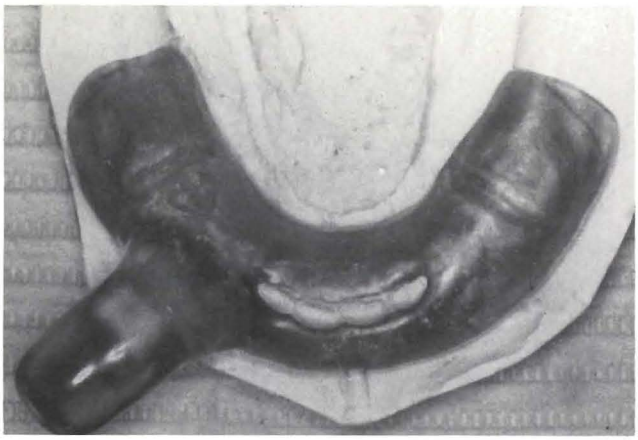

Figure 2. Mandibular acrylic splint to maintain the commissure during healing.

There is some controversy among experienced operators, regarding the timing and nature of surgical therapy. Some advocate early excision and repair.[5,12] Others prefer a conservative approach, in which surgical revision is delayed until healing has occurred and the extent of the tissue damage is known.[3,4,6,8,18] Because many burns heal with minimal deformity, if proper wound care and splint therapy are instituted, surgical intervention is often unnecessary.[2,22,23]

CASE REPORT

A sixteen-month-old boy was brought to the emergency room, forty minutes after sustaining an electrical burn of the lip from biting through an electrical cord. The child was in stable condition and there was no history of loss of consciousness. The Oral and Maxillofacial Surgery Service was consulted and examination revealed an ulcerated area 3 cm in diameter, involving the right labial commissure. Gray necrotic tissue surrounded by erythema and edema extended from the skin of the cheek through the vermilion border to the buccal mucosa (Figure 1). The remainder of the physical examination and a complete blood count were within normal limits.

The patient was admitted to the Pediatric Service and started on intravenous aqueous penicillin G, 165,000 units every four hours. Tetanus prophylaxis was omitted, because of a history of immunization. The burn was irrigated with hydrogen peroxide and normal saline and then dressed with silver sulfadiazine (Silvadene) cream, four times daily. The child was given a clear liquid diet, which was advanced, first to a full liquid, then to a regular diet, as tolerated.

Four days after sustaining the burn, the child was taken to the operating room, where maxillary and mandibular alginate impressions were obtained under general anesthesia. The child tolerated the procedure well and was discharged two days later. Amoxicillin oral suspension, 135 mg every eight hours for one week, was prescribed.

Figure 3. Splint in place.

Figure 4. One year after the injury. Excellent symmetry with minimal scarring has been achieved, without surgical reconstruction.

Following the operating room procedure, a mandibular acrylic splint was built, the wearing of which was expected to prevent scar contraction. The splint covered the mandibular arch, except for the primary dentition, and extended into the vestibule. An ovoid acrylic post extended from the arch to maintain the commissure on the injured side (Figure 2).

Two weeks after sustaining the electrical burn, the child was readmitted to the Pediatric Service and was brought to the operating room for insertion of the splint. The splint was stabilized with two circummandibular wires. The child was discharged the following day and was seen periodically in the Oral Surgery Clinic, to reinforce the importance of proper home care.

The splint was well tolerated and was worn continuously for six months (Figure 3). When the splint was removed the commissure was of good quality without contracture. The remaining scar was soft and pliable. One year after sustaining the electrical burn the child has a good functional and cosmetic result and no surgical revision is planned (Figure 4).

DISCUSSION

The prompt application of splint therapy, before the start of wound contracture, minimized postburn scarring and prevented the development of microstomia in the preceding case. In order for the splint to be effective it must be worn continuously for the first six months.[14,23-25] With removable appliances, noncompliance is common and the development of microstomia is often the result.[23,25] Removable appliances are also contraindicated in young children, because they are prone to breakage and subsequent aspiration. The unavailability of tooth structure to insure adequate preparation for construction of a fixed appliance makes the success of such an appliance difficult and uncertain.

These problems were overcome in our case by the use of a mandibular acrylic splint fixated with two circummandibular wires. The method of determining the position of the commissure post , namely by measuring the distance from the uninjured commissure to the incisal midline was previously described.[24] The splint was fabricated with sufficient relief to allow for the eruption of the primary molars. Because meticulous oral hygiene was maintained by the patient's mother, no damage to the primary dentition was noted upon removal of the splint.

Previously described splints have uniformly included the use of bilateral commissure posts, to compensate for the sphincter-like pull of the orbicularis oris,[2,12,14,22-27] The construction of splints that place active pressure against the opposing oral commissures has been reported.[22,26,27] Because these obstruct the oral cavity, they make it difficult for the patient to eat and speak. This probably explains why there have been no reports of their use in young children. Our splint was fabricated with a unilateral post to decrease the risk of pressure necrosis of the uninvolved commissure and to allow for greater comfort and better function. Excellent functional and cosmetic results were obtained with this design.

CONCLUSION

Electrical burns of the mouth in children present a difficult treatment dilemma. Proper management may involve the pediatric dentist, orthodontist, prosthodontist, and oral surgeon. The restoration of function, comfort and esthetics should be the desired goal. The fabrication of an acrylic splint to minimize the effects of contraction and the subsequent development of microstomia was described.

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Direct bonded glass ionomer crowns

Clinic

Frank J. Foreman, DDS
William D. Theobald, DDS

The restoration of severely carious primary maxillary incisors is one of the most important challenges in pediatric dentistry. The children who require restoration of these teeth are usually among our youngest and most challenging patients. Ease and speed of application, whether to save time and expense in the operating room, to maximize available sedation time, or to minimize chair time for the very young unsedated patient, are highly desirable attributes, therefore, in any restorative procedure on these teeth. Along with these attributes, the procedure should provide a restoration that is strong enough to withstand the forces of occlusion in the primary dentition, while maintaining aesthetic requirements. Another desirable attribute would be ease of repair, should the restoration fail.

Stainless steel crowns are the strongest and most durable restorations for extensively involved primary incisors.[1] This procedure is also relatively quick and not excessively sensitive to technique. In order to obtain good esthetics, however, the cutting of labial windows and the placing of composite resin facings in the stainless steel crowns are required. These procedures add greatly to the working time and require careful and skillful technique for good results.[1] A more esthetic technique

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utilizes celluloid crown forms for composite resin crowns.[2-5] This technique is reported to be less injurious to the pulp and gingiva and better retained than polycarbonate crowns.[3] These crowns are relatively simple and quickly placed and finished; and, with the newer light-cured composite resins, the color stability is excellent. The primary limitation to their use, however, is that an adequate amount of dentin and enamel is required to retain the crown.[2] In situations where there is an inadequate amount of enamel, a material is required that will bond both to dentin and enamel, will be aesthetically acceptable, will be able to withstand occlusal forces, and will not be excessively time-consuming or sensitive to technique.

Glass ionomer restorative materials have recently been shown to bond both to dentin and enamel.[6-9] Its bond strengths to both enamel and dentin, however, are considerably lower than those of the acid-etch resin technique.[9] The compressive strength of glass ionomer is about half that of microfilled composite resins and its tensile strength is about one quarter.[10,11] Also its wear resistance is significantly less than the composite resins.[12] Its surface hardness is superior, however, to that of the microfilled composite resins.[11] A distinct advantage of glass ionomer restorative materials over composite resins is its ability to leach fluoride over extended periods of time.[6,9,10,13,14]

Perhaps the greatest difficulty in the use of glass ionomer restorative materials on primary incisors has been in its placement. Most glass ionomer restorative materials require a sealed surface for at least twenty-four hours after placement before the restoration can be finished.[14,15] With the newer glass ionomer restorative material, Ketac-Fil*, however, this problem is partially overcome. This material requires only a fifteen- minute set before a final finish can be accomplished.[9]

For over a year now we have utilized this glass ionomer filling material to restore primary maxillary incisors with direct bond crowns. Our preliminary findings are that the material utilized in these techniques is aesthetically pleasing, is adaptable to a variety of clinical situations, is well retained, and wears well.

CLINICAL PROCEDURES

Two criteria were used as indications for glass ionomer crowns on primary maxillary incisors.

- ☐ Inadequate tooth structure and enamel to retain a composite resin crown.
- ☐ The parent or child desired aesthetic results superior to stainless steel crowns and were willing to risk future appointments for repair in case of fracture or loss. Some parents are not concerned with aesthetics and, therefore, prefer the stainless steel crowns because of their durability. Other factors that were taken into consideration in using this technique, but were not necessarily contraindications to its use, were excessive wear already present on the incisors and a deep overbite with minimal overjet.

The preparations were essentially identical to our technique for composite resin crowns. It is advantageous to leave as much enamel as possible and often the preparation consisted only of excavation of caries. An attempt was made to maintain the natural incisal edge, unless it was extremely undermined or there was excessive overbite.[5] Proximal slices were made only if they were required to clear the contact. If there was spacing between the incisors, an attempt was made to increase the size of the teeth to improve aesthetics. Often, with this minimal tooth preparation, only nitrous oxide sedation with no local anesthesia was required.

In contrast to the technique for composite resin crowns, in which all of the exposed dentin is covered with a base, glass ionomer crowns seldom require a base. Calcium hydroxide was applied only on the dentin within 1.5 mm of the pulp.[9,15,16] The dentin was then treated with polyacrylic acid (Duralon liquid)for ten seconds to condition the smear layer and, then, rinsed.[7,9,15,17] The glass ionomer filling material (Ketac-Fil) was then mixed as described by the manufacturer. Once placed, the glass ionomer filling material was protected from dehydration and moisture contamination by either of two methods. One method utilized celluloid crown forms as in the composite resin crown technique. The forms were left in place during the initial set, and removed fifteen minutes later. In the second method, a fabricated vacuform† stent was placed over all the involved teeth and held in place during the fifteen-minute setting time.

When utilizing the celluloid crown-form technique, one capsule of glass ionomer was adequate for one crown. The capsule of glass ionomer was activated, triturated for ten seconds, and then expressed into the ven-

*ESPE-Premier, Norristown, PA
Duralon, Premier Corp., Norristown, PA
***Pedodontic Crown Forms, Unitec Corp., Morrovia, CA
†Buffalo Dental Manufacturing Co., Inc., 575 Underhill Blvd., Syosset, NY 11791.
‡Carbide bur #7902, SS White, Philadelphia, PA
♣ Gel-Kam, Scherer Laboratories, Dallas, TX.

Figure 1a. Case 1. "Baby-Bottle Caries". Maxillary central and lateral incisors at first appointment.

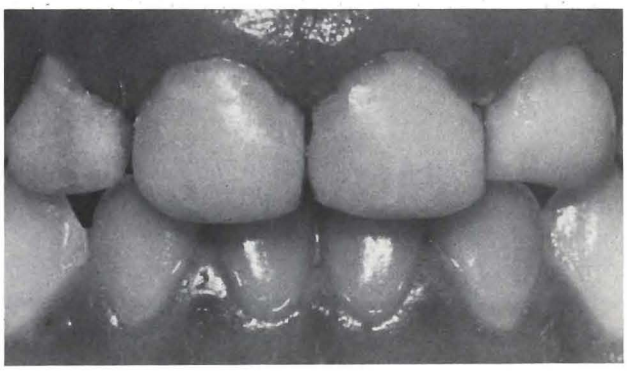

Figure 1b. Case 1. Recall appointment at fourteen months. All crowns intact.

ted crown form, which was then seated over the tooth. Excess glass ionomer was removed from the gingival margin and vents and these areas were varnished. With other glass ionomer filling materials, finishing is usually delayed for twenty- four hours. With this glass ionomer, after the initial fifteen-minute set, however, the crown form may be removed by slicing the lingual of the form with a finishing bur. Inevitably, when using a minimal preparation and enlarging the size of the tooth, there is a large shoulder of material at the cervical margin. As with composite resin crowns, this was routinely finished with a fine carbide finishing bur.‡ With glass ionomers, however, all finishing must be accomplished under a water spray.[9]

The vacuform stent technique requires a stone cast of the primary maxillary incisors. The damaged teeth were waxed to ideal contours, a duplicate stone model of the waxed teeth was obtained, and a vacuform stent was fabricated. At the operative appointment, the teeth were prepared, based with calcium hydroxide, and treated with polyacrylic acid as previously described. Four capsules of the glass ionomer filling material were mixed and expressed into the stent, which was then placed over the teeth. After fifteen minutes the stent was removed and the gross excess was finished. The patient was given another appointment and the crowns were separated and finished at that time. These techniques proved to be adaptable to a variety of clinical settings.

CASE REPORTS

Case #1

A four-year, eight-month-old girl came to our clinic requiring extensive restorative work on her primary molars. Also she had severe, but for the most part arrested, baby-bottle-caries on her maxillary incisors (Figure 1a). At that time the parent and the child indicated that they were not concerned about the aesthetic deficiencies of the carious incisors, but did not desire stainless steel crowns. An alginate impression was obtained of the maxillary incisors, therefore, and a custom fluoride tray, for daily application of two drops of 0.4 percent stannous fluoride gel,♣ was fabricated.[18] After completion of her restorative needs in the molars, which she tolerated excellently with nitrous oxide sedation, the caries on the maxillary incisors was found to be completely arrested. The patient indicated, however, that now, she would like an aesthetic restoration for the incisors. A stent was fabricated from the duplicated, waxed model and all four incisors were restored under nitrous oxide sedation with no local anesthetic. The teeth were separated and finished, two weeks after initial insertion. The crowns were evaluated again, when the patient was five years and eight months old, ten months postinsertion. One crown had been lost six weeks earlier while chewing meat, but the other crowns were intact and wearing well. A celluloid crown form was used and the lost crown was replaced, within 20 minutes, without local anesthesia or nitrous oxide sedation. At age six years, 0 months, the patient was again recalled and all crowns were intact (Figure 1b).

Case #2

A five-year, eight-month-old girl was evaluated at our clinic with very extensive, rampant caries causing difficulty in mastication. She had had a previous traumatic, emergency dental appointment, which left her a very frightened child. Her maxillary incisors displayed extensive dark, hard, eburnated dentin, with very little intact enamel (Figure 2a). The child attended kindergarten, and the mother reported that the child was ashamed of the appearance of her front teeth, which caused her to be shy and to smile rarely. With her parents' permission, this child was treated under general anesthesia. The incisors were prepared first and celluloid crown forms were used. The crown forms were left in place, while the extensive amount of restorative work on the posterior teeth was completed. The crown forms were removed after about two hours, and the crowns were then

finished. The patient was recalled at age six years, five months and all of the crowns were intact and wearing well. Her mother also reports a remarkable change in personality following the surgery. The child is now very outgoing and smiles often. The patient was recalled again at age six years, ten months (Figure 2b).

Case #3

A three-year, five-month-old girl presented to our clinic with apparent active baby-bottle-caries on the incisal and lingual surfaces of her maxillary central incisors and a lesser amount of caries on one maxillary lateral incisor (Figure 3a). Because of an emergency dental procedure, five months previously, to suture her traumatized lip, the child was now very apprehensive. After consultation with the mother, the patient was given an appointment and sedated with 1000 mg of choral hydrate and 50 mg of hydroxyzine, supplemented with nitrous oxide. The sedation was excellent and no local anesthetic was used. There was no preparation other than the removal of caries (Figure 3b). The celluloid crown form technique was used and the central incisors were restored with glass ionomer; while the lateral incisor, having an adequate amount of enamel, was restored with a small particle size, light- cured composite resin[♧] crown (Figure 3c). At a four- month recall, the glass ionomer crowns were intact and wearing well. The composite resin crown, however, had been lost. The child appeared to brux on the incisal notch of the lateral incisor from which the crown was lost. The caries was arrested and it was decided to reevaluate the tooth in six months.

DISCUSSION

This is a preliminary report of a potentially valuable restorative material and technique. The required life span of these restorations on primary incisors is from one to six years. Because of the relative lack of compressive and tensile strength, one might expect a greater degree of fracture with glass ionomer as opposed to composite resin crowns. Also because the bond strength is less, retention might be expected to be less. Since glass ionomer bonds to both dentin and enamel, the in-

Figure 2a. Case 2. "Baby-Bottle Caries", first appointment.

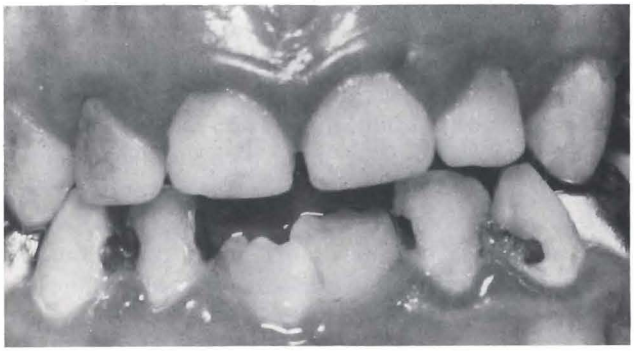

Figure 2b. Case 2. Recall appointment at fourteen months.

[♧]Prisma-Fil, L.D. Caulk, Milford, DE.

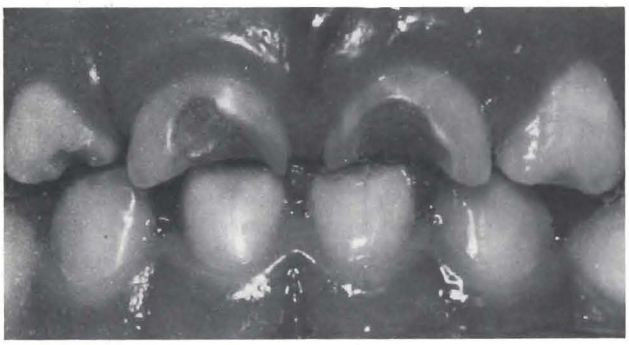

Figure 3a. Case 3. "Baby-Bottle Caries", initial appointment.

Figure 3b. Case 3. Caries removal only.

creased area of retention and the internal retention obtained from the dentin could compensate, however, for the reduced bond strength. The wear resistance also is considerably less than the light-cured composite resins and one would expect more rapid wear of the lingual surfaces. Glass ionomer crowns are not preferable to composite resin crowns, therefore, if adequate enamel is available for retention. If adequate tooth structure is lacking, however, the alternative restorations are stainless steel crowns, with their aesthetic deficiencies, or modified stainless steel crowns, with their added complexities. Like composite resin crowns, glass ionomer crowns are subject to simple repair, without discomfort to the patient, if lost or fractured. The extended fluoride release, however, is unique to the glass ionomer and should, like the silicates, prevent any recurrent caries.[13] It may also be of benefit to adjacent incisors or canines. Because of this quality, glass ionomer fillings show great potential in the restoration of Class V caries on primary canines and molars, where recurrent caries is a primary cause of restorative failure.

CONCLUSION

The glass ionomer filling materials show a great potential in restoring severely carious maxillary incisors with direct-bond crowns. The crowns are relatively quickly and easily placed and finished. If lost or fractured, they are easily repaired. After one year in function, they appear to wear well, are well retained, and remain aesthetically pleasing.

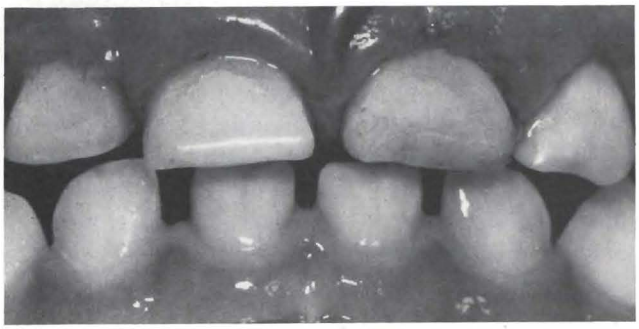

Figure 3c. Case 3. End of first appointment. Glass ionomer crowns on the maxillary central incisors, composite resin on the maxillary right lateral incisor crown.

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Clinical appearance of permanent successors after nonextraction treatment of grossly carious primary molars in highly anxious children

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Several techniques can be used to facilitate the management of the highly anxious child patient. In some cases, behavior management techniques such as desensitization, modelling or aversive conditioning may be indicated; whereas in others, a pharmacological approach may be more appropriate.[1,2] The latter may include the use of sedative or hypnotic agents, relative analgesia or general anaesthesia.

In 1978, following the introduction of a school-based dental care program in an isolated Australian community, difficulties arose in the treatment of a group of highly anxious children. Facilities did not exist for either relative analgesia or general anesthesia; nor was it practicable in a school environment to premedicate patients with hypnotic or sedative drugs. At the request of the regional health authority, an assessment of the situation was made by one of the authors (G.G.C.). From the information obtained, it was apparent that the main fear-provoking stimuli were injections. This coincided with observations made elsewhere.[3,4] In addition, there was evidence that the main form of dental treatment, before the introduction of the new service, had been the extraction of symptomatic teeth.

After taking into account the local constraints, a treatment plan was devised to introduce children to dental procedures in gradual stages. Every effort was made to eliminate injections in the first part of the acclimatization program. For example, instead of immediately placing a restoration in a carious lesion not involving the pulp, the primary molar in question was first treated by silver fluoride followed by stannous fluoride.[5] The aim of the treatment was to slow or arrest progression of the lesion. When placement of a restoration was unavoidable, cavity preparation was completed without local anesthesia using slowly rotating round burs in a reduction handpiece. To limit cutting to a minimum, a fluoride-releasing restorative material, glass ionomer cement, was used instead of amalgam.

Considerable attention was paid to the kind of treatment used for grossly carious primary molars with overt pulp exposures and little remaining tooth structure. Infection from such a source has been implicated in the occurrence of enamel defects in the subjacent permanent successors.[6-8] Another factor taken into consideration was that the premature loss of primary molars can lead to space problems in the permanent dentition.[9,10] Under normal circumstances, these grossly carious teeth would have been extracted and, where appropriate, space maintainers placed. Because of the high degree of patient anxiety and the absence of pharmacological means to control the situation, however, an alternative nonextraction approach was adopted. In an attempt to control infection, a modified

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pulpotomy technique employing a combination of antimicrobial agents was used in the treatment of teeth with relatively intact pulp chambers, while teeth with little or no remaining tooth structure were treated with metallic fluorides.

The present study was undertaken to determine the coronal condition of the permanent successors to grossly carious primary molars treated with these techniques.

MATERIALS AND METHODS

Children between the ages of five and ten years were chosen for the acclimatization program on the basis of their high level of anxiety and low level of cooperation, when attempts were made to carry out the first stages of conventional dental treatment. All selections of patients were made by dental personnel not involved in the present study.

A total of ninety-four children commenced the program in 1978; two withdrew at baseline and twenty-one moved from the study area, however, in the first twelve months following the closure of a major local industry. All children were residents of Bourke, an isolated community in western New South Wales, Australia, where the water supply contains less than 0.2 ppm fluoride. Before each child entered the program, the appropriate details were given to the parents and their written consent obtained. Medical histories of the children showed that none had any condition that would preclude participation in the study. As far as it could be determined none of the children had received fluoride supplements.

Despite some initial behavioral difficulties with a few children it was possible to obtain all the required clinical records (bite-wing radiographs, intraoral photographs and wax impressions of the teeth) before treatment commenced. Details of the materials and techniques used to obtain these records have been published previously.[5] In situations where advanced periapical morbidity was suspected, periapical radiographs were made as soon as patient cooperation could be obtained.

At no stage of the program was any form of physical restraint used to administer treatment.

In the course of the six-year study, a number of grossly carious molars with overt pulp exposures were encountered. In the teeth with relatively intact pulp chambers, a modified pulpotomy procedure was used. The site was isolated with cotton rolls and, working without local anesthesia, carious dentin and necrotic pulp tissue were removed with sharp excavators. As much necrotic material as possible was removed from the pulp chamber via the exposure site. If vital tissue was encountered, it was retained and the roof of the pulp chamber overlying the necrotic portion was removed, using round burs rotating slowly in an 8 to 1 reduction handpiece (W & H 808). A mixture (1:1 by volume) of Kri 1 paste (Pharmachemie) and Ledermix paste (Lederle) was placed in the pulp chamber, covered with a pellet of cotton wool and sealed in with IRM (Caulk). At a subsequent visit the IRM and cotton pellet were removed and, if necessary, more Kri 1 Paste/Ledermix paste added. Following the placement of a fast-setting zinc oxide-eugenol base the cavity was restored with glass ionomer cement.†

In no instance was any attempt made to ream and file the root canals; an effort, however, was made to work some of the Kri 1 paste/Ledermix paste down the canals using the point of a fine probe. Occasionally two dressings with Kri 1 paste/Ledermix paste were required to resolve a chronic alveolar abscess.

Grossly carious molars with little or no remaining coronal tooth structure received a sixty-second application of a 40 percent AgF solution (Creighton) followed by a spot application of 10 percent SnF_2 paste (Creighton). The excess material was removed with cotton pellets. During the application of AgF, some of the solution was worked into the canals with the point of a fine probe.

The permanent successors to these teeth, as well as other primary molars, were examined for enamel defects, when they reached the occlusal plane. All children in the program with recently erupted premolars were included in the inspections. The examiner who carried out this aspect of the study was unaware of the caries status of the primary precursors. Inspections were carried out under standardized lighting conditions, after the teeth had been cleaned with a toothbrush, isolated with cotton rolls and dried.

Reexamination of eighty-seven newly erupted premolars in twenty children selected at random showed a reproducibility ratio of 0.76. Where differences existed between the first and second examinations, the defects in question were invariably small demarcated opacities approximately 1 mm or less in diameter.

RESULTS

Of the ninety-four children in the study, thirty-nine (40 percent) had one or more carious primary molars in which lesions had reached the stage where a modified pulpotomy or metallic fluoride treatment was required. During the six-year program, thirty-one teeth were treated with a modified pulpotomy and fifty-three teeth, which had little or no coronal tooth structure remaining, were treated with metallic fluorides.

† Aspa (De Trey) was used initially but was replaced by Fuji II (GC) as soon as that product became available.

Table 1 ☐ Coronal condition of permanent successors to grossly carious primary molars in modified pulpotomy and metallic fluoride treatment groups (22 children).

Coronal condition of permanent teeth	No. of teeth	Treatment of primary precursors			
		Modified pulpotomy		Metallic fluorides	
		Upper arch	Lower arch	Upper arch	Lower arch
Nil defects	32	8	10	2	12
Opacity – demarcated					
Single (white) <2mm diam	7	1	1	3	2
Single (brown) <2mm diam	1	0	0	0	1
Both of above	1	0	0	0	1
Single (white) >2 mm diam	2	0	0	1	1
Multiple (white) <2mm diam	2	0	0	1	1
Opacity-diffuse	1	0	0	0	1
Hypoplasia					
Shallow enamel depression	1	0	1	0	0
Hypoplasia + Opacity					
Pin-point pits + single (white) demarcated opacity <2mm diam	2	0	0	1	1
Total	49	9	12	8	20

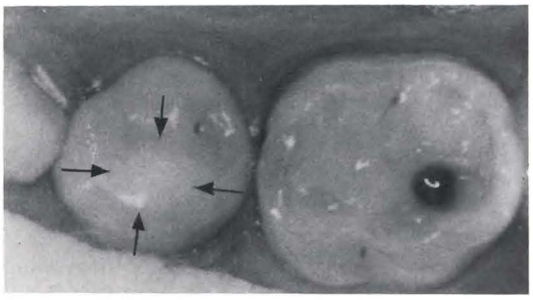

Figure 1. Photograph of the tooth with the severest opacity (arrow) seen in the permanent successors to grossly carious primary molars.

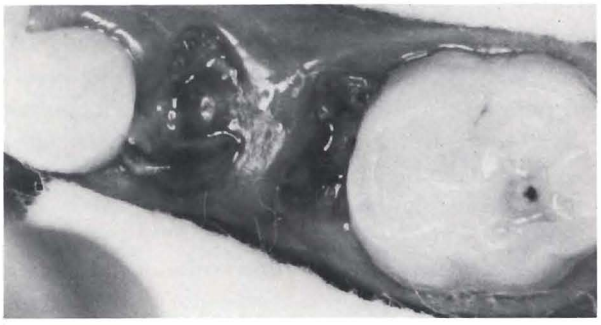

Figure 2. Pretreatment photograph of the primary precursor to the premolar shown in Figure 1. The tooth was treated with metallic fluorides.

Figure 3. Pretreatment bite-wing radiograph of the grossly carious primary molar shown in Figure 2.

As a result of children leaving the study school before the treated teeth had exfoliated and been replaced by permanent successors, ten teeth were lost from the modified pulpotomy group and thirteen teeth from the metallic fluoride group. An additional two teeth were lost from the metallic fluoride group as a result of extraction. The extractions were done by persons not involved in the present investigation. Although fully erupted, ten of the permanent successors to primary teeth treated with metallic fluorides had to be excluded from the study, because the four children involved were unavailable at the time of the clinical assessment for enamel defects.

In Table 1 are data on the coronal condition of the permanent successors to the remaining twenty-one primary molars treated with a modified pulpotomy and the remaining twenty-eight molars treated with metallic fluorides. No enamel defects were apparent in eighteen (86 percent) of the succedaneous teeth from the modified pulpotomy group and in fourteen (50 percent) of those from the metallic fluoride group. Opacities accounted for two of the three defects in the succedaneous teeth from the modified pulpotomy group and for twelve of the fourteen defects in the succedaneous teeth from the metallic fluoride group. The hypoplastic defects consisted of a shallow enamel depression in a succedaneous tooth from the modified pulpotomy group and pin-point pits in two teeth from the metallic fluoride group.

Photographs of the tooth with the severest opacity and the tooth with the severest hypoplastic defect are presented in Figures 1 and 4, respectively. Shown in Figures 2, 3, 5 and 6 are photographs and bite-wing radiographs of the primary precursors at the beginning of treatment. The radiographs taken at the beginning of treatment each show a radiolucent area in the furcation region of the treated tooth. Although the areas covered by the bite-wing radiographs were insufficient to allow

Table 2 ☐ Comparison of the coronal condition of seventeen contralateral pairs of premolar teeth (10 children) in which one of the primary precursors had been free of deep lesions (control) and the other treated with a modified pulpotomy or metallic fluorides (test).

Treatment	No. of pairs	Enamel defects test side versus control side	
		No difference	Difference
Modified pulpotomy	7	7	0
Metallic fluorides	10	4	6*

*Defects test side = 6; defects control side = 0. Difference between test and control significant at 0.05 level ($x^2 = 4.16$; df = 1: McNewars Test[11])

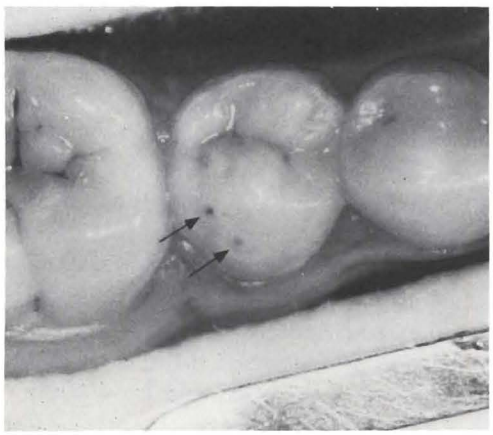

Figure 4. Photograph of the tooth with the severest hypoplastic defect seen in the permanent successors to grossly carious primary molars. The defect consists of two pin-point pits (arrow).

Figure 5. Pretreatment photograph of the primary precursor of the tooth with the hypoplastic defect illustrated in Figure 4. The tooth was treated with metallic fluorides.

Figure 6. Pretreatment bite-wing radiograph of the grossly carious primary molar shown in Figure 5.

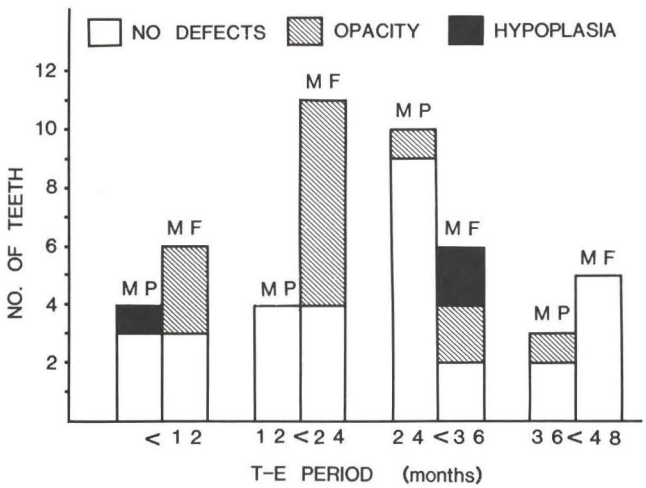

Figure 7. Distribution of enamel defects in permanent successors in relation to the period from initial treatment to exfoliation (T-E period) for the primary precursors. (MP = modified pulpotomy; MF = metallic fluorides).

examination of the furcation region of most of the upper primary molars, bite-wing radiographs of eighteen of the twenty lower molars treated with metallic fluorides showed such radiolucent areas. The permanent successors to ten of these eighteen teeth were free of enamel defects. Of the twelve lower molars treated with a modified pulpotomy, seven had a radiolucent area in the furcation region. The permanent successors to six of these seven teeth were free of enamel defects. In none of the instances where periapical radiographs were taken, because advanced periapical morbidity was suspected, was there any evidence of such having occurred.

No relationship was apparent between the distribution of enamel defects in the permanent successors and the length of the initial treatment to exfoliation period for the primary precursors (Figure 7).

The caries experience of the children was such that only seventeen of the forty-nine grossly carious molars had a contralateral counterpart that was free of deep lesions. A comparison of the coronal condition of the permanent successors to these seventeen teeth (test side) and their contralateral counterparts (control side) is presented in Table 2. In the modified pulpotomy group, there were no enamel defects on either the test or control sides. In the metallic fluoride group, however, the teeth on the test side had a significantly higher

number of defects ($P<0.05$) than their counterparts on the control side. In both the modified pulpotomy and metallic fluoride groups, the teeth on the test side erupted six to twelve months earlier than their contralateral counterparts.

Except for two teeth from the metallic fluoride group, which were extracted by persons not involved in this study, none of the primary molars in either the modified pulpotomy or metallic fluoride group had to be extracted prematurely. Nonetheless, it was necessary to extract retained root fragments of four primary molars in the metallic fluoride group after the permanent successors had begun to erupt. The retained roots were causing a deflection in the eruption path of the permanent tooth.

DISCUSSION

The constraints produced by the high level of anxiety of the children and the inability to use pharmacological agents to help control the situation, markedly reduced the treatment options for grossly carious primary molars. In essence, the treatments had to be simple, of short duration, and not require the use of injections, which were a major source of the children's apprehension.

It is not known whether the form of treatment chosen modified any untoward effects on the permanent successors because of the retention of the grossly carious primary molars. Nonetheless, no association was evident between the presence of teeth treated with the modified pulpotomy technique and enamel defects in the permanent successors. Possibly as a reflection of their greater degree of carious destruction, however, there was an association between the presence of carious primary molars treated with metallic fluorides and enamel defects in the succedaneous teeth. Although these primary teeth were basically little more than carious root stumps, there were surprisingly few hypoplastic defects in the permanent successors and defects that were present were of a minor nature. In this respect, it is of interest that Niswander and Sujaku found a relationship between retained primary tooth fragments and opacities in the succedaneous teeth, but no relationship between the retained fragments and hypoplastic defects in the permanent successors.[12]

Because of the absence of adequate prestudy dental histories, it was not possible to ascertain how many of the grossly carious primary molars were symptomatic at some stage during their breakdown; nor was it known for how long these teeth had been in an advanced stage of destruction. Some indication of the spread of infection from these teeth was obtained from the bite-wing radiographs taken at baseline. The behavior problems encountered were such that it was not possible to take periapical radiographs of each of the affected teeth at that stage of the program. Periapical radiographs were only taken, when advanced periapical morbidity was suspected. Nonetheless, the details of the furcation region of the primary mandibular molars, as distinct from the primary maxillary molars, that were obtained from bite-wing radiographs were sufficient to show that approximately half the mandibular molars treated with a modified pulpotomy and almost all those treated with metallic fluorides had some bone loss. Brook and Winter have suggested that the degree of irreversible damage to a succedaneous tooth from a diseased primary precursor can be influenced by:

- ☐ The stage of development of the permanent tooth.
- ☐ The virulence of the organisms present.
- ☐ The resistance of the host.
- ☐ The duration of the infection.[8]

Whatever factors operated in this study, the end result of any spread of infection was not sufficient to cause problems of cosmetic or reparative significance in the succedaneous teeth.

The choice of medicaments for the modified pulpotomy technique was empirical. Kri 1 paste, which contains iodoform, parachlorophenol, camphor and menthol, has been used as a resorbable endodontic paste since 1928.[13] Details of its use in endodontic therapy for primary molars were stated by Rifkin.[14,15] The other medicament used in the modified pulpotomy technique, Ledermix paste, is a tetracycline-corticosteroid compound, which has been used as a dressing for carious pulp exposures, including exposures in teeth with a history of painful pulpitis.[16] Before this study, the authors utilized the antimicrobial and antiinflammatory properties of the Kri 1 paste-Ledermix paste combination to provide an interim dressing for primary molars with carious pulp exposures that were scheduled for root canal therapy. It was learned that the teeth invariably remained free of symptoms, even when there was a protracted period between the placement of the dressing and the start of root canal treatment. In the present investigation, the combination of the medicaments was found particularly useful in teeth where vital tissue remnants were encountered within a pulp chamber. Instead of being removed, as would have been the case, if local anesthesia had been employed, the remnants were covered with the two-paste mixture. None of the teeth treated with a modified pulpotomy became symp-

tomatic or required further pulp therapy, after the initial course of treatment.

The treatment of carious primary molars that were little more than root stumps was limited by the inability to place a retainable dressing. The kind of treatment used was selected because of the antimicrobial properties of the two agents, silver fluoride and stannous fluoride.[17,18] Another factor was that this combination of agents was also being used in the program to treat carious enamel and dentin lesions in primary molars, in an attempt to arrest or slow their progress.[5] Despite their advanced stage of tooth loss, virtually all the teeth treated with metallic fluorides remained free of symptoms during the investigation. If discomfort did occur, it was usually due to an excessive mobility of the tooth during chewing and could be relieved by smoothing off any projecting tooth structure to the level of the gingival margin. It is not known whether the two teeth from this group that were extracted by persons not involved in the investigation were symptomatic or not. It was necessary to remove retained root fragments of four teeth treated with metallic fluorides, after the succedaneous teeth began to erupt. The fragments were not causing pain, but were producing a deflection in the eruption path of these teeth.

By the time these extractions were required, the cooperation of the children involved had improved to the point where there was no obvious resistance to the use of a local anesthetic. Although no quantitative monitoring of anxiety levels was made, it was the opinion of the authors that a general improvement occurred approximately eighteen months after the commencement of the program. By that stage, the children had had three six-month-recall visits, in which some form of treatment had been used, but no injections had been given.

If the children in this study are representative of larger population groups, it raises the question as to the criteria for the extraction of grossly carious primary molars at a stage when the calcification of the crowns of the permanent successors is likely to be well advanced. Under such circumstances the treatment and retention of "poor prognosis" primary molars may pose little additional risk to the integrity of the enamel surface of the permanent successors. Furthermore, in situations such as the one encountered in this study, the minimization of extractions of grossly carious primary molars, especially in the early stages of treatment, could greatly facilitate patient acclimatization to dental procedures.

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A new feeding device for treatment of glycogen storage disease

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Successful management of type I glycogen storage disease (Van Gierke's) requires frequent feeding of glucose or starchy foods without galactose or fructose to prevent hypoglycemia, ketotic acidosis and elevation of triglycerides, lactate and uric acid. Few patients can tolerate an interval between feedings longer than three hours. To facilitate nighttime management of these patients, intragastric drip infusion of concentrated solutions of either glucose or dextrins (Karo syrup) has been recommended.[1-5]

Since many patients do not readily accept the nightly introduction of a nasogastric feeding tube, LaVelle and Rhead proposed a method for continuous intraoral feeding with an oral feeding device.[6] This device consists of a 5 mm tube, which is permanently attached to a stainless steel orthodontic band on a maxillary molar tooth. A standard polyethylene feeding tube is threaded into the tube at night. A 50 percent glucose solution is delivered by pump and drips from the posterior end of the feeding tube. Since the drip is very slow, aspiration is not expected to pose a problem. We selected a mutual patient (J.W.) of the authors and treated him, using the orthodontic band technique of Lavelle and Rheads.[6] Several drawbacks were noted:

- ☐ The polyethylene tubing did not fit tight in the metal tube and was frequently dislodged.
- ☐ The pooling of glucose caused in T.T. a higher incidence of caries than experienced before the use of this device.
- ☐ Finally, the solution pooled in the lateral aspect of the oral cavity and frequently ran out. The parents of T.T. increased the drip, therefore, with the result that the amount of fluid delivered was intermittently greater than necessary and the patient showed a sudden gain in weight.

Because of these drawbacks, a removable maxillary acrylic appliance was developed, which promised to correct these deficiencies. It is the purpose of this paper to describe the feeding device, report on its successful use over several years in the patient (J.W.), who had previously rejected the other device; and discuss briefly the risk of complications, countermeasures, and possible uses in other disorders.

THE ORAL FEEDING DEVICE

An accurate impression of the child's maxillary arch was obtained, using a quick setting alginate, which was poured in stone and separated. A modified Hawley type appliance was designed and constructed on the model

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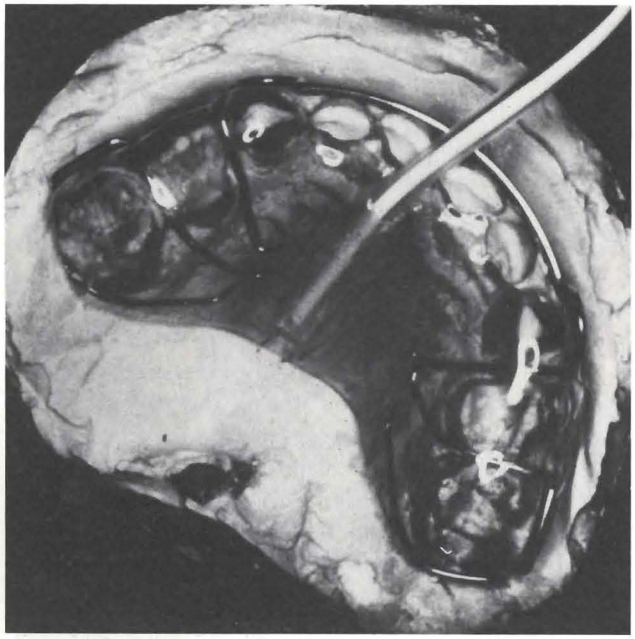

Figure 1. Completed appliance on stone cast. Note occlusal coverage of posterior teeth, tube positioned within the duct, and the posterior limit of the appliance.

(Figure 1). A passive labial wire, which contacted the incisors at the apical third level, was constructed, to prevent the labial displacement of the incisors and improve retention, using 0.030 inch stainless steel round wire. The palatal acrylic was extended over the occlusal surfaces of all posterior teeth, past the lateral occlusal margin until a slight undercut of the buccal surface of these teeth was engaged. The amount of acrylic thus added to the occlusal surfaces of the maxillary posterior teeth was just enough to allow patency of the feeding tube, when the patient bites on his anterior teeth. The acrylic on the occlusal surfaces was "ground in", using articulating paper so that all the mandibular teeth contacted simultaneously and in an unrestricted manner. The resultant occlusal vertical dimension, with the appliance in place, was 1.5 to 2 mm less than the postural resting vertical dimension. The posterior portion of the appliance was U-shaped and ended at the midpalatal area. Because of the inherent design of the appliance, there was not need for a posterior palatal seal. The acrylic portion was fabricated by waxing, flasking, boiling out and curing under pressure. This technique was chosen over the endothermic type, because it produces less distortion and porosity, and decreases the chance of breakage. A polyethylene feeding tube was waxed into the palatal portion and ended at the posterior margin of

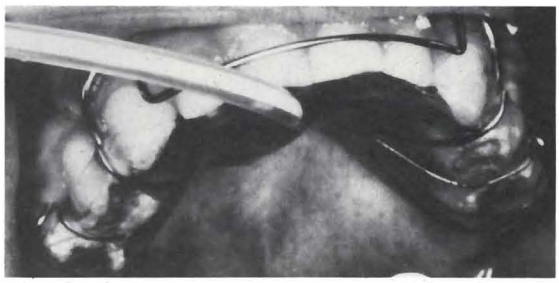

Figure 2. Appliance positioned on the oral cavity of the patient.

the appliance. The oral surface was highly polished, while the palatal surface was left in this natural state.

THE PATIENT (J.W.)

Our patient was a five-year-old boy at the time the removable acrylic oral prosthesis was tried, following unsuccessful use of the orthodontic band.[6] His early clinical course, which was typical of type I glycogen storage disease, led at nine months to the demonstration of glucose-6-phosphatase deficiency in a liver biopsy. He was managed by feeding carbohydrates every two to three hours during the day, and three to four hours at night. His growth was normal: height, 10th percentile; and weight, 50th percentile. Repeated monitoring, four hours after a standard noontime meal, showed, as expected, low blood sugar (25-35 mg/dl), a ph of 7.3, high lactate (102 mg/dl), and pyruvate (4.2 mg/dl). He was normoglycemic, two to three hours after a meal. Despite adherence to a frequent feeding schedule, he developed progressive hypertriglyceridemia, gradually rising from 310 at eighteen months to 2160 mg/dl at five years. The patient was placed, therefore, on continuous drip infusion of 0.5 gm glucose/kg/hr, equivalent to 20 ml of 50 percent glucose/hr. This was delivered through the oral feeding device by a "Kangaroo Infusion Pump". The patient is consistently retaining the drip infusion and making occasional swallowing movements during sleep. Serum triglyceride, measured as before, four hours after the noontime meal, decreased markedly, to 800 mg/dl after four months and 386 mg/dl after ten months on the regimen. Serum urate also decreased from 12.2 to 9.6 mg/dl; and the liver is notably smaller, a finding that is typical of improved glucose hemostasis in glycogen storage disease. Blood sugar, measured immediately after discontinuation of the oral drip infusion, was consistently normal. Linear growth proceeded along the 5th percentile (NCHS growth chart) since the

first year of life, when he was first seen by us. In the two years since institution of nightly oral drip feeding, he has reached the 25th percentile for height, while weight remained constant in the 50th percentile. He is well-adjusted and performs above average in school. He had two dental cavities in two years of observation.

DISCUSSION

The appliance recommended in this report corrects several of the drawbacks previously noted with another device.[6] Of major importance is the fact that only rarely is any of the fluid lost, thus preventing pooling of the fluid around the teeth and decreasing the danger of dental caries. The patient (J.W.) had no caries at five years of age and developed over the two years that the appliance was used only two carious lesions. The parents were instructed to brush the teeth immediately before placement of the appliance at night and after removal in the morning. Fluoride mouth rinses were also recommended.

J.W. has always been cooperative in the management of the disease, which may have aided him to accept this new intraoral feeding appliance. Further observations in patients of different ages are necessary to evaluate the applicability of the device and it's drawbacks. Unfortunately, we did not have the opportunity to try it in another patient. J.W. rejected insertion of the nightly intragastric feeding tube and wanted to continue on three-hourly feedings. We were encouraged by the parents to experiment with an intraoral device and modify the orthodontic band described by LaVelle and Rhead, especially since the arrival of a sibling made it difficult for the parents to get up every three hours at night. We searched the literature for other devices, but found none. We believe that our modified appliance is a definite improvement for the reasons stated above and offers another treatment option for glycogen storage disease. The prosthesis may also prove useful for cachectic adults on home feeding programs. Older patients who already have a dental prosthesis would require only a minor addition to the dental plate.

Treatment should be individualized, especially in patients with glycogen storage diseases other than type I, who may not require continuous nighttime feeding. Among the treatment options available is the feeding of uncooked corn starch, recently introduced by Sidbury.[7] On this regimen, patients may maintain adequate blood sugar levels for six hours. Both our patients (J.W. and T.T., the twelve-year-old boy mentioned in the introduction) were offered this option. J.W. rejected it, because he required cornstarch every four to five hours and thus would have to get up twice during the night. By contrast, T.T. maintains on cornstarch feedings normal glucose levels for six hours during the day and often longer during sleep. He refused a trial with another oral feeding device, which he blames for his obesity. He is currently maintained on one nightly starch feeding, which we suspect may not be taken regularly. This limited patient example demonstrates the need for different treatment approaches and we offer the oral feeding device as one option. It may prove to be even more useful in the care of cachectic adults than in the care of children with glycogen disease, in whom uncooked starch feedings should be tried first.

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Double teeth with hypodontia in identical twins

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Aida H. Salcedo, DMD

Double teeth, hypodontia and supernumerary teeth are terms ascribed to conditions that occur with some frequency in the mouths of children

Double teeth is a term used to describe joined teeth. Other terms that are frequently used to describe this condition include fusion and gemination. Fusion of teeth arises through the union of two separate tooth germs.[1] Gemination arises from an attempt of a single tooth bud to divide at the time of the initial crown development.[1] Kelly described several clinical and radiographic criteria to distinguish between fusion and gemination.[2] In clinical practice, however, it is sometimes difficult to differentiate between these terms. The term *double tooth* is, therefore, the more appropriate one to use.

Hypodontia is a term used to describe the congenital absence of one or more teeth in the dentition.

The term *supernumerary* is used to describe any tooth or structure formed from a tooth germ, in excess of the usual number for a given region of the dental arch.[3]

These anomalies are frequently encountered in different individuals and it is rare to see them together in an otherwise physically normal child.

The following report describes an interesting finding of double teeth and hypodontia in identical twins. In addition, one of the twins (T.R.) also has a supernumerary tooth that is fused to the central incisor.

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REPORT

Twin A

T.R., a 3.5-year-old Filipino male was brought for dental examination to the Dental Faculty, University of Malaya. Two weeks before the dental visit, the patient was given an antibiotic by a general practitioner for swelling of the upper right side of the face. When the facial swelling subsided, the patient's mother noticed pus draining through the gum in the area of the right maxillary anterior teeth. This prompted her to bring the child for dental examination. The mother also said that the patient had a twin brother. There was no history of dental anomalies in the family.

Clinical examination revealed the presence of a double tooth in the upper right anterior region, involving the right primary maxillary central incisor and a supernumerary tooth (Figure 1). Caries was evident in the labial vertical groove of the double tooth. The component of the double tooth located closest to the midline was discolored and nonvital.

The left primary mandibular lateral incisor was not evident clinically. The radiograph (Figure 2) confirmed that this tooth was missing. There was also no radiographic evidence of the left mandibular permanent lateral incisor. The developing maxillary right permanent lateral incisor appeared much smaller than its antimere.

The double tooth had a double crown with separate

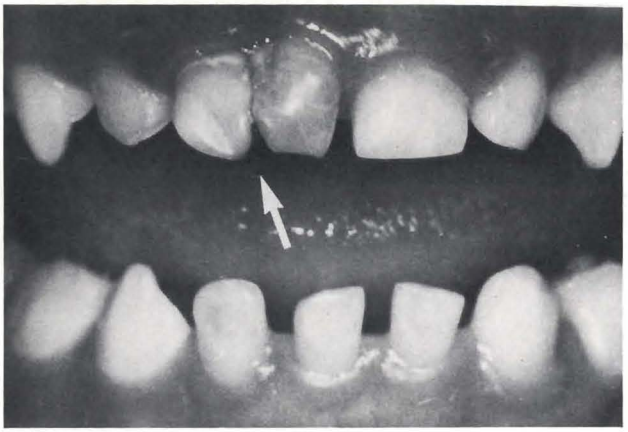

Figure 1. Double teeth in Twin A; a supernumerary tooth and the maxillary right primary central incisor are fused. Note that the mandibular left primary lateral incisor is missing.

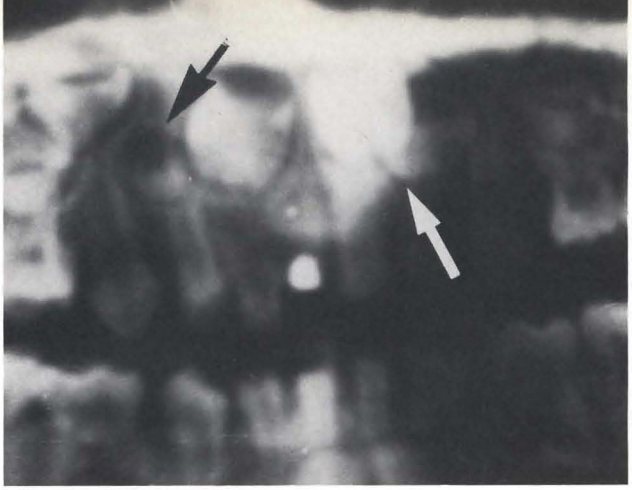

Figure 2. The mandibular left primary and permanent lateral incisors are missing. The developing maxillary right permanent lateral incisor appears smaller than its antimere.

pulp canals and pulp chambers (Figure 3). Treatment included a pulpectomy for the discolored nonvital mesial component of the double tooth and an acid-etched, filled- composite restoration.

Twin B

L.R. is the monozygotic twin brother of T.R. Oral examination revealed the presence of two double teeth, one in the maxilla and the other in the mandible (Figure 4). The left primary central incisor and primary left lateral incisor were joined in the maxillary arch and the left primary lateral incisor and left primary canine were joined in the mandibular arch.

The mandibular right primary lateral incisor was not evident clinically. The radiograph (Figure 5) confirmed that this tooth was missing. There was also no radiographic evidence of the maxillary right permanent lateral incisor and the mandibular permanent lateral incisors. Each of the double teeth had two separate pulp chambers and pulp canals (Figures 6 and 7).

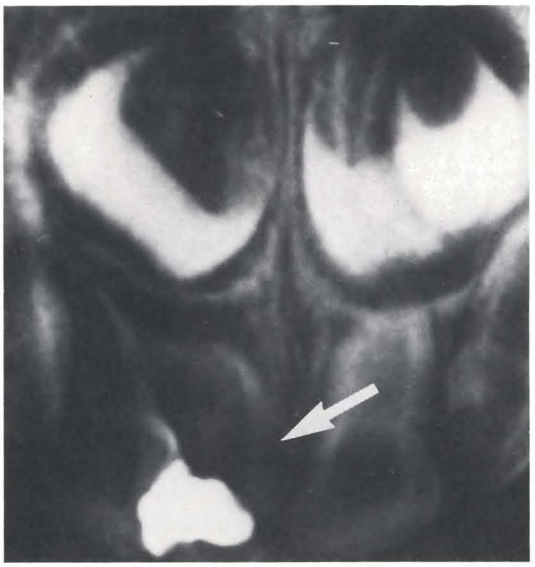

Figure 3. Periapical radiograph of a double tooth, showing separate pulp canals and chambers.

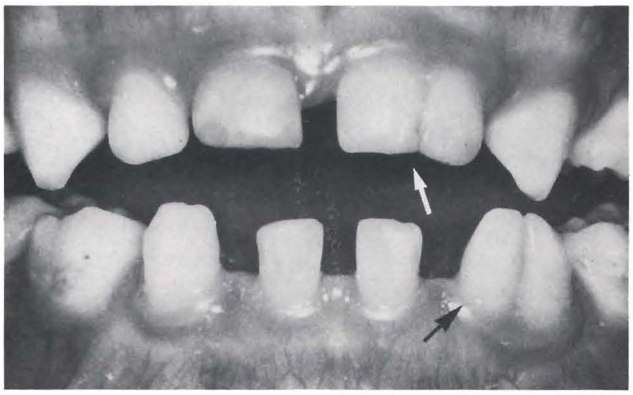

Figure 4. Double teeth in Twin B. The maxillary left primary central and lateral incisors are fused; and the mandibular left primary lateral incisor and canine are fused. Note that the mandibular right primary lateral incisor is missing.

DISCUSSION

There is now considerable evidence to support the theory that heredity is the origin of this anomaly. Because the anomaly appeared to be evenly distributed among widely scattered racial groups, Brook and Winter felt that if the condition is of genetic origin, it is probably either autosomal recessive or dominant with very little penetrance.[4] A familial distribution of this anomaly was reported by Tratman, Levitas, and Curzon and Curzon.[5-7] Grahnen and Granath described a family in which two female twin siblings presented with double teeth.[8] Since the patients described in this report are identical twins, it was not surprising to note that the anomalies found in the patients were almost identical. The anomalies were found to be, however, on opposite sides of the jaws. Mensing also described a case of identical twins where fused teeth were found to be mirror images.[9]

Other than the fusion, each of the twins has another dental anomaly, hypodontia of the primary and permanent dentitions. The missing tooth in the primary dentition was the mandibular lateral incisor: the condition in

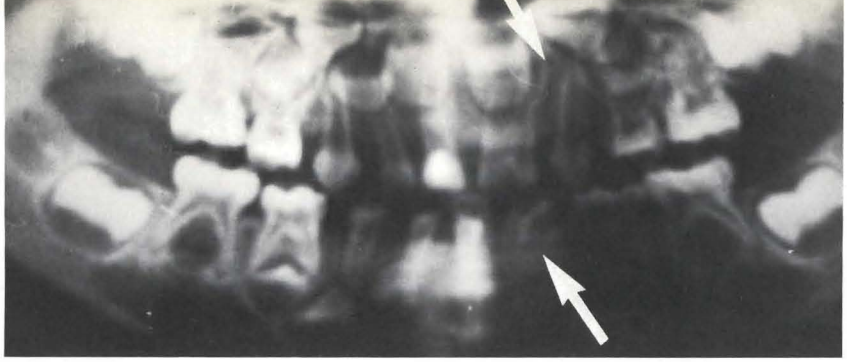

Figure 5. There is no radiographic evidence of the mandibular permanent lateral incisors, or of the mandibular primary right lateral incisor.

one member of the twin was the mirror image of the condition in the other member.

In studying radiographs of the succedaneous teeth, it was reported that the presence of primary double teeth could affect the number of teeth in the permanent dentition. There is a wide variation in the proportions of patients who presented with hypodontia of the permanent dentition, in instances where primary double teeth had been present. Approximately two thirds of Munro's patients, a third of Grahnen and Granath's, and a third of Ravn's patients presented with hypodontia of the permanent dentition, in instances where primary double teeth had occurred. In these cases, absence of the permanent successor was noted in the two instances where fusion occurred between the teeth of a normal series. The permanent successor was present when fusion occurred between a supernumerary tooth and a tooth of a normal series.

Both children also had a permanent lateral incisor missing in the mandibular quadrant where a primary double tooth was not detected. Again, the missing teeth were on opposite sides of the jaws. Although a primary double tooth could occur in conjunction with the absence of a permanent successor and the contralateral tooth, only one member of the twin (L.R.) has a mandibular primary double tooth.[12] It is likely, therefore, that the missing permanent lateral incisor in L.R. and the missing permanent lateral incisor in T.R. were not due directly to the presence of primary double teeth, but rather that they were related to the absence of the mandibular primary lateral incisors.

The discolored mesial component of the double tooth in T.R. was probably due to caries that occurred in the line of fusion of the crowns. Extensive progression of the caries resulted in pulpal death. Since the pulp chambers and canals of this double tooth were separate, pulp death of the mesial component would not affect the distal component, which remained normal. Hence pulp treatment was limited to the discolored mesial component.

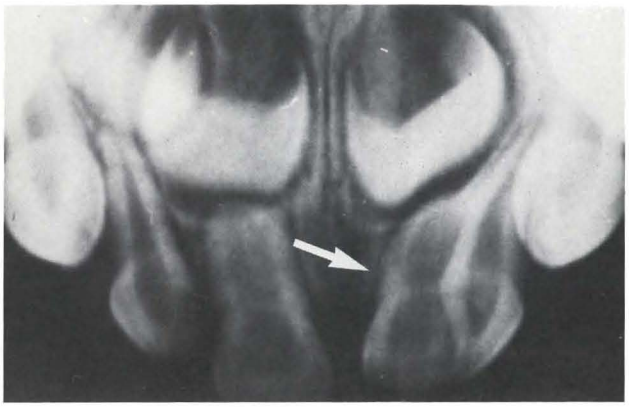

Figure 6. Periapical radiograph of fused maxillary left primary central and lateral incisors.

Figure 7. Periapical radiograph of fused mandibular left primary lateral incisor and canine.

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Dental services

Who uses the services of pediatric dentists?

H. BARRY WALDMAN, DDS, MPH, PhD

Data are now available from the 1983 National Health Interview Survey which permit an analysis of the use of dental services by children; specifically, in terms of the types of specialists and general practitioner providers, and differences in use patterns for the various types of services by gender, race and family income.[1,2] The following presentation will summarize the data of most interest to pediatric practitioners.

NUMBER OF DENTAL VISITS

By age

Parents and guardians reported almost 120 million dental visits in 1983 for children between two and seventeen years of age. Pediatric dentists provided almost 19 percent of the visits for children between two and four years of age and approximately 9 percent for children between five and eleven years; 1.4 percent for children between twelve and seventeen years of age (Table 1).

It should be noted that the designation of a specialty visit is set forth by the respondent and does not necessarily conform to the classifications established by the dental profession. In addition, some services provided by one specialty category possibly should be classified under another specialty category. For example, orthodontic service visits provided by a pediatric dentist may have been attributed to an orthodontist.

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Table 1 ☐ Number of dental visits by type of practice and patient-age: 1983.[1,2]

	Age		
	2-4 years	5-11 years	12-17 years
	thousands		
Pediatric dentists	1,350	4,338	872*
(Percent of total visits)	(18.8%)	(9.2%)	(1.4%)
Orthodontists	50*	7,949	26,056
Other specialists	195	886	3,477
General practitioners	5,571	34,095	32,957
Total visits	7,166	47,268	63,362

*Figure does not meet standards of reliability or precision.

It should be noted that in a number of instances the data reported in the National Health Interview Survey have relative standard errors in excess of 30 percent and, therefore, should be used with extreme care.

The relative standard error of an estimate is obtained by dividing the standard error (i.e. primarily a measure of sampling variation) by the estimate itself and is expressed as a percent of the estimate.[2]

Table 2 ☐ Number of dental visits to pediatric dentists by age and gender: 1983.[2]

Age	Male	Female	Total
	thousands		
2-4 yrs	596*	753*	1,350
5-11 yrs	1,839	2,499	4,338
12-17 yrs	358	514*	872*
18+ yrs		54*	54*
Total	2,793	3,820	6,613

*Figure does not meet standards of reliability or precision.

Table 3 ☐ Number of dental visits and visits per person to pediatric dentists by age and race: 1983.[2]

Age	White		Black	
	Number in thousands	Visits per person	Number in thousands	Visits per person
2-4 yrs	1,291	.15	59*	.03
5-11 yrs	3,773	.20	497*	.15
12-17 yrs	872	.05	na	—
18+ yrs	54*	—	na	—
Total	5,990		556	

*Figure does not meet standards of reliability or precision.

Table 4 ☐ Number of dental visits per person to pediatric dentists by age and family income: 1983.[2]

	Age			
Family income	2-4 years	5-11 years	12-17 years	Total
Under $10,000	.02	.20	—	.13
$10,000 to $19,999	.10	.09	.02	.07
$20,000 to $34,999	.21	.23	.04	.15
$35,000 and over	.19	.33	.08	.19
Unknown	.05	—	.01	.03

Table 5 ☐ Type of dental services provided per 100 dental visits, by age and gender: 1983.[2]

	Age					
	2-4 years		5-11 years		12-17 years	
Service	Male	Female	Male	Female	Male	Female
Examination	73.5	77.1	48.9	48.6	37.4	33.3
Cleaning	40.2	54.9	41.8	40.6	25.4	24.3
X-ray	19.2*	27.6*	31.3	27.5	20.7	22.6
Filling	16.3*	14.6*	20.9	18.4	15.1	16.4
Straightening	0.0*	0.0*	12.9	17.1	38.4	43.3
Crown/Cap	4.2*	1.4*	2.9*	2.9*	2.5*	0.7*
Fluoride treatment	23.8*	35.4	18.7	22.5	11.0	11.2
Pulling	5.3*	4.8*	8.5	8.5	3.8	4.6

*Figure does not meet standards of realiability or precision.

By gender

In each age cohort between two and seventeen years, more dental visits were reported for girls than for boys (Table 2). (Note: numerically, there are more boys than girls in each cohort.) Based upon the number of pediatric dentists (using the ADA reported number of 2,949 pediatric dentists in 1982 and the Department of Health and Human Services reported number of 2,398 pediatric dentists in 1984) there were between approximately 2,250 and 2,750 reported visits per pediatric dentist in 1983.[3,4]

By race

Almost six million dental visits to pediatric dentists were reported for white children; somewhat more than a half million were reported for black children. Black children between two and four years of age, and five and eleven years of age, had fewer visits per child to pediatric dentists than their white counterparts (Table 3).

Family income

Except for children from families with incomes between $10,000 and $19,999, there was a direct relationship between increasing income and the number of pediatric dentist visits per child. The decrease in visit rates per child from families with incomes between $10,000 to $19,999 may reflect economic difficulties faced by those families with income slightly above Medicaid income limits. Thus, children in low income families may receive needed dental services that are unavailable to children in slightly higher income families (Table 4).

TYPES OF SERVICES

The following data refer to the dental service received by children from all dental practitioners.

By gender

Between two and four years of age, girls received more preventive types of services per 100 dental visits than boys received: examinations, cleanings, radiographs, and fluoride treatments; while boys received more repair services than girls: fillings, crowns/caps and pullings (Terms are those used in the study).

Between five and eleven years, boys continued to receive more services per 100 visits than girls, except for orthodontic services and to a minor degree, fluoride treatments. By the teen years, girls received more repair services than boys, except for crowns.

Thus, in general, while young boys received repair services and young girls tended to receive preventive

services, by the teen years, the tendency was to reverse these services; teenage girls received more repair services and somewhat less preventive treatment than teenage boys (Table 5).

By race

Between two and four years of age, black children received less dental care per 100 dental visits than white

Table 6 ☐ Type of dental services provided per 100 dental visits, by age and race: 1983.[2]

Service	Age					
	2-4 years		5-11 years		12-17 years	
	White	Black	White	Black	White	Black
Examination	76.4	68.8*	49.5	41.4	35.2	31.2*
Cleaning	52.0	19.3*	40.7	49.3	24.8	29.1*
X-ray	25.5	12.3*	28.4	39.4	21.2	34.1*
Filling	15.6*	11.4*	18.8	27.2	15.7	18.0*
Straightening	0.0*	0.0*	16.2	5.9*	42.8	6.9*
Crown/cap	3.4*	0.0*	2.8	3.0*	1.1*	7.6
Fluoride treatment	31.0*	22.6*	21.1	16.9*	11.3	11.2*
Pulling	4.1*	12.3*	7.1	20.5*	3.6	16.2*

*Figure does not meet standards of reliability or precision.

Table 7 ☐ Type of dental services provided per 100 dental visits, by age and family income: 1983.[2]

Service	Age							
	2-4 years				5-17 years			
	Under $10,000	$10,000-$19,999	$20,000-$34,999	$35,000 and over	Under $10,000	$10,000-$19,999	$20,000-$34,999	$35,000 and over
Examination	68.0*	81.5	68.2	94.7*	41.4	38.9	43.1	41.1
Cleaning	46.1*	42.2	46.2	54.8*	29.0	33.0	33.6	30.0
X-ray	24.6*	23.9*	17.3*	39.3*	30.8	27.3	25.1	22.3
Filling	23.4*	17.3*	16.3*	0.0*	24.1	22.0	17.2	13.0
Straightening	0.0*	0.0*	0.0*	0.0*	16.4	22.2	31.1	36.9
Crown/cap	0.0*	3.2*	5.1*	0.0*	3.8*	1.7*	2.3*	1.8*
Fluoride treatment	22.9*	35.7*	26.1*	34.5*	15.2	17.4	15.4	15.5
Pulling	4.0*	8.1*	6.3	0.0*	16.1	8.5	4.5	3.9

*Figure does not meet standards of reliability or precision.

Table 8 ☐ Percent of population using fluoride products by age, race and family income: 1983.[2]

Age	Fluoride toothpaste	Fluoride supplements	Fluoride mouth rinse	Total using Fl. products
Under 2 years				
White	32.1%	16.1%	0.6%*	41.4%
Black	26.1	3.9	0.3*	28.6
Under $10,000	29.0	7.2	0.1*	32.9
$10,000-$19,999	30.8	14.5	1.1*	39.7
$20,000-$34,999	32.1	18.5	0.4*	43.0
$35,000 and over	34.0	18.8	0.4*	44.2
Total	31.0	14.0	0.6*	39.2
2-4 years				
White	92.8	14.5	7.4	93.5
Black	89.2	3.9	11.6	90.5
Under $10,000	89.4	7.3	7.0	89.9
$10,000-$19,999	92.7	11.8	8.6	94.0
$20,000-$34,999	93.8	15.8	8.1	94.4
$35,000 and over	94.6	19.1	8.4	96.1
Total	91.9	12.7	7.9	92.7
5-11 years				
White	96.0	10.8	17.9	96.5
Black	92.7	4.2	17.5	93.2
Under $10,000	93.4	6.6	15.2	93.8
$10,000-$19,999	95.9	8.1	18.2	96.4
$20,000-$34,999	96.9	11.3	18.7	97.5
$35,000 and over	96.9	13.9	18.3	97.5
Total	95.2	9.7	17.6	95.7
12-17 years				
White	95.8	2.5	15.7	96.0
Black	92.3	1.0*	17.2	92.6
Under $10,000	93.3	1.4	13.2	93.4
$10,000-$19,999	95.0	2.5	16.1	95.2
$20,000-$34,999	96.6	2.2	17.5	96.8
$35,000 and over	97.2	3.2	16.7	97.3
Total	95.0	2.3	15.7	95.2

*Figure does not meet standards of reliability or precision.

children received in each service category, except "pullings".

Between five and eleven years, and twelve and seventeen years, black children received more dental services per 100 dental visits than white children received, except in examinations, orthodontic services and fluoride treatments (Table 6).

By family income

The types of dental services provided per 100 dental visits to children varied greatly by family income. There are some differences, however, which are of particular note.

In very young children, ages two to four, there is a decrease in the number of fillings and extractions, and a general increase in preventive services, such as examinations, cleanings and fluoride treatments, with an increase in family income.

In children between five and seventeen years, there is a general decrease in the number of radiographs, fillings, crowns and extractions, and a general increase in orthodontic treatment, with an increase in family income (Table 7).

USE OF FLUORIDE PRODUCTS

Toothpaste

In 1983, less than a third of the children under the age of two years and well over 90 percent of children between two and seventeen years of age used fluoridated toothpaste.

Fluoride supplements

Fourteen percent of children under age two received fluoride supplements. By twelve to seventeen years of age, approximately 2 percent of children continued to receive fluoride supplements.

Fluoride rinse

Almost 18 percent of children between ages five and eleven years were involved in mouthrinse activities; almost 16 percent between ages twelve and seventeen were similarly involved.

In general

Children from families with higher incomes used more fluoride products. Blacks used less fluoride products than whites, except for fluoride mouth rinses. There were essentially no differences in the use patterns of fluoride products by girls and boys in each of the age cohorts (Table 8).

OVERVIEW

The availability of data on the use of dental services provides an opportunity to monitor developments in children's dentistry on a more rationale basis, particularly the evolving use of the services of pediatric dentists. In addition, the 1983 data now permit a better comprehension of the variations in patterns of use by gender, economics, and race since the last recession. National data for subsequent years will permit a better appreciation of the use of dental services as the patterns of dental disease evolve.

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Health program

An evaluation of a preschool dental health program

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Consistent with its philosophy that "oral health is an integral part of general health," the American Dental Association (ADA) has developed a K-12 Oral Health Teaching-Learning curriculum entitled "Learning about your oral health" for use in the schools. The Level I (Preschool) curriculum package consists of a comprehensive booklet containing five detailed lesson plans and other materials including spirit masters, flannel board cutouts, glossary of terms, background information for teachers, activities and letters for parent involvement. A list of suitable supplementary materials and audiovisuals is also provided. The ADA Preschool Curriculum provided an excellent opportunity to assess and evaluate dental health education geared to very young children.

The universal prevalence of dental disease is a constant reminder of the need for effective preventive dental health education. Intervention during early childhood would seem to be a most appropriate action to ensure healthy dental habits throughout life. A field experiment in dental health affords a unique opportunity for educators to promote the health of children and also to help control a serious and costly health problem.

Levy, in an excellent review of preschool oral health programs, indicated that most programs are inade-

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quately designed and lack proper evaluation methodologies.[1] This study sought to remedy that situation by utilizing an evaluation model that addressed the goals, behavioral objectives, content, and media of the curriculum, as well as measuring student, teacher, and parent outcomes.

Information gained from this project will provide a significant indication as to the program's effectiveness and acceptability by students, teachers, and parents. The development of valid and reliable measures of dental health knowledge and attitudes for preschool children will also enhance the efficacy of such a program.

PREVALENCE OF DENTAL DISEASE

It has been substantiated that by age two, when all the primary teeth have erupted, half of the children in the United States have at least one decayed tooth.[2] Reports of the dental health of preschool youngsters have been relatively few, but those that have been conducted have shown a need for interceptive dental care at the age of between two and three years. Through studies it was shown that a progressive increase in caries was experienced from the age of one through seven. These studies used the DEF index, which shows caries of a preschool child in terms of the average number of decayed teeth. Hennon, Stookey and Munlerj, and Infante and Owen found that for the age of one year the DEF ranged from .011 to .013.[3,4] At the age of two years, the same authors found the DEF ranged from 1.23 to 1.36; and at age three, 1.79 to 4.65. Wisan, Lavell and Colwell found that at four years of age the DEF ranged from 2.79 to 3.1, and he also found that at five years old the DEF ranged from 3.62 to 4.7.[5] Tank and Storvicks' study revealed that six-year-olds had 4.16 DEF.[6]

These studies reveal that over half of the two-year- olds in the United States had one or more carious teeth. In addition, fluoridated water utilization does not seem to stem the carious nature of preschool children.[7-9]

IMPORTANCE OF DENTAL HEALTH EDUCATION

In the previous discussion, it became evident that a serious dental problem exists for preschool children. The preponderance of preschools exacerbates the prevalence of preschoolers available for health education, and suggests, therefore, the importance of having preschool dental health programs. It would appear, from the literature, that these programs should include the following:

- ☐ Inculcation of the brushing habit.
- ☐ Familiarization with dental care professionals.
- ☐ Involvement of parents in the educational intervention.

Dental health care for children is usually neglected, because parents believe that "baby teeth" will soon fall out and are unimportant.[10] Early loss of primary teeth can have permanent effects on the development of the jaw, teeth and other facial structures. In addition, lack of teeth for proper chewing can lead to poor nutritional habits.

Perhaps most importantly, it should be stressed here that habituation of an important aspect of dental health should commence at a very early age.[11] The process can begin at about age three, when habit patterns are still being formed rather than being firmly established and resistant to change, as is true of older students. Bird and Hazel showed that knowledge does not necessarily lead to long term practice changes and that changes in dental health behavior in children will probably have to be developed with the children, as part of their daily activities along with involvement of parents.[12] Patterns of behavior are deeply ingrained at this time and mothers have a primary role in the learning situation.[13]

The elimination or reduction of caries is ample justification for teaching children and their parents good oral health habits. Dental caries can lead to pain and infection, which may result in the removal of primary teeth, and subsequent malocclusion.[14]

PSYCHOSOCIAL ROLE OF PARENTS

The best way of motivating preschoolers toward good oral health is through the parent's example.[15] The child's instinct appears to be enormous, but very few parents perform well as role models, as far as good dental health habits are concerned. Parents can be introduced to the curriculum and given instructions in the proper toothbrushing technique, so that children and parents can work together toward a common goal. In addition, parents can serve to motivate the child away from the classroom.

Children's preventive practices tend to be controlled by their parents' actions and attitudes. It was found that regardless of social class and educational level, all mothers can become good role models for their children's dental health practices.[16] Involvement of parents also increased dental awareness among children, especially when combined with parent in-service meetings.[17]

Due to lack of manual dexterity of young children, and the importance of parental involvement, it has been

suggested by several authors that a parent help with the toothbrushing either by showing the child first and then have the child practice, or by having the child brush first and the parent then complete the task by giving special attention to areas that were omitted.[18-21]

According to Leatherman, when considering dental health education for the preschool child, the principle objective should be to teach and motivate parents and their children to practice oral hygiene so as to prevent the onset of dental disease.[22] Specifically, it was suggested that parents be taught plaque control by means of systematic brushing (self and child) at least once a day, preferably at night. In addition, teaching parents and teachers the importance of avoiding harmful nutritional habits should be stressed. It was also mentioned that confidence between the parents and child and the dental professional must be established, to foster and maintain good oral health habits.

It is sufficient to state that a large body of evidence suggests the influence of the parent is necessary to have the greatest impact on dental health education for preschoolers. It is precisely for this reason that this study placed an emphasis on evaluating the parental component inherent in the curriculum.

PROCEDURES

This study was designed to evaluate the effects of the ADA's Preschool Oral Health Program, in terms of its impact on students', teachers' and parents' knowledge, attitudes, and behaviors (where applicable), gained from the curriculum. The best procedures to carry out the proposed project were completed in three distinct phases. The planning phase began with the recruiting of six preschools, comparable socioeconomically, that comprised the experimental and control groups. The pilot study was conducted at two preschools. The study design was developed during this phase, as was the random selection of schools to experimental or control groups. The experimental tests and survey forms were developed to secure data necessary to ensure the equivalence of the study groups, as well as determine the preexperimental levels of knowledge and attitudes regarding dental health and dental health care professionals. Items were developed to assess the traditional educational measures of skills, knowledge, and attitudes appropriate for this age level. The project staff was assisted by two experts in early childhood education. Other survey forms to evaluate the teachers' perspective of the program and the effectiveness from the parents' viewpoint were also developed during this phase. Preschool teachers, not involved in the experimental phase, were asked to review all survey items to insure content validity.

Pilot-testing of all instruments (knowledge and attitude measures and survey forms) were conducted at the two preschools that were selected to serve as pilot schools. Their selection was based upon their homogeneity to the preschools that were utilized in the experiment. Surveys were subjected to vigorous testing and were revised accordingly.

The experimental phase of the project included exposing the teachers to a two-hour orientation session to acquaint them with the contents of the ADA Oral Health Curriculum. This process has been shown to be preferable to a longer workshop for teachers. The total curriculum package (lesson plans, spirit masters, flannel board, puppets, films) was presented. General instructions and guidelines on how to utilize the materials were provided by project personnel. The teachers had an opportunity to review every aspect of the curriculum plan so that any difficulties in adapting the program to individual classroom situations were resolved prior to implementation. Teachers were involved in the data collection procedures to ensure their suitability for use with their students.

Previous to the pretesting of the preschoolers, a meeting was held at each preschool with the parents of the children included in the study. At this meeting, the curriculum was briefly reviewed, to acquaint the parents with the goals of the study. In an attempt to influence the parents to cooperate in the program, a dentist instructed the parents in the proper method of toothbrushing. It was anticipated that this would serve as a motivational device, as referred to by Blinkhorn.[23] In addition, the parental presurvey was administered. A mail survey was conducted to gather data from parents who did not attend the meeting. The survey was designed to collect social demographic information relevant to students and schools that were deemed important to the meaningful analysis and interpretation of the program's educational effects. Pretest measures of the students' dental health knowledge and attitudes were used to determine group equivalence and also as a baseline for measuring any subsequent changes. In addition, parents were surveyed at this time along with a teacher assessment of the orientation portion of the program. Local dentists agreed to present the toothbrushing portion of the program in the classroom, as well as orient the parents and teachers to the proper brushing technique. The formal classroom teaching and experimentation with the oral health teaching-learning program began once the pre-

survey and pretesting of all the experimental and control groups had been completed.

Through consultation with experts in preschool education and evaluation of school based programs, project personnel determined that data collectors must be trained to work with the instruments and children. Graduate students volunteered to be trained by project staff to administer and collect the data properly. Each data collector worked with one preschooler at a time, to ensure the validity of the students' responses as well as create a nonthreatening atmosphere for the youngsters.

The research design for the study was an adaptation of the Solomon Four Group Design. This design was chosen because its format attempts to control for history and maturation, as well as any contemporary effects which may occur between the pretest and the posttest via the treatment. This design also combines the pretest, posttest, experimental-control design with the simple randomly-assigned-subjects design. Information is provided by the pretest/posttest procedure and simultaneously shows how the experimental condition affects the group of subjects not being pretested.

Immediately following the experimental teaching phase, the posttesting of students was completed. Also at this time, a systematic survey of teachers and parents was conducted, in order to assess their reactions and comments concerning the effectiveness and impact of the program. A summary meeting was held at all preschools to meet with parents and school personnel. This enabled the project staff to interview a selected sample of parents, administrators, and teachers.

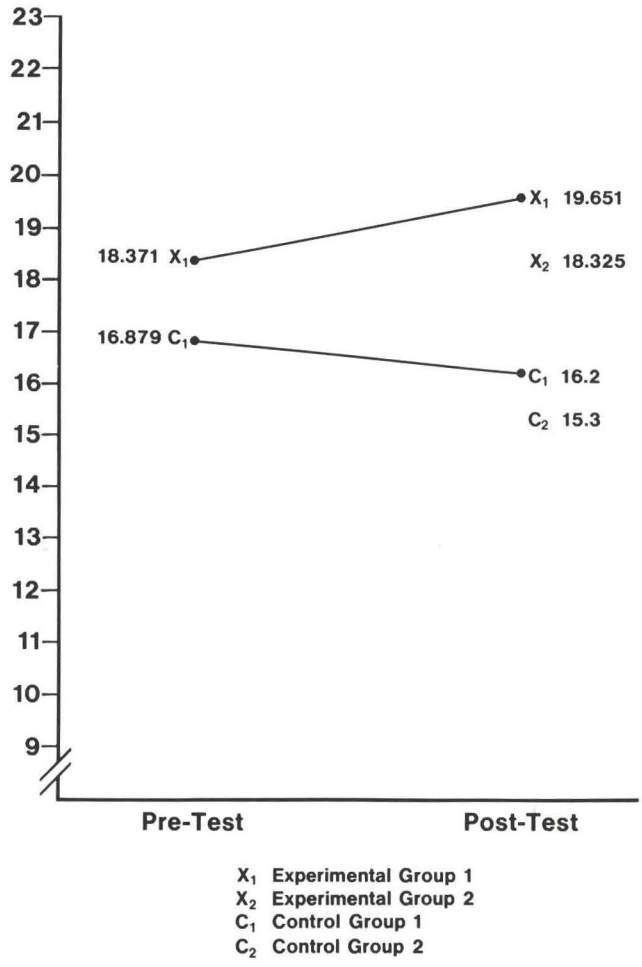

Figure. Student dental health knowledge: mean scores all students.

RESULTS AND DISCUSSION

Data were collected at four schools with an attempt to control the pretest effects by not collecting pretest data at schools three and four. A t-test on the pretest scores indicated significantly different pretest scores, hence an analysis of covariance (ANCOVA) was performed on the data to control for the pretest effect. As seen in Table 1, the groups were significantly different ($p<.01$) on the posttest scores, despite the pretest effect. In addition, gain scores were computed and the results again indicated that the knowledge of those preschoolers in the experimental group was significantly higher ($p<.01$) than those preschoolers in the control group.

Table 1 ☐ ANCOVA on student knowledge scores controlling for pretest effect.

Source of variation	Mean square	F
Covariate: Pretest	539.47	64.029**
Main effects: Posttest	135.44	16.075**
Explained	337.45	40.052**
Residual	8.43	

**p< .01

Figure 1 shows the mean knowledge scores for all children in all groups. The experimental groups' scores were consistently higher than the control groups' scores. The study team believed it would be best to break down the student groups according to age. The entire group consisted of students varying from age three to six. Regardless of age, the children in the experimental group scored higher on the knowledge survey than those in the control group. When knowledge scores were correlated with the age of the children, the results indicated that generally the older the student, the less, although

statistically significant, the gain in knowledge. This is most likely due to the assumption that the younger children in the pretest groups had more significant pretest effects. In addition, the younger children are more impressionable and easily influenced.

Attitudes of preschoolers toward dental health was extremely difficult to discern via direct student input. It was determined that we could best ascertain attitude change by asking parents to observe and report any change in their child's attitudes. The following statements were reported by parents in the experimental groups:

- "Changes in desire to brush teeth."
- "More aware of oral health."
- "Ryan now believes it's necessary to brush, if you want healthy teeth."
- "We felt this was an excellent program and Alan seemed to understand the material and gained a true appreciation for healthy teeth and gums. When Alan asked to buy "fluoride toothpaste" with the quarter his Grandpa had given him, we knew the program had succeeded."

We were able to determine through results of the parental survey some student behavior. Table 2 indicates that those preschoolers in the experimental group were reported, by their parents, to brush and floss more frequently, since the onset of the oral health program. In addition, the survey was able to obtain anecdotal messages, which are included below:

- "Practiced more dental health habits."
- "It really encouraged Erin with her toothbrushing."

A student survey was developed by the study team with recommendations from early childhood education experts. The survey was pilot tested and then revised for use during the experiment. A Kuder-Richardson test of reliability indicated a relatively high degree of reliability (see Table 3). The survey was also submitted for item analysis and found three items to be poor discriminators. These items were revised.

Validity was judged by a panel of experts including Professors of Early Childhood Education and several preschool teachers. There was consensus that the survey tested the curriculum objectives and was age appropriate.

Each teacher in the experimental group was asked to complete a survey after each of the five lessons. In addition, each teacher completed a cumulative evaluation form. There were eight female teachers (no male teachers) who taught an average of 7.6 years. Six teachers had higher education degrees, while two had received Montessori Certification. There was a total of 163 students with an average of 18.8 students in each classroom, who participated in the project. The students ranged in age from three to six years.

Table 2 ☐ T-values of pre-and postprogram student behavior.

Behavior	Preprogram Mean (SD)	Postprogram Mean (SD)	T-value
Brush	4.45 (.70)	4.65 (.59)	−3.15**
Floss	1.92 (.73)	2.56 (1.23)	−5.00**

**p < .01

Table 3 ☐ K-R reliability results.

Overall	
Pretest (N = 100)	KR = .75
Posttest (N = 163)	KR = .75
By group	
(E) Group 1 (N = 64)	
Pre	KR = .86
Post	KR = .81
(C) Group 2 (N = 36)	
Pre	KR = .86
Post	KR = .79
(E) Group 3 (N = 48)	
Post	KR = .84
(C) Group 4 (N = 15)	
Post	KR = .61

E = Experimental
C = Control

The cumulative teacher survey (Table 4) asked, in Likert forced-choice form, ten questions pertaining to the curriculum. The results indicated that the package more than adequately prepared the teachers to feel comfortable with the material. They believed that the methods and activities for involving parents were very helpful and led to a favorable parental response toward the curriculum. There was a general consensus that the methods and materials for student use were age appropriate and useful, especially the flannel board and films. Teachers strongly believed that the program changed the children's dental health habits and they would strongly recommend this curriculum to other teachers.

Lessons one through four were judged age appropriate by all teachers. Lesson five was judged less age appropriate and somewhat difficult to implement. This may have been due to the lack of time for all the activities, as it was the last lesson to be presented. Some teachers believed that a few of the activities were not appropriate for the size of the group, but could be utilized with fewer children.

A parental survey was devised to ascertain the effectiveness of the parental component of the curriculum. Several analyses were undertaken to determine whether the parental component added significantly to

Table 4 ☐ Cumulative ADA preschool program teacher evaluation.

Item	Strongly agree	Agree	Disagree	Strongly disagree
1. After reading the Forward and Dental Health Facts, I felt well prepared to teach the program.	5	3	0	0
2. I found the glossary for teachers helpful.	3	5	0	0
3. The methods and activities for parental involvement provided helpful suggestions.	2	6	0	0
4. Most of the activities and materials were useful.	6	2	0	0
5. The concepts were age-appropirate for students.	4	3	1	0
6. The discussion questions were age-appropriate for the students.	4	3	1	0
7. The activities were age-appropriate for the students.	3	4	1	0
8. Parental response to the program was favorable.	6	2	0	0
9. This program changed the children's dental health behavior.	6	2	0	0
10. I would recommend the use of this program to others.	5	3	0	0

Table 5 ☐ ANOVA: parental involvement for experimental groups.

Source of variation	Mean square	F ratio
Between groups	1.24	1.14
Within groups	1.08	

Note: There is no significant difference between the two experimental groups in regard to parental involvement.

Table 6 ☐ Correlation coefficients for parental involvement and student posttest knowledge scores.

Group	Correlation coefficient
Experimental 1	.81**
Experimental 2	.67**

**p < .01

Table 7 ☐ T-values for pre- and postprogram parent helping behavior.

Behavior	Presurvey Mean (SD)	postsurvey Mean (SD)	T-value
Take to dentist	4.16 (1.01)	4.57 (.71)	2.27*
Help child floss	2.87 (1.28)	2.55 (1.28)	2.88**

* p < .05
**p < .01
Note: Lower help child floss mean value indicates increased helping behavior

the effects of the program on the children. A t-test (Table 5) indicated that both experimental groups were equal in their level of parental involvement.

Another analysis was computed to determine whether the parental involvement correlated with the students' knowledge scores utilizing the Pearson R correlated coefficient. Table 6 shows that there was a strong, positive correlation at the $p<.01$ level between student knowledge scores and parental involvement. A third analysis indicated that after the curriculum was implemented, parents helped children floss more frequently and planned to take their child to the dentist more regularly (Table 7).

Perhaps the most enlightening information concerning the parental component came from anecdotes on the parent surveys and from interviews.

- ☐ "...made me more aware of trying to be consistent about dental hygiene."
- ☐ "We floss more regularly because she reminds us."
- ☐ "(She loved)...telling us each day we should be doing things."
- ☐ "Thank you for presenting this program to my child. I wish I, as a child, had such exposure instead of the mouth full of cavities I have now."

Parents were asked to note activities that their children were particularly interested in, once the curriculum was implemented. Consistently, the children were most interested in brushing, flossing, the nutritional value of foods, the coloring books and the witch poster. While the other activities were mentioned by parents, the above list was cited most frequently.

In addition, the parents were asked to determine those activities most frequently engaged in by both parents and children. Analyses indicated that the most frequent interaction occurred between parent and child when they talked about the dentist and the dental helpers. Other items discussed included function of the teeth, oral safety, placing the emergency dental care sheet in a convenient location, and attempting to provide health promoting snacks.

CONCLUSIONS

From the student and parent surveys, it can be seen that the program was successful in improving the knowledge and attitudes of preschoolers enrolled in the experimental curriculum as compared to those children not in the program. In addition, it is evident that the students' behaviors improved toward brushing their teeth.

The student survey can be considered to be a valid and reliable measure of preschoolers' knowledge concerning the oral health curriculum. An important note

here is that this survey worked very well with the youngsters who took part in the experiment. These children came from white, middle class families whose parents were employed in white collar and professional careers. Thus, we cannot generalize the survey, nor its results to other, different populations.

The curriculum received a very favorable response by the teachers. The purposes and discussions for each lesson were evaluated very positively and most of the activities were very well accepted. Lesson five appeared to be accepted less favorably, perhaps due to lack of time or the activities being a bit too difficult for the children. Overall, it appeared that if the activities were age and level appropriate, then the concomitant lesson was judged positively as well.

Overwhelmingly, the parents believed the program to be very valuable. The parents were very enthusiastic and believed that the children encouraged parental follow- through with their own enthusiasm regarding the program. It appeared that the program was taken seriously by both children and parents, and the parents attempted to follow the guidelines recommended in the curriculum. Parents' comments indicated that they were amazed as to their children's concern and willingness to follow good dental practices. Obviously, with this group of children, parental involvement improved the behavior and knowledge of the students.

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CONFERENCE ON BOTHERED CHILDREN AND CHILD ABUSE

According to a Conference paper, "the problem of child battering and child abuse is becoming more and more widespread. . .In recent years there has been a dramatic increase in the number of reported cases of child abuse. This increase has been particularly noticeable in industrialized countries where both child health services and social welfare programmes have attained a level of sophistication and coverage as to permit the detection of and response of cases of child abuse. . ."

WHO Chronicle, Vol 40, p 239.

Nutrition and immunity: I. Basic considerations II. Practical applications

Nutrition

R.K. Chandra, MD, FRCP(C)

Part I

The well-known association between malnutrition and infection has prompted the examination of immune responses in undernourished individuals. The major determinants of infectious disease are host immunity, virulence of the microorganism, environmental sanitation and personal hygiene. It is recognized now that nutrition modulates immune responses and influences the incidence and severity of infectious complications. This selective review summarizes the present state of knowledge of nutrition-immunity interactions. For more details, reference should be made to monographs and review articles listed in the bibliography.[1-6]

IMMUNE SYSTEM

The immune system protects us from a variety of harmful substances, including microorganisms and mutant malignant cells. It can be viewed as a protective umbrella of host-resistance factors including the physical barriers of skin and mucous membranes, mucus and cilia on epithelial surfaces, phagocytes including polymorphonuclear leukocytes and macrophages (white blood cells and tissue cells, respectively, that are capable

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of taking up bacteria and molds), complement system (a series of proteins that interact with one another and enhance immunity), immunoglobulins and antibodies, and cell-mediated immune responses. The three principal cell types involved in immunoregulation are T and B lymphocytes and macrophages. T lymphocytes are a heterogeneous group of cells that mediate cellular immune responses, such as delayed hypersensitivity, graft rejection, destruction of virus-infected cells and of cancer cells. T lymphocytes also regulate responses of other immunocompetent cells. Upon interaction with microorganisms, T cells get "activated" and show several metabolic changes, including altered prostaglandin synthesis and release.

B lymphocytes constitute about 12 percent of peripheral blood lymphocytes. Upon stimulation by microorganisms or other antigens or by products of T cells and macrophages, B cells rapidly increase protein synthesis and produce antibodies which are immunoglobulins of five different classes – IgG, IgM, IgA, IgD and IgE. Microphages are phagocytic cells located in various organs (e.g., alveolar macrophages in the lungs). They provide an early defense barrier, ingest bacteria and produce substances (e.g., interleukin-1) that enhance immune responses.

EPIDEMIOLOGY

A survey of historic records and older medical literature indicates an association, sometimes a temporal one, between famine and pestilence. More recent surveys, including some prospective longitudinal studies, do confirm the association between malnutrition and morbidity and mortality. Risk of death correlates with nutritional status. The course and severity of many infectious diseases are affected by nutritional status. Measles, for example, is more severe and prolonged in malnourished children in whom it is often a life-threatening illness. This also applies to diarrhea, tuberculosis, Pneumocystis pneumonia, herpes and other organisms.

IMMUNOLOGIC CHANGES IN PROTEIN-ENERGY MALNUTRITION

The most consistent effects of protein-energy malnutrition (PEM) on the immune system and its ability to deal with infection (Figure, *p. 197*) include absent or reduced delayed cutaneous hypersensitivity response to common microbial antigens, decreased number of thymus-dependent T lymphocytes, reduced capacity of neutrophils to kill ingested bacteria and molds, reduced level and activity of various complement proteins, decreased concentration of IgA antibody present over mucous membranes and decreased antibody affinity (ability to bind antigens). The lymphoid tissues serve as barometers of the nutritional state. The thymus is the site of T cell proliferation and maturation; and death from starvation results in profound thymic atrophy to the extent that it may be difficult to locate the organ.

VITAMINS AND IMMUNITY

Although isolated deficiencies of vitamins are rare in clinical practice in industrialized countries, studies in laboratory animals show that many vitamins are extremely important for optimum immunity. Vitamin A deficiency reduces lymphocyte response to mitogens and antigens, whereas modest doses of beta-carotene and retinoids stimulate immune responses. Deficiencies of the B group of vitamins, especially B_6 are associated with decreased antibody responses and impaired cellular immunity. Extreme deficiency of vitamin C impairs phagocyte function and cellular immunity. Vitamin E deficiency decreases antibody response to T cell-dependent antigens. The effect is compounded by selenium deficiency. Modest supplements of vitamin E may enhance immune responses.

TRACE ELEMENTS AND IMMUNITY

Iron deficiency is the most common nutritional problem worldwide, even in industrialized countries. Iron is a double-edged weapon. On one hand, free iron is necessary for bacterial growth: removal of iron with the help of lactoferrin or other chelating agents reduced bacterial multiplication. On the other hand, iron is needed by neutrophils and lymphocytes for optimal function: bactericidal capacity and lymphocyte proliferation response are impaired. Thus, whereas iron deficiency results in impaired immunity, large doses of iron, especially when given intravenously or intramuscularly, may have adverse consequences.

Zinc deficiency results in growth failure, dermatological manifestations, diarrhea, loss of hair, mental disturbance, hypogonadism in males and intercurrent infections with opportunistic organisms. There is depression of immune and other host defense mechanisms, including T cell response and chemotaxis of neutrophils. Thymic hormone activity is very low.

Copper deficiency is associated with an increased incidence of infection, as is seen in patients with Menkes' kinky-hair disease, an inherited disease with defec-

tive copper metabolism and low serum copper. The function of the reticuloendothelial system is depressed and the microbicidal activity of granulocytes is reduced. Impaired antibody response to heterologous red blood cells and low levels of thymic hormone activity have been reported.

Selenium in conjunction with vitamin E, which also is an antioxidant, protects against lipid peroxidation of cell membranes. The role of selenium in prevention of infectious illness in human beings is at present not clear. Deficiency induced in animals, however, reduced antibody responses.

Iodine plays an important role in the microbicidal activity of polymorphonuclear leukocytes. Recent studies have demonstrated decreased microbicidal activity of neutrophils from hypothyroid patients; improved function followed treatment.

LIPIDS AND IMMUNITY

Lipids exert a significant influence on immune responses. Deficiency of essential fatty acids results in lymphoid atrophy and depressed antibody responses. While adequate amounts of essential fatty acids are critical for immune response, excess polyunsaturated fatty acids (PUFA) suppress immunity. Large amounts of linoleic and arachidonic acids induce atrophy of lymphoid tissue, diminish T cell immune responsiveness to antigenic stimulation and delayed cutaneous hypersensitivity. *In vitro* studies also support an immunosuppressive effect of excess PUFAs. The effects of PUFAs on lymphocyte responses may vary according to the specific immune function or component being examined, the duration of feeding and the age of introduction to the diet. The underlying mechanism(s) by which PUFA suppress the immune response is unknown, but may be mediated in part through PUFA-derived prostaglandins. High blood cholesterol levels in experimental animals are associated with increased susceptibility to infection and reduced cell- mediated immunity and phagocyte function.

OBESITY

Obese individuals suffer from infections, especially respiratory infections, more often than lean persons. This may be the result of mild impairment of cell-mediated immunity and phagocyte function. Hyperlipidemia and hormonal changes seen in the obese, as well as the unexpected presence of iron and zinc deficiencies, may be the underlying pathogenetic factors that depress immunity in the obese.

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Part II

Protein-energy malnutrition (PEM) and deficiencies of several nutrients are associated with impaired immune responses. Obesity also may adversely influence immune function. Deficiencies of protein and some amino acids, as well as vitamins A, E, B_6 and folate, and trace elements, are associated with reduced immunocompetence. In contrast, excessive intake of fat, in particular polyunsaturated fatty acids, iron, zinc and vitamin E are immunosuppressive. There are many practical applications of our recently acquired knowledge regarding nutritional regulation of immunity.

IMMUNOLOGIC TESTS FOR NUTRITIONAL ASSESSMENT

Most of the conventional methods of nutritional assessment measure body size and composition (Table 1). Few

attempt to evaluate function. Thus the suggestion to use immunologic responses as sensitive functional indices of the nutritional state is a distinct departure from the approaches currently in use.[1] No one group of tests is satisfactory for obtaining a complete picture of the individual's ability to resist disease. "[Responses to] tests of immunocompetence are altered early in the development of undernutrition and therefore provide a functional measure of mild deviations from normal nutritional health. They reflect a broad measure of nutrition without being specific for any given nutrient. Assessment of immunocompetence by currently available methods in conjunction with other methods of nutritional assessment can identify individuals who are most in need of appropriate nutritional support, and thus provide crucial prognostic information in terms of risk of disease, duration of hospitalization, and chances of survival. And survival, after all, is what preventive and therapeutic medicine is all about."[2]

PREDICTION OF POSTOPERATIVE COMPLICATIONS

Many recent studies have examined the usefulness of preoperative skin testing to predict complications after surgery for a variety of diseases.[2-4] Most of the data are derived from adults. The reliability of this procedure is shown in Table 2. It is clear that the values of sensitivity and specificity of these tests and their positive and negative values in predicting the development of infection and mortality vary considerably from one study to another.[2] This could be due to a number of factors, including the total number of cases in a study, the prevalence of malnutrition in the group studied, selection of the cut-off point for a test to be considered abnormal, the primary diagnosis and the antigen used for skin tests.

NUTRITIONAL STATUS AND VACCINATION

The protective efficacy of immunization against various communicable diseases depends mainly on the quality and magnitude of immune response. Since nutrition is a critical regulating influence on immunocompetence, it is not unexpected that malnutrition is a significant determinant of response to immunization.[5] Two examples are given here. Tuberculin conversion after BCG vaccine is decreased, if the immunized subject is undernourished. There is a quantitative correlation between extent of malnutrition and the percentage tuberculin conversion. Infants with low birth weight show a poor response. Another recent observation is the role of nutritional supplements in improvement in response to influenza virus vaccine given to the elderly (Table 3).

Table 1 □ Methods of Nutritional Assessment

Clinical	Biochemical
Dietary intake	Serum albumin
Physical examination	Serum transferrin
	Creatinine/height index
Anthropometric	Zinc
Weight-for-height	
Mid-upper arm circumference	Immunologic
Skin-fold thickness	Delayed cutaneous hypersensitivity
	Lymphocyte count
Hematologic	Terminal transferase activity
Hemoglobin	T cells
Red cell morphology	
Ferritin	Miscellaneous
	Hand grip strength
	Dark adaptation
	Taste acuity

THE ELDERLY

In old age, there is an increased incidence of infection, degenerative disease and cancer, conditions often associated with immunodeficiency. In addition, there is a progressive decline in immune functions with advancing age, especially cell-mediated immunity.[6] At the same time, malnutrition is a frequent problem among the elderly over 65 years of age, due to conditions which decrease food intake, such as emotional, motivational and dental problems and altered taste acuity. The lean body mass decreases and blood levels of many nutrients fall. The question arises, therefore, as to whether the slow progressive decline in immunity associated with aging is due in part to nutritional deficiencies. Unfortunately, few studies have considered nutrition and immune function simultaneously in elderly subjects.[7,8] While the findings of recent studies do support a casual relationship between undernutrition and impaired immunity in many elderly individuals, it is unknown whether maintenance of good nutrition and immunological vigor during the aging process will prevent at least some of the diseases associated with aging.[7] Again, recent work has documented the beneficial effect of nutritional supplementation on antibody response to influenza vaccination (Table 3).

INFANTS

Low birth weight due to preterm delivery (9 percent of all births in U.S. and Canada) or intrauterine growth retardation (2.5 percent of all births in U.S. and Canada) is associated with marked and prolonged impairment of immunity. The immune system develops during the first trimester of pregnancy, nutritional deprivation during fetal life may be expected to have a more profound and longer lasting effect on the immune system than acquired postnatal malnutrition. This has been documented both in man and in laboratory animals. Fetal growth retardation is associated with involution of the thymus and impaired cell-mediated immunity, as shown by the number of circulating T cells and lymphocyte transformation response to mitogens. There is a reduction in serum levels of IgG. Antibody responses to some antigens are slightly reduced. The depression of cell-mediated immunocompetence in small-for-gestation-

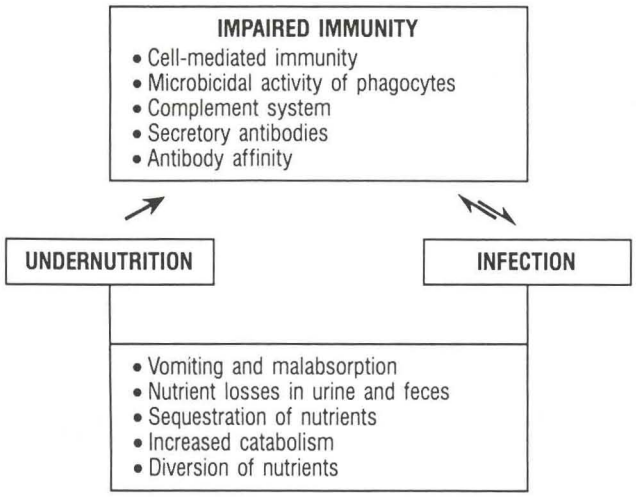

Figure. Major effects of nutrition and infection on the immune system.

age low birth weight infants has been shown to persist for periods of several months to years. In contrast, appropriate-for-gestational-age infants of comparable weight recover their function by the age of three months. These effects may have clinical and biological significance. Infants with depressed immune responses have 3-fold increase in infections.

ACQUIRED INFECTIONS

The prevention or early detection and treatment of nutritional deficiencies may reduce the risk of life- threatening acquired infections in the immunocompromised host, such as patients with tumors and leukemia.

OVERNUTRITION

Obesity is associated with increased frequency of respiratory infections and postoperative wound infection. Hyperlipidemia results in impaired phagocyte and lymphocyte function. The role of excessive intake of lipids, particularly cholesterol and polyunsaturated fatty acids (PUFA), in depressed immunity has been outlined previously. Similarly, large doses of vitamin E and iron may have detrimental effects. We must be cautious in advocating large doses of nutrients as health supplements. Zinc given as 300 mg supplements to healthy men resulted in impaired lymphocyte and neutrophil responses.[9] The pathogenetic mechanisms were not clear but alterations in serum and membrane lipids may be contributory. Thus optimum immune function is best achieved by intake of various nutrients within a defined range and both undernutrition and overnutrition are detrimental.

SUMMARY

Nutrition, immunity and infection are intricately linked to one another. Nutritional deficiencies and excesses influence various components of the immune system. Early studies investigating the association between nutrition and immunity focused on generalized protein-energy malnutrition, particularly in children in developing countries. The extent of immunological impairment depends not only on the severity of malnutrition but on the presence of infection and on the age of onset of nutritional deprivation, among other factors. In industrialized nations, immune function has been shown to be comprised in many malnourished hospitalized patients, small-for-gestational-age infants and the elderly. Obesity also may adversely influence immune function. Imbalances of single nutrients are relatively uncommon in humans and investigations of protein and amino acids and specific vitamins, minerals and trace elements generally are carried out in experimental animals. Deficiencies of protein and some amino acids, as well as vitamins A, E, B_6 and folate, and trace minerals are associated with reduced immunocompetence. In contrast, excessive intake of fat, in particular polyunsaturated fatty acids, iron and vitamin E are immunosuppressive. Knowledge regarding nutritional regulation of immunity is leading to many practical applications.

Table 2 ☐ Reliability of Preoperative Anergy (Absence of Delayed Cutaneous Hypersensitivity) to Predict Postoperative Malnutrition and Associated Complications.*

Outcome	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Sepsis	61 (50-80)	74 (62-90)	28 (14-39)	92 (84-97)
Mortality	49 (37-60)	74 (60-88)	25 (21-29)	91 (90-92)

*Data are shown as mean (and range) of values obtained from several reported studies, largely based on adults undergoing major surgery for a variety of primary diagnoses. For example, anergy was seen in 61% of all patients who subsequently develop sepsis. Again, 74% of anergic patients showed sepsis.

Table 3 ☐ Response to influenza Virus Vaccination in Nutritionally Supplemented Elderly above 65 years and Non-Supplemented, Age-Sex-Matched Controls

Group	Number Studied	No. Achieving Seroconversion	Log Reciprocal Geometric Mean Antibody Titre
Supplemented	15	14*	5.7 ± 1.2†
Non-supplemented	15	9	2.5 ± 0.7

*P <0.05 †P <0.01

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Case reports

Pulpal necrosis of an unknown etiology in a newly erupted premolar: report of case

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Seemingly healthy teeth can on occasion develop pulpal morbidity. Fortunately this is an infrequently observed phenomenon. Factors causing or contributing to such necrosis include internal resorption, external resorption, enamel defects, and "intrafollicular caries."

Internal resorption is a condition of odontoclasia starting in the pulp. The pulp chamber and root canal become larger by virtue of the resorption of the surrounding dentin. The cause of internal resorption is now always known; there is speculation, however, that whatever the cause, a vascular change in the pulp occurs.[1]

External resorption can be classified in two types. One type occurs at the apex or on the lateral surface of the root.[2] The other type begins on a relatively small area of the root, invades the cementum and dentin, and usually produces an expanding, excavated defect in the dentin that has the radiographic appearance of an interdental process.[3] This type of resorption has also been described as external-internal resorption.[4]

The cause of most enamel defects is a disturbance in tooth formation. If the defect in a permanent tooth is associated with the occurrence of periapical infection in

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the preceding primary tooth, it is called a "Turner's Tooth," named after the investigator who first reported the occurrence and its etiology.[5] Histologic examination of the enamel in the affected teeth shows hypoplasia and poor mineralization. Notching is often found in the cervical area.[6]

The phenomenon of "intrafollicular caries" has been periodically reported.[7-10] This condition appears as an abnormal radiolucency in the coronal dentin of an unerupted permanent tooth. It is most frequently found in premolars.[8] Most authors report that this condition is a form of external resorption.[8] These teeth have been treated by surgical exposure or after eruption. Upon excavation, a soft material similar to caries has been found.[10] Some defects extended to the pulp.[7]

CASE REPORT

A twelve-year-old Black male was brought by his parents to the pediatric dental clinic at Creighton University, complaining of pain in the mandibular right quadrant. The child had a normal medical history with no complicating illnesses. His family history was noncontributory, and he appeared to be of normal size and weight. His dental history consisted of routine restorative dentistry, pit and fissure sealants, as well as the previous removal of a mesiodens located lingual to the permanent central incisors. The parent could not recall whether the restorative care in the primary dentition included pulpal treatment. There was no history of orofacial or dental trauma. Approximately seven months earlier the child presented at the pediatric dental clinic complaining of pain in the area of the mandibular right canine. At that time periapical radiographs were taken of the fully erupted mandibular right lateral incisor, canine and first premolar, and all appeared to be normal. These teeth were also tested with ice, heat, percussion, and an electric pulp tester and all were found to be within normal limits. A diagnosis of the problem was not made and on a follow-up appointment the problem seemed to have resolved itself.

The patient had an Angle Class I occlusion; all permanent teeth with the exception of the third molars were present. The gingiva and mucosa appeared normal, except for a small swelling and tenderness in the buccal mucosa, adjacent to the mandibular right second premolar. The tooth was found to be sensitive to percussion and did not respond to electrical or thermal testing. Periapical and bitewing radiographs showed a definite periapical lesion, and a diagnosis of pulpal necrosis was made (Figures 1 and 2). After conferring with the parents, it was decided to proceed with conventional endodontic therapy.

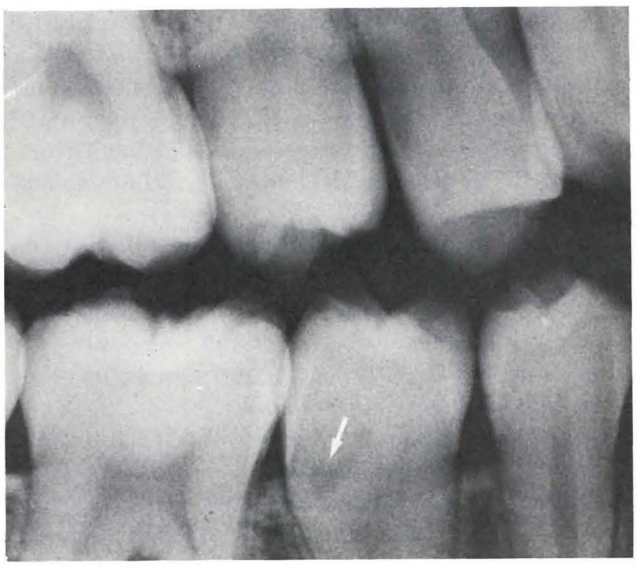

Figure 1. Bitewing radiograph with arrow demonstrating radiolucent lesion in cervical area.

Figure 2. Periapical radiograph with arrows demonstrating radiolucent lesion as well as periapical lesion.

Inferior alveolar and lingual nerve anesthesia as well as buccal infiltration were accomplished with a 1.8 cc carpule of 2 percent xylocaine with 1:100,000 epinephrine. A rubber dam was placed and the area disinfected. When the pulp chamber was opened, it was obvious that the pulp had undergone liquefaction ne-

crosis. To test for the presence of microorganisms, a sterile paper point was inserted into the pulp chamber, then placed in thioglycollate culture medium. The canal was then filed and cleaned and sealed with a moistened pellet of camphorated paramonochlorophenol. The patient was then scheduled for completion of the endodontic procedure.

The sample of pulpal tissue was grown in thioglycolate medium, and then transferred to a blood agar plate, gram stained and read from the blood agar plate and by microscopic examination. The culture was positive for alphahemolytic streptococcus. Surprisingly, no other genus of microorganism was found.

Careful observation of the cervical aspect of this tooth, (Figures 1 and 2), presented the possibility of a developmental defect within the tooth, which allowed oral strains of streptococcus to enter the pulp. Clinically the defect was not observable. One would suspect that if the source of the bacteria was the oral cavity, numerous microorganisms would be present. Thus, the true etiological source of the bacteria remains suspect.

DISCUSSION

Although the true etiology of the necrosis in this case is unknown, there are several possible causes. The appearance of the radiolucency in the cervical area of the involved tooth was consistent with some type of resorption. The radiographic appearance of the radiolucency in this case was consistent with that of external-internal resorption, as reported by a number of authors.[3,4,11]

The tooth may have had a developmental defect in the cervical area, which allowed communication with the inner portion of the tooth. Pindborg reported that notching in the cervical area is often found in "Turner's Teeth."[6] The patient was not seen in this clinic during the primary or mixed dentition stages; and, the parent was unable to report whether the pulp of the primary molar overlying the premolar was treated or whether the tooth was extracted. If it could have been documented that the primary molar had been abscessed, this premolar could be viewed as a "Turner's Tooth", with the cervical notching being the source of the enamel defect.

The radiolucency had a similar radiographic appearance to the resorption process seen in "intrafollicular caries". Lacking previous radiographs, it is impossible to determine whether this might be a case of "intrafollicular caries" appearing in the newly erupted tooth. The radiographs of the initial visit are inconclusive regarding this possible diagnosis.

CONCLUSION

A case of pulpal necrosis of unknown etiology in a newly erupted premolar is presented. The tooth showed evidence of a periapical lesion and pulpal necrosis. The only clinical or radiographic evidence of morbidity, except for the periapical lesion, was a radiolucent area in the cervical area of the tooth. The cause of this lesion, and the subsequent pulpal involvement are open to conjecture.

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Russell-Silver syndrome: microdontia and other pertinent oral findings

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Richard K. Wesley, DDS, MSD

Russell-Silver syndrome is a type of intrauterine growth retardation, characterized by short stature noted at birth, hemiatrophy or asymmetry and variation in sexual development.[1,2] The syndrome was independently described by Silver in 1953 and Russell in 1954, each author stressing different aspects of the syndrome.[1,3] Currently, the disease is described as Russell-Silver syndrome; Russell dwarfism; Silver syndrome as a distinct entity separate from Russell dwarfism; Silver-Russell syndrome; and combined together as Silver syndrome.[1-21] The basic distinguishing feature is the degree of asymmetry, which is present in the Silver syndrome, but not found in Russell dwarfism.[4] Generally, a patient must present with three out of four major manifestations; and the diagnosis is supported, if the patient presents with one or more minor manifestations (Table 1).[2,4,11,13] A genetic basis for the syndrome is unknown.[6,11,12] Over 150 cases have been described in the world literature.[20] Rarely are complete dental evaluations performed. The purpose of this paper is to report the dental findings of a patient and review the pertinent literature (Table 2).

CASE REPORT

A 5.5-year-old white female with a known diagnosis of Russell-Silver syndrome presented to the University of Detroit School of Dentistry for a dental evaluation. The child was the product of a forty-week pregnancy, which was uneventful. Her birth weight was 2 kg and her length was 39 cm. Her physical examination revealed

Table 1 ☐ Silver's criteria for the syndrome.[11]

Major manifestations
1. Shortness of stature
2. Significant asymmetry
3. Small size despite being born at term
4. Variations in the pattern of sexual development
   a) Elevated urinary gonadotropins
   b) Early sexual development
   c) Premature estrogenization of urethral or vaginal mucosa
   d) Retarded bone-age in relation to sexual development

Minor manifestations
1. Short 5th fingers
2. Incurved 5th fingers
3. Triangular shape to face
4. Turned-down corners of the mouth
5. Café-au-lait areas of pigmentation of skin
6. Syndactylism

Table 2 ☐ Oral manifestations of Russell-Silver syndrome.

Facies:	triangular
Facial height:	decreased
Symmetry:	hemiatrophy in Silver variant
Mandible:	hypoplastic or normal
Mouth:	down-turned corners (shark's mouth)
Palate:	high arched or normal
Tooth size:	microdontia to larger than normal in width
Dentition:	normal color and texture
Eruption:	normal pattern
Crowding:	hypoplastic mandible
Congentially missing:	maxillary lateral incisors and four second premolars
Ramus height:	reduced
Gonial angle:	increased
Condyles:	blunted

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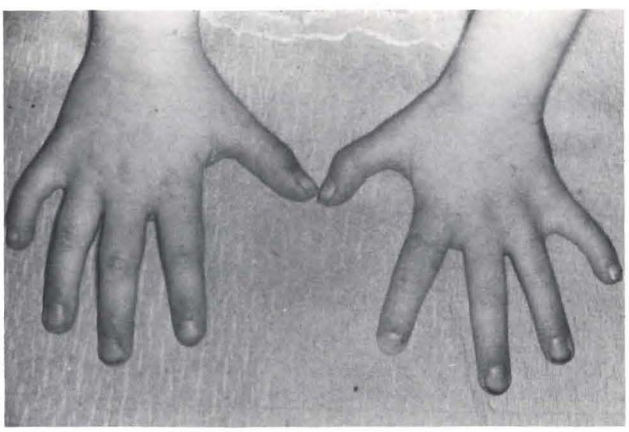
left side hemiatrophy and unilateral congenital hip dislocation, which was treated by a pelvic harness. She was diagnosed at twelve months of age with Russell-Silver syndrome, based on the findings of a prenatal onset of growth retardation and continued growth delay, normal head size with frontal bossing, low weight and small stature, triangular facies, bilateral clinodactyly and left side hemiatrophy. The chromosomal karyotype was 46xx, normal female.

Physical findings demonstrated a fragile appearing, bright, cooperative child. She weighed 11.5 kg and her height was 95 cm, which both fall well below the third percentile. Her facies were triangular with frontal bossing and her mouth appeared down-turned (Figure 1). There was mild hemiatrophy of her left side, bilateral clinodactyly and short inturned fifth fingers (Figure 2). Her voice was high pitched.

The dental examination revealed an intact primary dentition with a flush terminal plane. There was generalized maxillary anterior spacing, a mild open bite with 6 mm of over jet, due to a persistent finger habit. The teeth were of normal texture and color (Figure 3). Measurements of the crowns of the primary teeth were made on study models by three independent examiners, using a Helios style sliding caliper with a Vernier scale according to the techniques described by Hunter.[22] Microdontia of the primary dentition was concluded after noting that the dimensions of all of her teeth fell below the fifth percentile as compared to the Table of Crown Sizes of Primary Teeth by Moyers.[23] The teeth on the left side were slightly smaller than on the right side, which was consistent with the left side hemiatrophy.[24]

The panoramic radiograph revealed congenital absence of the permanent second premolars, dental age equal to chronologic age and blunted condyles (Figure 4). A lateral cephalometric radiograph was traced ac-

Figure 1. Triangular facies with frontal bossing and down-turned corners of the mouth (shark's mouth).



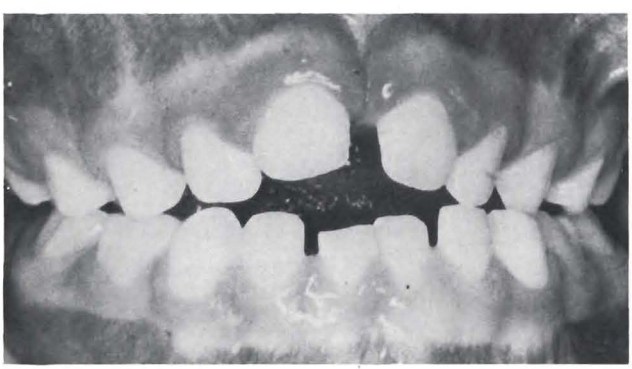


Figure 3. Teeth appear normal in texture, color, and spacing.

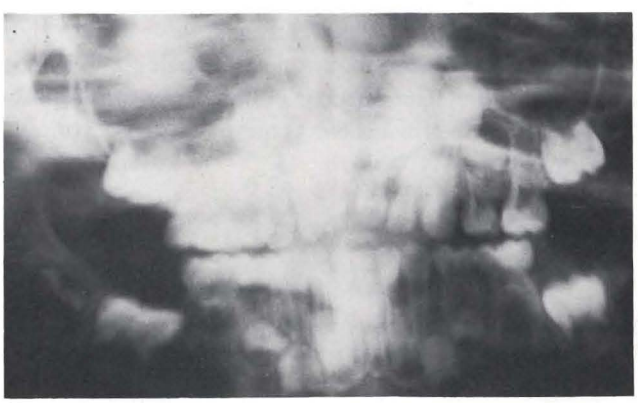


Figure 4. Radiograph reveals congenital absence of second premolars, and a dental age equal to the chronologic age.

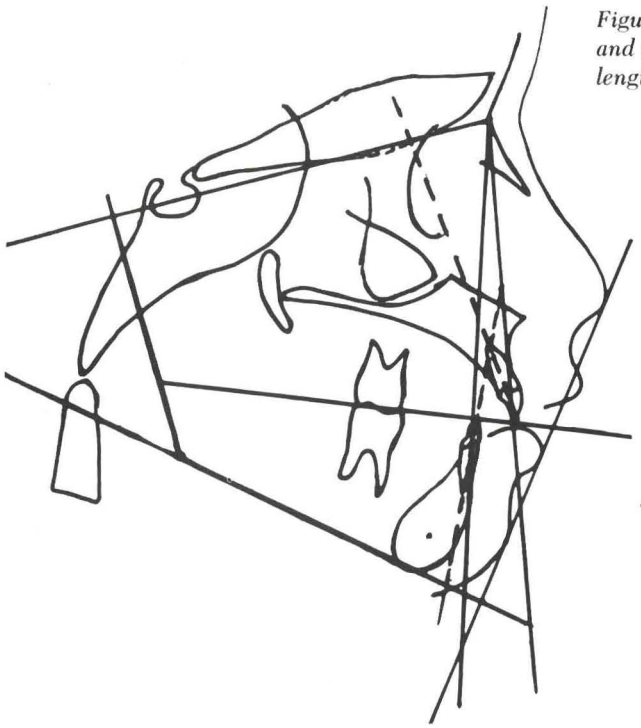


Figure 5. Cephalometric analysis reveals decreased posterior and anterior cranial base lengths, normal mandibular body length and reduced ramus height.

cording to the landmarks described by Henkin *et al* and Taussig *et al* (Figure 5).[6,25] In comparing our patient to the normal control patients in these studies, we found the angle between the anterior and posterior cranial bases to be more obtuse than in the controls. There was a decrease in both the anterior and posterior cranial base lengths, as well as a decrease in the total cranial base length. The mandibular body length was normal, but the ramus height was reduced, with an increased gonial angle. The palate height, which was evaluated cephalometrically, was high-arched.

DISCUSSION

Diagnosis of the syndrome is based on clinical findings, particularly prenatal onset of growth retardation, as found in our patient.[1,3,4,6,26] Several authors described the short stature as primordial dwarfism.[3,8,11] Most authors feel, however, that there is a period of catch-up growth and the overall height is not grossly retarded.[4,13,17] The projected adult height for a female is between 140-150cm, or at the 25th percentile.[18] Studies of the bone-age of patients indicated a retarded bone-age, normal bone-age and inconsistent data.[1,3,9,11-16,18,26] Treatment with growth hormone is ineffective.[4,6,18,28]

Hemiatrophy is a common finding in the Silver syndrome and is used as a distinguishing feature from Russell dwarfism.[1,11-13,16] Our patient presented with left-side hemiatrophy, which included her maxilla and mandible.[2,13] Several authors feel the hemiatrophy is actually evidence of retarded bone-age on one side of the body.[1,13] Clinodactyly and a short inturned fifth finger are common findings.[1,3,11,13,14,26]

As with our patient, overall body size is small and lean, with small amounts of muscle tissue and little subcutaneous fat.[3,4,18] A delay in developmental milestones has been attributed to a paucity of muscle tissue, which slows gross motor accomplishments.[4,12] Our patient's head was normal size with a mild hypoplastic mandible and frontal bossing.[3,5,8,13,26] The lateral profile presents as pseudohydrocephalus and is considered a diagnostic tool in infancy.[5,9] Pneumoencephalography is unnecessary.[3-5] Delay in closure of the anterior frontanelles has been noted.[3,4] Hypoglycemia, causes unknown, has been reported, but suspected to be due to a cranial mass, large in relation to the small body size.[4,8] The voice may be high pitched as in our patient.[3,13] Although cafe-au-lait pigmentation is a common finding, our patient did not present with any signs.[1,2,7,14-16] In the past, an initial diagnostic criterion was variation in sexual development from precocious sexual maturation, to normal levels of gonadotropins.[12,14,15,18,26] Recent studies show only 34 percent of cases present with a variation.[1]

Our patient presented with triangular facies, which most patients outgrow.[3,5,11,13,18] Her mouth had down-turned corners, and some patients occasionally also have the philtrum upturned, giving the overall appearance of a "shark mouth".[3,12-14] Dental findings include normal eruption of the primary dentition with normal color and number.[1,2,11,14] While our patient did not have crowded teeth, several authors have noted poorly aligned teeth crowded in small jaws.[2,5,9,11,14] The congenital absence of teeth has been reported.[6,9] A high arched palate based on clinical examination was reported and confirmed on a cephalogram, in our patient.[5,11,13] The only well-documented dental findings were reported in a patient described as the "Russell Variant" of Silver-Russell dwarfism, who also had cystic fibrosis and a normal fraternal twin.[6] Their findings of congenitally missing second premolars, reduced ramus height, increased gonial angle and blunted condyles were consistent, in our patient. In addition, our patient presented with a more obtuse angle between the anterior and posterior cranial bases, a decreased anterior cranial base length, and a normal mandibular body length. In contrast, their patient had primary teeth with slightly larger than normal mesiodistal crown dimensions, narrow arch-width and resultant crowding of the mandibular anterior teeth and a palate height which was normal. There was apparent retardation of root formation and eruption, which may have been due to the cystic fibrosis.

True generalized microdontia is exceedingly rare, with a frequency of 0.2 percent in the permanent dentition.[29,30] The teeth are well-formed, with a crown size smaller than two standard deviations from the mean.[31]

Crown size reduction has been associated with low birth weight and endocrine abnormalities, particularly pituitary dwarfism of early onset.[29,31-36] Patients with a diagnosis of interuterine growth retardation, however, would not be expected to have teeth so small as to be classified as microdontia.

SUMMARY

The pertinent clinical systemic and oral findings have been presented. Systemically, the patient presented with prenatal onset of growth retardation marked by an initial low birth weight, hemiatrophy, normal head size, frontal bossing, and triangular facies. Oral findings include an intact appearing primary dentition marked by microdontia, congenital absence of second premolars, blunted condyles, decreased anterior and posterior cranial base lengths, a mild hypoplastic mandible, and decreased facial height.

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Delayed eruption associated with an odontoma

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Many cases of odontomas have been reported in the dental literature. Odontomas comprise 22 percent of odontogenic tumors in the jaw.[1] They are composed of enamel, dentin, cementum and pulp tissue. They are all classified as composite odontomas or may be subclassified as compound or complex. When the composite odontoma is composed of material resembling the morphology of a tooth or multiple teeth, it is classified as a compound odontoma. If the odontoma consists of an unorganized mass of odontogenic tissues, it is termed a complex odontoma.

Complex odontomas comprise approximately 25 percent of all odontomas and have a predilection for the posterior mandible in females. Compound odontomas are more common, exhibit no sex predilection, and tend to occur in the anterior maxilla.[2]

The etiology of odontomas is uncertain but hypothesized to involve local trauma, infection, inheritance or mutant gene interference with genetic control of tooth development.[3,4]

CASE REPORT

This thirteen-year-old male was under dental care at a military dental facility since age six for routine preventive and restorative care. His medical and dental history was unremarkable until January 1981, at age nine, at which time his left maxillary primary central incisor was extracted to encourage eruption of the permanent successor. The adjacent permanent incisor erupted normally some time earlier (Figure 1). Seven months later, in August 1981, the permanent incisor was still unerupted and a new radiograph was taken (Figure 2). At this time the patient was referred to an oral surgeon for further evaluation.

The gingival tissue was reflected and a window of

Figure 1. Radiograph in January 1981 showed unerupted maxillary left central incisor and retained primary incisor.

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Figure 2. Radiograph taken in August 1981 after extraction of retained primary incisor showed no change in eruption of permanent successor. The radiopacity, which was clinically present, went undetected in the radiograph.

bone was removed overlying the unerupted incisor. The blood clot was twice removed at three-day intervals to aid in the eruption of the tooth. Three months later the patient returned and a new periapical radiograph showed no further eruption. The patient was then referred to the Department of Pedodontics. A panoramic and periapical radiograph showed no further root development had occurred during the past year (open apex), when compared with the earlier radiographs. A radiopaque mass was first noted on the crown of the incisor and a differential diagnosis of odontoma or enamel pearl was made. It was decided to monitor the tooth over the next six months.

The patient returned seven months later (June 1982) with symptoms of pain and swelling in the region of the unerupted central incisor. A fistula that suppurated when probed was present on the alveolar ridge. The unerupted incisor could be located through the fistula by probing. After consultations with the Departments of Endodontics and Oral Surgery, it was decided to encourage the tooth to erupt by orthodontic means. The pulp vitality would be tested as soon as feasible.

Both maxillary first permanent molars were banded and the maxillary lateral incisors and right central incisors were bonded on 17 June 1981, and .020 round wire was ligated into place (Figure 3). Two weeks later a flap was reflected to locate the tooth (Figure 4). At this time a bracket was bonded to the facial surface and the flap sutured back into position. Elastic thread was tied from the unerupted incisor to the arch wire. At no time was there evidence of a pathological condition on the facial surface. The lingual surface was embedded in bone. Over the next 1.5 months, the left central incisor was gradually extruded. On 16 August, the pulp was tested with cold, and normal response was elicited. Edgewise wire was used until 8 November, when all brackets were

Figure 3. Maxillary molars and incisors banded and bonded to allow active eruption of incisor.

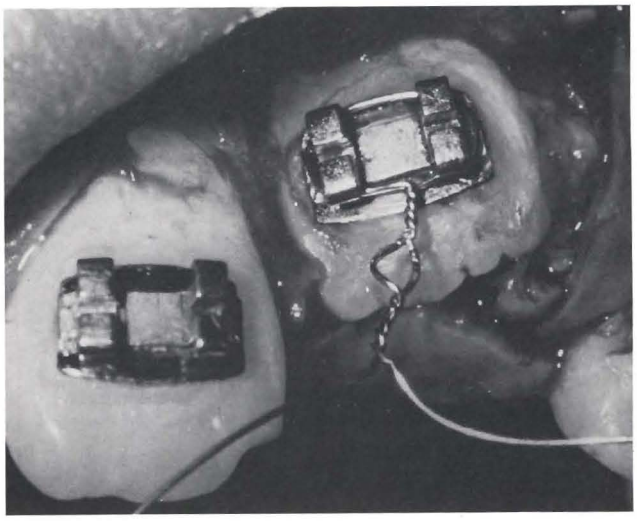

Figure 4. Surgical exposure of the unerupted incisor, to allow bonding of the bracket.

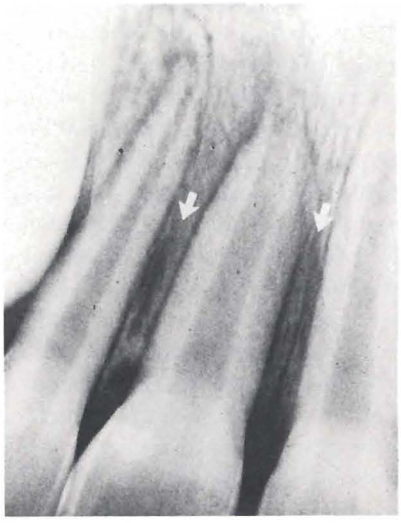

Figure 5. Postorthodontic radiograph in November 1982, showing presence of radiopacity with a halo of radiolucency.

removed. Photographs and a periapical radiograph were taken, at which time the radiopaque lesion was again noted. The presumed original diagnosis of an enamel pearl was no longer valid (Figure 5). The palatal gingiva was also found to be abnormal in morphology and texture (Figure 6). The patient was referred for oral surgery and on 24 November, a one- millimeter, white, calcified

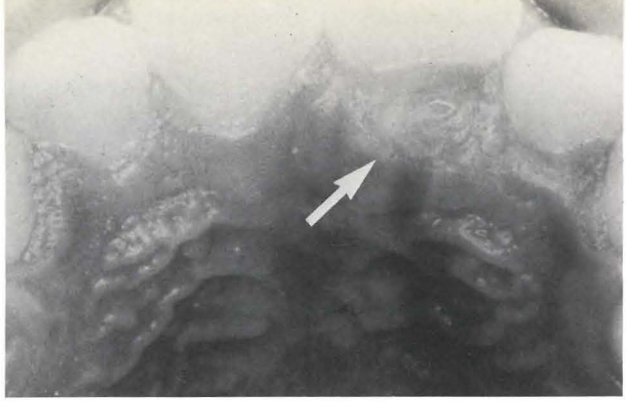

Figure 6. View of palatal gingiva showing abnormal morphology and texture, November 1982. (Courtesy of Richard C. Edwards, Chief Department of Oral Surgery at USAF Regional Hospital Maxwell AFB).

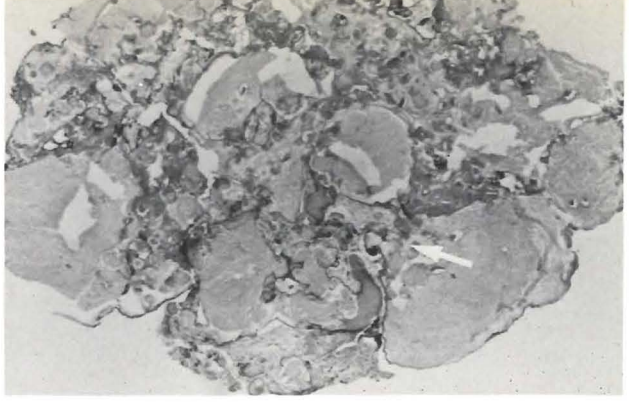

Figure 7. Photomicrograph of unorganized mass of enamel, dentinoid material and epithelium (H & E, orig mag × 40). Arrow points to area shown in higher magnification in Figure 8.

mass was removed, under local anesthesia. No recurrence of the lesion occurred, as of July 1983.

Histologic findings

The histologic results were confirmed by the Armed Forces Institute of Pathology to be consistent with a complex composite odontoma. The lesion consisted of an unorganized mass of enamel, cementum, dentinoid material, and epithelium (Figure 7). Figure 8 shows additional areas of odontogenic epithelium with keratinization and cells devoid of nuclei, giving them a "ghost-like" appearance.

DISCUSSION

This patient presented with an unusual complex odontoma, which delayed the eruption of a permanent central incisor. Delayed eruption of one incisor may be caused by a supernumerary tooth, dilaceration, early loss of the primary tooth, or as in this case, an odontoma. Conservative treatment was followed, waiting for the permanent central incisor to erupt. The treatment in this case was prolonged, however, by the failure initially to diagnose the opacity. Although extraction of the primary tooth was indicated, the opacity should have been further diagnosed by utilizing several radiographs from various angles to differentiate between an enamel defect and an odontoma. Active intervention would have begun, therefore, months earlier. This odontoma presented with ghost-cell keratinization, a phenomenon first reported in 1973 by Levy.[3] He observed this condition in eight cases, four of which occurred in the maxillary central incisor region, in 20 percent of the odontomas. His hypothesis on the etiology of ghost-cell formation stated that as the dentin and enamel formed, they cut off the blood supply from the enamel epithelium. This led to cell death and keratinization, which

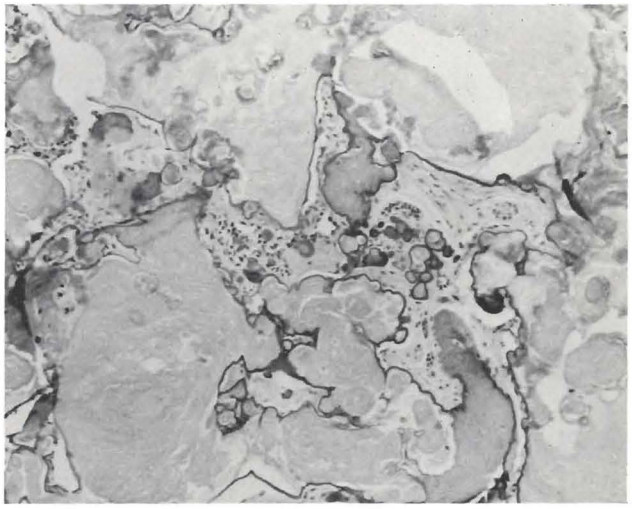

Figure 8. Sheets of eosinophilic, swollen epithelial cells that have lost their nuclei, but still demonstrate a faint outline of the cellular and nuclear membrane. Within the cellular stroma are islands of dystrophic calcification and islands of odontogenic epithelium (H & E, mag × 100).

formed the ghost cells. A subsequent article by Sedano and Pindborg in 1975 reported a 10 percent incidence of ghost cells with 16 percent occurring in the complex odontomas.[5]

Following active orthodontic and surgical intervention, the central incisor was brought into alignment.

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Special acknowledgement to Major Richard C. Edwards, Chief Department of Oral Surgery at USAF Regional Hospital Maxwell AFB for his surgical removal of the lesion.

Multiple dental extractions in a child with Glanzmann's thrombasthenia: report of case

Jean R. Jasmin, DCD, DSO
Didier Dupont, MD
Patrick Velin, MD

Glanzmann's thrombasthenia is an inherited autosomal recessive disorder of platelet function, which was depicted first in 1918.[1] It appears often among certain ethnic groups, such as gypsies and Zoroastrians; family histories disclose consanguinity in 10 percent of cases. The hemorrhagic tendency, which is usually diagnosed during the first trimester of life, is the main feature of this condition. The clinical symptoms are characterized by varying degrees of mucosal and cutaneous bleeding, epistaxis, frequent superficial bruises, gingival bleeding, menorrhagia, prolonged bleeding from superficial injuries, surgical procedures, dental extractions and during postpartum. The hematologic factors include a prolonged bleeding time with a normal platelet count, a defective clot retraction, and failure of platelets to aggregate in response to adenosine diphosphate (ADP), epinephrine, collagen, thrombin or arachidonic acid; but aggregation occurs normally with ristocetin and bovine factor VIII, in contrast to the Bernard Soulier syndrome, in which the opposite aggregation pattern is seen.[2-4] A deficiency of the glycoproteins currently designated IIb and III seems to be the physiopathologic support of this disease.[5] Two types have been individualized: type I, which is the more frequent and characterized by an absence of clot retraction and an absence of glycoproteins and fibrinogen; type II, which exhibits a certain degree of clot retraction with less diminished glycoproteins and fibrinogen. Patients affected by this disease are supplemented by transfusions of fresh platelets and maintenance of blood volume and constituents.

This report describes a dental surgical procedure in a child suffering from Glanzmann's thrombasthenia without the use of platelet transfusion.

CASE REPORT

On November 14, 1983, Ernest B., a nine-year-old caucasian male born from gypsy parents, was referred by his pediatrician to Lenval Children's Hospital in Nice, for

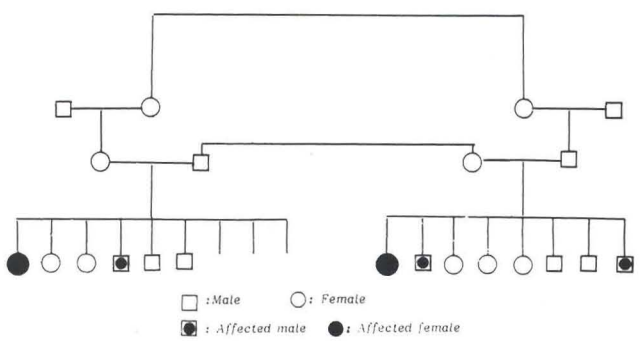

Figure 1. Proband's family pedigree.

Dr. Jasmin is Director of the Pedodontics Department; Dr. Dupont is Director of the Intensive Care Department; and Dr. Velin is Assistant Director of the Intensive Care Department, Lenval Children's Hospital, 06200 Nice, France.

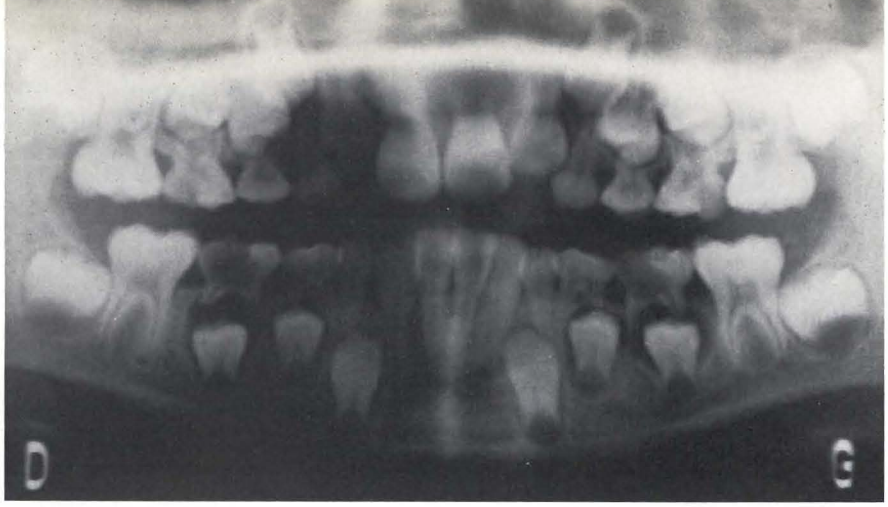

Figure 2. Proband's panoramic radiograph.

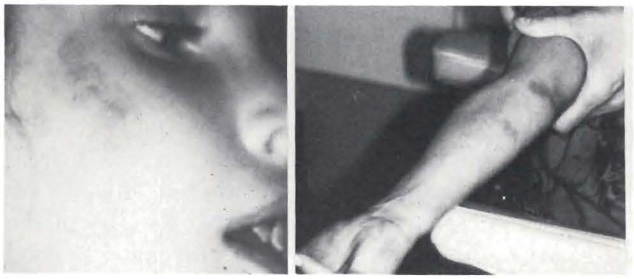

Figure 3. Proband's face and arm showing bruises.

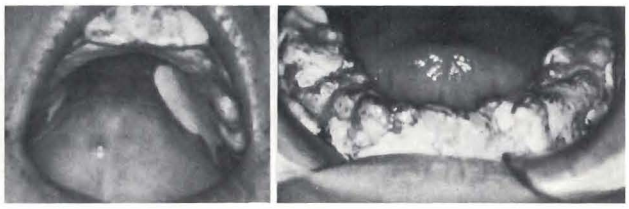

Figure 4. Splint in position; the periodontal pack enhances the physical pressure.

painful teeth. The medical history disclosed that the child was diagnosed as suffering from Glanzmann's thrombasthenia; between February 1977 and October 1983, there were fifty-five hospital admissions for treatment of prolonged bleeding: forty-four massive epistaxes, one gingivorrhagia, three hemarthroses, one macroscopic hematuria and six hospital admissions in the department of surgery for painful abdominal syndromes, among which one at least was related to an intradural hematoma of the small intestine and one for an acute intestinal invagination. During the numerous hospital admissions, the child received twenty-seven transfusions: fresh whole blood, fresh platelets and platelet concentrates. Since this series of events, determinations for the presence of alloantibodies were made monthly, using three different tests: saline, red cells heated with bromelin, and the indirect Coombs' test. In 1982 and 1983, the patient was tested for anti HL-A antibody by microlymphocytotoxicity. All tests were negative.

Family history disclosed consanguinity; the parents are first cousins. Ernest is one of the eight siblings; his eldest sister and his youngest brother are affected by the same condition and had multiple hospital admissions for epistaxis and hemorrhagic manifestations. Further investigations revealed that two first cousins are affected by a disorder similar to that seen in our patient. The pedigree of Ernest's family discloses a recessive autosomal inheritance (Figure 1).

TREATMENT

When admitted to hospital on November 14, 1983, the child complained of pain upon percussion in both mandibular primary second molars. The clinical examination disclosed four severely carious teeth (all the primary second molars) and a crowded dentition, which necessitated serial extractions. A panoramic radiograph (Figure 2) showed the mandibular second primary molars with apical abscesses and the maxillary second molars with pulps exposed by caries. At this time the patient presented with numerous bruises (Figure 3) and an epistaxis that required a pack.

One month later, on December 10, consultation with the patient's hematologist and the anesthesiologist led to the decision to hospitalize the child for extractions under general anesthesia. The hematologic status of the child was as follows:

Red blood cells: 4,400,000 White blood cells: 9,900
Hemoglobin: 11,5g/100ml Hematocrit: 36,5%
Platelet count: 375,000/ml Bleeding time (Ivy's method): 20 min. Kaolin cephalin time: 43s (normal 38-48s) Prothrombin time: 35 (normal 35) Fibrin: 4g/l

Mandibular and maxillary alginate impressions were taken to prepare for the construction of splints for both arches, using a soft acrylic. Because the patient's physical findings were normal in all aspects, replacement therapy was not instituted to prevent the development of alloantibodies. Nevertheless, two units of platelet concentrates and two units of fresh frozen plasma were

made available, in case of massive postoperative bleeding.

Halothane applied with a mask was used for induction of the anesthesia, and intubation was oral to avoid the risk of epistaxis. The anesthesia was maintained by inhalation of oxygen, nitrous oxide and halothane. Analgesia was provided with fentanyl.* Eight primary teeth were removed as atraumatically as possible, no abnormal bleeding was observed during surgery; the sockets were packed with a resorbable, oxidized, regenerated cellulose (Surgicel†) and sutured with a resorbable material; the splints were inserted and stabilized, using a periodontal dressing (Coe pack ‡) (Figure 4). The recovery was uneventful. A few hours later, there was a slight oozing from the mandibular right sockets; this oozing stopped spontaneously a day later. A hematologic analysis showed:

Red blood cells, 3,950,000; Hemoglobin, 10,9g/100ml; Hematocrit, 37 percent.

In view of these results and in the absence of oozing, no replacement therapy was needed; three days later the child was discharged. The splints were removed ten days following surgery, and the healing of the extraction sites was satisfactory (Figure 5).

DISCUSSION

Glanzmann's thrombasthenia is a bleeding disorder, severity of which is related to the heterogeneity of the disease, and which may improve spontaneously with age. A treatment of the cause does not exist; the only effective therapy consists of transfusions of fresh platelets or of platelet concentrates. Patients afflicted with Glanzmann's thrombasthenia are doubly at risk:

- ☐ Hemorrhagic complications, which may be overcome by supplemental therapy.
- ☐ Development of alloantibodies, following a transfusion of platelets, and posttransfusion thrombocytopenic purpura.[6,7]

Because dental extractions present a significant challenge to hemostasis, a careful medical history, including the frequency of the bleeding episodes, the number and specificity of treatments, is necessary to determine the best course of treatment. In our case report, a local hemostatic agent combined with sutures and physical pressure obtained with splints were sufficient to control the postsurgical bleeding. Although there was a slight oozing during the twenty-four hours immediately following the surgery, the postoperative stability of the blood state was reassuring; the stability of the blood state, if within normal limits, allows the clinician to avoid supplemental therapy, which in the course of time could account for development of alloantibodies.

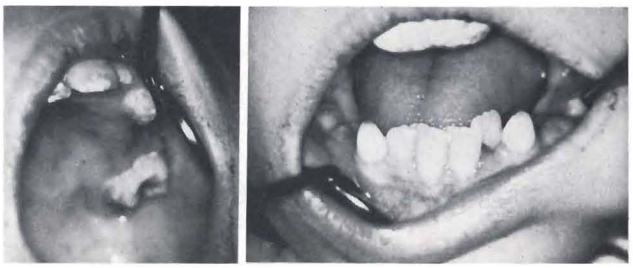

Figure 5. Healing of the extraction wounds ten days after surgery.

CONCLUSION

Our case report gives evidence that dental extractions are possible in children suffering from severe Glanzmann's thrombasthenia, as it was for our patient, without using supplemental therapy. Local hemostasis was achieved with resorbable, oxidized cellulose and physical pressure. A slight oozing that ceases within twenty-four hours does not require a transfusion of platelets, if the blood homeostasis remains within normal limits.

* Fentanyl: Laboratoire Janssen-Le Brun, 5 rue de Lubeck, 75116 Paris, France.
† Surgicel: Surgikos, Johnson & Johnson, 29 rue Mac Mahon, 75017 Paris, France.
‡ Coe Pack: Coe Laboratory Inc., Chicago, IL 60658.

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manageable young children, subjects received either 50 mg/kg or 75 mg/kg chloral hydrate, over two visits.[5] Successful sedations occurred in only 25 percent of the cases for either dosage. No doubt, the relative success is highly dependent on the level and severity of apprehension/resistance of the child. Less drug will be required for lower levels of pretreatment anxiety. Given the paucity of controlled data, there is considerable need for further study in this area. Future investigations should seek to identify valid and reproducible behavioral selection criteria, in order to assess the effectiveness of various dosage schedules for rectal chloral hydrate.

Based on limited evidence, it appears that dosages in excess of 50 mg/kg chloral hydrate, rectally, are needed to overcome severely resistive behaviors in young children (when chloral hydrate is used alone).

I would add that there are several ways in which compliance with oral ingestion can be enhanced. One method we use with considerable success is to add medications to a small can or package of commercial fruit juice (pour out about half of the juice) and have the parent give the container to the child with a straw. Most children enjoy drinking from a straw, and if kept NPO for 4-6 hours, will be rather thirsty. When this fails, we attempt rectal administration. When rectal dosages of 50- 75 mg/kg fail, we seriously consider general anesthesia.

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A second reply

☐Rectal chloral hydrate can be administered in several concentrations. The most popular concentrations are the 324 mg, 500 mg and 628 mg suppositories. They are usually placed in the rectum as far as possible and generally held in position for only a few seconds. After the placement of the suppository, the patient is placed in the prone position and the administrator holds the buttocks together for at least a couple of minutes. The suppository is then absorbed, either in the lower rectum which delivers blood to the liver or because of reverse peristalsis, the suppository is moved higher in the rectum and absorbed in the venus blood supply and bypasses most liver metabolism for awhile. This will allow better systemic effects from rectal administration of the drug, as opposed to the oral route. Fecal material in the bowel should not cause any problem with absorption; but, if there is fecal material in the rectum, the suppository will be expelled or delayed absorption can be expected.

It is important that the patient be non per os (NPO) for two reasons. The most important reason is for the safety of the patient. It is possible that rectal, and for that matter, oral drugs can produce a fairly deep level of sedation, perhaps bordering on light general anesthesia. If the patient has had some food or fluid intake four to six hours prior to sedation they are at risk of regurgitation and aspiration. The second reason is that whenever we take normal food or fluid intake, this stimulates not only esophageal peristalsis but also rectal peristalsis. If the latter were the case, it is less likely that the suppository would be absorbed in the upper rectal area.

Generally, the onset of action of rectal chloral hydrate is about 30 to 45 minutes. This is when the peak clinical effect of the sedation will occur. However, the duration of action of most drugs given either internally or rectally can vary considerably. In general, we found the working time for chloral hydrate suppository sedation (50 mg/kg) was approximately an hour or more, if nitrous oxide is used.

The caveat to any deep sedation technique is monitoring the airway as well as the peripheral oxygenation with pulse oximetry. Chloral hydrate can be a very safe drug when utilized with proper monitoring techniques, as well as the use of an assistant who can continually support the airway, if the patient becomes very sleepy, to a point of deep sedation.

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ABSTRACTS

Shulman, Elliot R. and Corio, Russell, L.: Delayed eruption associated with an odontoma. J Dent Child, 54:205-207, May-June, 1987.

A case of delayed eruption of a permanent central incisor is presented. Orthodontic extrusion was necessary to bring the tooth into alignment after surgical exposure was unsuccessful. A subsequent finding of the presence of an unusually formed odontoma exhibiting ghost cell keratinization was reported.

Delayed eruption; Odontoma

Motokawa, Wataru; Ozaki, Masao; Soejima, Yoshio; Yoshida, Yutaka: A method of mixed dentition analysis in the mandible. J Dent Child, 54:114-118, March-April, 1987.

There are numerous methods available for mixed dentition analysis. The authors present a method (ILIW) of space analysis in the mandibular arch and compare it with three other analyses (Ono, Moyers, Ballard and Wylie) for

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ABSTRACTS

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accuracy of the predicted mesiodistal widths of unerupted permanent canines and premolars. The authors use a modified, fine-tipped electric digital caliper directly measuring the diameter of the patient's dentition.

Space maintainers, Arch length, Interlateral Incisor Width Analysis

McGaw, Tim; Raborn, Wayne; Grace, Michael: Analgesics in pediatric dental surgery: relative efficacy of aluminum ibuprofen suspension and acetaminophen elixir. J Dent Child, 54:106-109, March-April, 1987.

The relative analgesic efficacy of aluminum ibuprofen suspension, acetaminophen elixir, and placebo liquid was compared following dental extractions in children. At one hour and two hours, aluminum ibuprofen provided significantly superior analgesia, compared with acetaminophen and placebo ($p<0.05$). Total pain relief rating and global rating of drug efficacy were statistically superior for aluminum ibuprofen.

Dental surgery, Analgesic, Ibuprofen, Acetaminophen

Salman, Richard A.; Glickman, Robert S.; Super, Stuart: Splint therapy for electrical burns of the oral commissure in children. J Dent Child, 54: 161-164, May-June, 1987.

Both arc and contact burns to the mouth can be fatal; electrical burns to the commissure follow a generally slow wound-healing process depending on site and severity, with up to one year for the post-burn scar to become stable. Fabrication of an acrylic splint to minimize the effects of contraction and the subsequent development of microstomia is described.

Oral commissure; Electrical burn; Wound healing; Acrylic splint; Microstomia

Foreman, Frank J. and Theobald, William D.: Direct bonded glass ionomer crowns. J Dent Child, 54:165-169, May-June, 1987.

An alternate method of restoring incisors that lack sufficient enamel or tooth structure for composite resin crowns-and stainless steel crowns are not desired-is with the use of direct bond glass ionomer crowns. Three patient's clinical experiences are reported here, followed for up to one year. The procedures are relatvely quick, easy, atraumatic, adaptable to a wide range of clinical settings.

Direct-bonding; Glass ionomer crowns

Craig, Graham, G.; Powell, Keith R.; Cooper, Maxwell H.: Clinical appearance of permanent successors after nonextraction treatment of grossly carious primary molars in highly anxious children.J Dent Child, 54:170-175, May-June, 1987.

Primary molars that still had relatively intact pulp chambers were treated with a modified pulpotomy technique, using a mixture of antimicrobial agents. Those with little or no remaining crown structure were treated with metal fluorides. Following eruption, the permanent successors were examined for enamel defects; 65 percent of 49 teeth showed no discernible defects. Remaining tooth defects were minor. The treatment approach adopted did not appear to put enamel at risk.

Enamel defects; Nonextraction methods; Dental anxiety; Primary molars

Ralstrom, Curtis S.; O'Riordan, Michael; Krieger, Ingerborg: A new feeding device for treatment of glycogen storage disease. J Dent Child, 54:176-178, 1987.

An intraoral prosthesis is described that allows a slow-drip infusion of concentrated feeding solutions into the posterior aspect of the oral cavity. The device consists of an acrylic palatal plate containing a round canal, into which an exchangable polyethylene feeding tube is inserted, delivering a slow drip by infusion pump. Successful use in a patient with glycogen storage disease type I is described.

Glycogen storage disease; Removable feeding appliance

Nik-Hussein, Nik-Noriah and Salcedo, Aida: Double teeth with hypodontia in identical twins. J Dent Child, 54:179-181, May-June, 1987.

A pair of monozygotic twins were seen; each had a double tooth and a missing mandibular lateral incisor in the primary dentition. Moreover, one of them had a supernumerary tooth fused to the maxillary central incisor. The radiographs of the succedaneous teeth showed hypodontia of the permanent dentition, which might be related to the other conditions also present in the twins.

Double teeth; Hypodontia; Monozygotic twins; Agenesis

Waldman, H.B.: Who uses the services of pediatric dentists? J Dent Child, 54:182-185, May-June, 1987.

A review of children's use of dental services by various demographic characteristics and dental practitioners is provided.

Pediatric dentistry; Dental practioners; Demographics

Rubinson, Laurna and Tappe, Marlene: An evaluation of a preschool dental health program. J Dent Child, 54:186-192, May-June, 1987.

This study determined the effects of a preschool dental health program in terms of its impact on students, teachers, and parents. Groups were significantly different on posttest knowledge scores. There was also a strong positive correlation between student knowledge scores and parental involvement in the study.

Dental health education; Preschool program