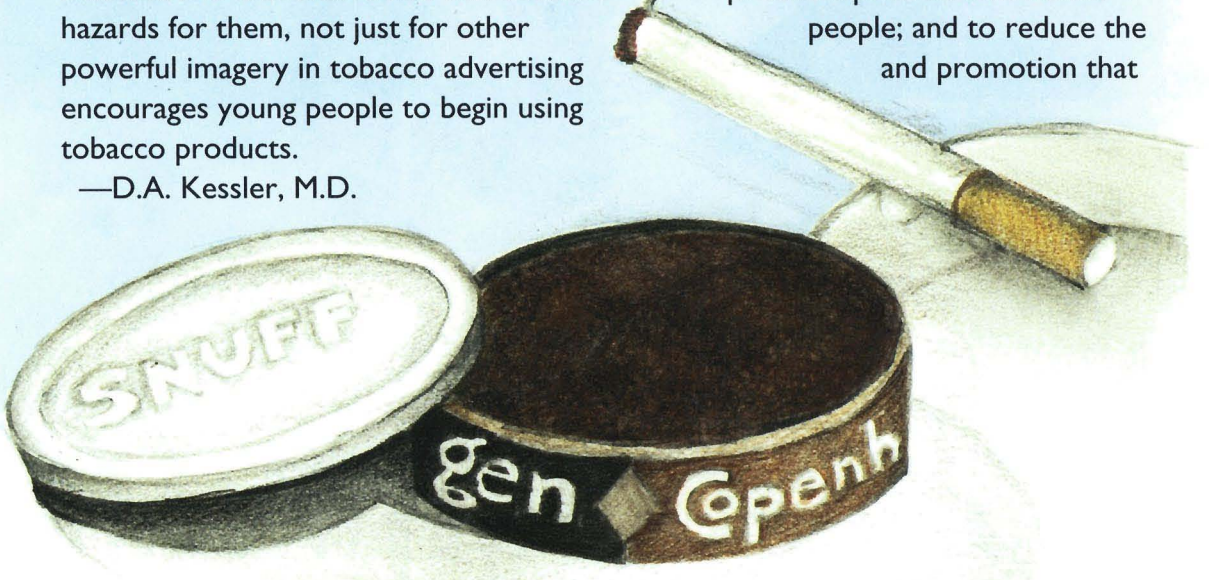
ASDC
AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN
JOURNAL OF DENTISTRY FOR CHILDREN
NOVEMBER——DECEMBER 1995

Ask a smoker when he or she began to smoke, and chances are you will hear the tale of a child. The image of children sneaking away to experiment with tobacco is a familiar one, and people often consider smoking a rite of passage. But many young people progress steadily from experimentation to regular use, with addiction taking hold within a few years, making the image more disconcerting. Between one third and one half of adolescents who try smoking even just a few cigarettes soon become regular smokers.

With some 40 million smokers in this country addicted to nicotine, a ban on tobacco is not feasible. Abrupt removal of these products from the market could lead to serious adverse effects on those addicted to nicotine and possibly result in a black market as well. A more reasonable approach is to focus on the problem of smoking where it begins—in young people. A comprehensive and effective policy is needed to prevent future generations of young people from becoming addicted to nicotine in tobacco. Such an approach should have three objectives: to reduce access to tobacco products by children and teenagers; to convince young people that nicotine is addictive and that tobacco products pose serious health hazards for them, not just for other people; and to reduce the powerful imagery in tobacco advertising and promotion that encourages young people to begin using tobacco products.

—D.A. Kessler, M.D.



SMOKING BY PARENTS IS THE PREDOMINANT DETERMINANT OF THE LEVEL OF CHILDREN'S EXPOSURE TO ENVIRONMENTAL TOBACCO SMOKE.
—*Jonathan M. Samet* etal

ASDC

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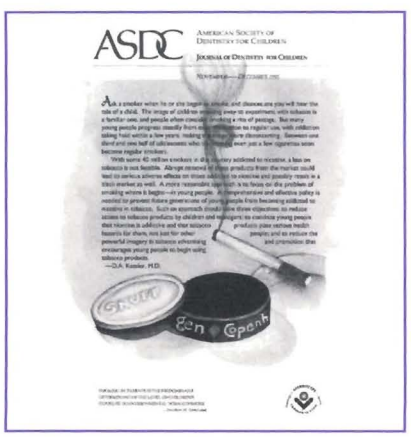

Many young people progress steadily from experimentation to regular use, with addiction taking hold within a few years. Forty million people in the United States are considered to be addicted to nicotine.

Art and design by Sharlene Nowak-Stellmach

NURSING-BOTTLE CARIES

HEALTH SERVICES

CLINIC

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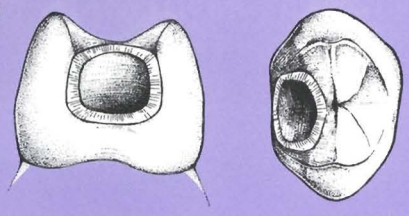

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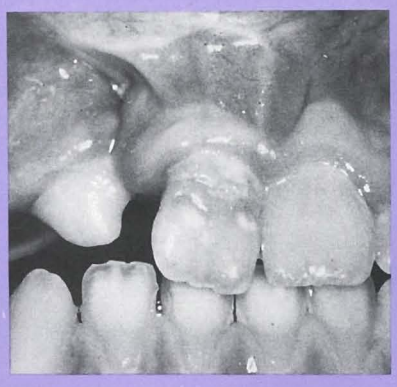

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MANPOWER PLANNING

Calendar

1996

ASDC Annual Meeting, Westin Canal Place, New Orleans, LA, October 23-27
3rd Congress of the European Academy of Paediatric Dentistry, June 8-11—Bruges, Belgium—Pre-Congress June 7-8, 1996
8th Annual National Conference on Special Care Issues in Dentistry, April 19-21
VIII Latin American Congress of Pediatric Dentistry, August 28-31, Lima, Peru

1997

ASDC Annual Meeting, Registry Resort, Naples, FL, October 22-26

For The Busy Reader

Nursing-bottle caries: The importance of a developmental perspective—page 381

The progressive character and the specific pattern of the decay draws special attention. Nursing-bottle caries can be considered a process: depending on its stage of development, it has typical clinical manifestations based on the preceding stage and predictive of the next stage. Complicated by a particular eruption pattern, the nature of the cariogenic agent and the time of exposure to the latter are the primary contributors to the seriousness of the disorder.

Requests for reprints should be sent to: J.S.J. Veerkamp, ACTA/Pediatric Dentistry, Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

The delivery of dental and medical services in Canada—page 387

It behooves us to understand the workings of a national system for health care in a country that maintains that dental services are a nonessential component, because in the United States, in the foreseeable future, dental care will probably play no role in any health care system the country may adopt.

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

Two-year results with box-only resin composite restorations—page 395

The authors describe the results of box-only (a box-without-step) restorations in terms of treatment times and postoperative sensitivity. Marginal adaptation and radiographic findings are described for a two-year period. No differences in radiographic characteristics were observed among the three restorative materials.

Requests for reprints should be sent to: C.M. Kreulen, Department of Pediatric Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

Dental caries and its determinants in 2-to-5-year-old children—page 401

The authors describe on a group level the prevalence and the various determinants of dental caries, during the three-year observation period. Two hundred and fifty-two children, with an average age of 2.3 years (range 1.9 to 2.8 years) participated in the study. At the age of five years, 193 children were still in the study.

Requests for reprints should be sent to: Dr. J. Roeters, Department of Cariology and Endodontology, Faculty of Medical Sciences, University of Nijmegen, P.O. Box 9101, 6500 HB Nijmegen, The Netherlands.

Modifications of the palatal crib habit-breaker appliance to prevent palatal soft tissue embedment—page 409

Two simple modifications of the palatal crib appliance may prevent its palatal soft tissue embedment. The modifications include the use of heavier palatal wires and an acrylic palatal button. The palatal displacement of the appliance can cause infection, discomfort, anxiety, and bilateral mesial tipping of the banded molars.

Requests for reprints should be sent to: LTC Norman W. Ott, DMD, U.S. Army Pediatric Dentistry Residency Program, U.S.A. Dental Clinic Command, Fort George G. Meade, MD 20755-5700.

Abnormalities of the maxillary incisors in children with cleft lip and palate—page 412

The authors analyze the prevalence of dental abnormalities in number, size, and shape of the primary and permanent maxillary incisors in children with unilateral or bilateral clefts of the lip and alveolar process, with or without palatal involvement. Seventy-seven patients, ages three to sixteen, were selected for the study.

Requests for reprints should be sent to: Dr. Marco Vichi, Department of Orthodontics, University of Florence, Via Ponte di Mezzo 46, 50127 Florence, Italy.

Manpower planning for the children of your current pediatric dental patients—418

The increases in the general and child populations will be occurring at a time of marked decreases in the numbers of dentists, resulting in the lowest ratios of dentists-to-population recorded in the 20th century. Providing dental services for the overall increases in the numbers of children (particularly minority children) requires a review of the projections of the future availability of dental personnel.

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

Correction and update: Interest in pediatric dentistry—page 426

Between 1988 and 1993, there has been a progressive decrease in the number of dental school graduates (from 4,581 to 3,778). The numbers planning on specialty training have also decreased: The percent varied from 19 to 23 percent. The interest in pediatric dental specialty training remained relatively constant, 19.2 percent.

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

NURSING-BOTTLE CARIES

Nursing-bottle caries: The importance of a developmental perspective

J.S.J. Veerkamp, DDS, PhD
K.L. Weerheijm, DDS, PhD

In the last twenty years, the dental caries incidence declined dramatically. In the Netherlands this trend seems, however, to have levelled out in recent years. Based on a longitudinal epidemiological study, 55 percent of five-year-old children in 1987 as well as in 1993 have no dental cavities.[1] Stable figures indeed, for the last six years, but hardly any further improvement. One of the important reasons for this stabilization, rather than continued improvement, could be the incidence of dental caries in very young children, babies and toddlers.[2-5]

As soon as the decay affects the maxillary, primary incisors (among others), the name most commonly used is nursing-bottle caries. Other names mentioned in the literature are rampant caries, baby-bottle caries, nursing-bottle syndrome, milk-bottle syndrome, bottle-mouth caries, early-childhood caries, baby-bottle tooth-decay and nursing-caries.[6-8]

Though scientifically solid evidence is only available from clinical trials, the relationship of dental decay in the maxillary primary incisors and the use of a sweetened comforter (a bottle containing sweet beverages of any kind or breast feeding on demand at night after six months of age) has been reported so often that a cause-and-effect relationship is highly likely. In this article we will use the name, nursing-bottle caries, not because it is referring to a single cause, but merely because of its general acceptance.

The authors are with the Pedodontic Department of the Academic Centre for Dentistry (ACTA), Amsterdam.

A DEVELOPMENTAL APPROACH

The progressive character and the specific pattern of the decay draws special attention. Nursing-bottle caries has been reported in very young children.[9-11] Caries in young children affecting the maxillary anterior teeth, among others, is often attributed to the use of a sweetened comforter, even when other factors might constitute the main cause. Nursing-bottle caries can be considered a process: depending on its stage of development, it has typical clinical manifestations based on the preceding stage and predictive of the next stage. The nature of the cariogenic agent and the time of exposure to the latter are the main contributors to the seriousness of the decay; but the eruption pattern appears to be a serious complicating factor. Many studies on the subject experience difficulty in explaining this aspect of the syndrome. Studying groups of children with nursing-bottle caries, the age-limits of the groups studied are often too extended. The group encompasses several developmental stages of the primary teeth and, as a consequence, several stages of nursing-bottle caries. Those stages occur in quick succession in a toddler. The developmental aspect can be studied by creating a group, sufficiently large to take relationships between age and number of erupted and affected teeth into account. When this is not done, only general conclusions can be drawn. Also,

nursing-bottle caries cannot be described by creating a group of children of the same age and simply counting the total number of affected surfaces. It must be seen as a random picture of a continuous process.

When integrating the complexities of etiology and epidemiology, it seems wise to distinguish among the different developmental stages of the primary dentition.[12] Only in this way can a distinction be made between duration of a habit and the virulence of a cariogenic agent. Because of the importance of the developmental aspect of nursing-bottle caries, a general definition and four developmental stages will be presented.

DEFINITION

Nursing-bottle caries is a form of dental decay, starting shortly after their eruption, in the maxillary incisors on usually immune surfaces, the lingual surfaces. The decay pattern may be extended to include the primary molars, first the maxillary and then the corresponding mandibular teeth. The mandibular incisors are affected last.

The definition of nursing-bottle caries is not dependent on the number of affected teeth. It is dependent on the child's (dental) age and the positions of the affected teeth. In a sixteen-month-old child with nursing-bottle caries, one to four maxillary incisors will be affected; but not, however, the lower incisors nor the first primary molars. In a three-year-old child with carious lesions in all her teeth, except the four second primary molars, a different cause may be responsible: for instance, a recently terminated, at-risk feeding pattern, combined with a developmental disturbance of the enamel.

The pattern of nursing-bottle caries starts at a very young age; but in toddlers and preschoolers, other factors can play an important role. If a four-year-old child with eight dental cavities, two in the maxillary incisors and the other six evenly distributed among the primary molars, the pattern should not be labelled as nursing-bottle caries. It is unsatisfactory to call dental caries in the maxillary anterior teeth in a preschooler, nursing-bottle caries. Only when other lesions in the dentition point in this direction, can the diagnosis be considered correct, allowing the use of an appropriate therapy. When parents claim that they no longer give their child sweets, the location and extent of the lesions should support their claim.

DEVELOPMENTAL STAGES

Although occasionally hardly discernable, the pattern of nursing-bottle caries is recognizable in every stage of the disease. Early recognition is important, because at this stage, a preventive approach has its maximum effect: when a behavioral change succeeds, resulting in an effective alteration of the child's feeding pattern, the initial caries lesions can be restored to intact enamel surfaces. In general, the best treatment of nursing-bottle caries is a preventive one, regardless of its stage. A restorative effort is considered to be unsuccessful without the support of adequate prevention measures.

The time when a child with nursing-bottle caries is brought to a dentist depends on the parent's attention to the child's dental condition. Some parents notice the slightest white spot or discoloration, while others react only when the teeth are completely destroyed. In some cases, the problem-solving discussion can be brief; in others the parents suggest a number of plausible alternatives for treating their child's dental decay. In this way, every stage of nursing-bottle caries tells its own, specific story.

The major problem in early diagnosis is the relative lack of discoloration of an early lesion. The carious process begins with demineralization, white superficial lesions on the lingual or labiogingival surface of the maxillary incisors (Figure 1). Even using an air syringe, only the well-trained eye will take notice of the change in the superficial brilliance of the enamel.

Demineralizations are sometimes found interproximally, but most occur cervically in a circular pattern, the retention place for dental plaque. Discolorations occur later, mostly after damage of the enamel and dentin has occurred in areas also visible to the parents.

Every year, about 350 children (ages 14 to 45 months) are referred for treatment of nursing-bottle caries to the

Table ☐ Developmental stages of nursing-bottle caries (based on an average eruption age of the maxillary incisors at eight to twelve months and a normal eruption pattern.)

Stage	Age	Clinical appearance
1. Initial	10-20 months	Maxillary anterior teeth: opaque-white demineralizations, cervical/interproximal
2. Damaged	16-24 months	Maxillary anterior teeth: yellow-brown discolorations. Cervical/interproximal, superficial defects; #54, #64: first stage.
3. Deep lesions	20-36 months	Maxillary anterior teeth: marked enamel defects; pulpal irritations. #54, #64: second stage. #74, #84: first stage.
4. Traumatic	30-48 months	Maxillary anterior teeth: loss of large enamel/dentin parts, crown fractures, #54, #64: third stage. #74, #84: second stage.

Clinic for Special Dental Care (SBT) and the Pedodontic Department of the Academic Centre for Dentistry (ACTA) in Amsterdam. These children present with different stages of dental damage. Generally speaking, four stages of nursing-bottle caries can be seen by the dental practitioner (Table).

- ☐ *Initial (reversible) stage* Cervically and occasionally interproximally, opaque, chalky white demineralizations can be seen in the maxillary anterior teeth. For proper diagnosis, the teeth need to be dried thoroughly with an air-syringe. In fact, if the parents bring their children for regular half-year check-ups, the dentist is the only one who can make the difficult diagnosis. The dentist must be able to see clearly and to use the air-syringe to distinguish readily cervical or interproximal lesions. This stage is missed quite often. In general, an eighteen-month-old toddler is not inclined to cooperate ideally, and thus enable the dentist to make a routine examination. The general practitioner sees this stage very rarely. The demineralizations start several months after eruption, which usually is long before the child is taken by the parents for a dental visit. Pain or toothache does not occur in this stage (Figure 2).
- ☐ *Damaged (carious).* The lesions in the maxillary anterior teeth extend into the dentin and show marked discolorations (Figure 3). Because of the rapidity of the process, the discontinuity of the enamel surface, the penetration into the dentin, and the discolorations seem to take place simultaneously. Parents can spot the discolorations themselves (usually labial or lingual, occasionally interproximal). Incidentally children start complaining about toothache when extremely cold foods are ingested, such as ice-cream. The #54 and #64 are affected as in the first stage of nursing-bottle caries.
- ☐ *Deep lesions.* Lesions in the maxillary anterior teeth are larger (Figure 4). Depending on the time of eruption, the cariogenicity of the sweetened comforter, and the frequency of its use, this stage can be reached in ten to fourteen months. The first primary molars are all affected: the #54 and #64 are in the second stage, and the #74 and #84 have initial lesions (Figures 5 and 6). Depending on the factors mentioned above, lesions can be seen in #53 and #63 (Figure 4). Complaints of pain during toothbrushing or eating, especially when biting, are frequent. Incidentally, pulpal problems in the maxillary incisors can occur (spontaneous pain during the night; and pain after hot or cold drinks, lasting for several minutes). In this stage the diagnosis could be made easily, even without actually seeing the child's teeth (eg. after a telephone call). If the parents report problems in brushing their child's maxillary teeth, while brushing of the mandibular teeth does not present problems, and the child uses

Figure 1. Cervical demineralizations in #51, #52 and #53 indicate the beginning of nursing-bottle-caries. In #61, #62 and #63 a discontinuity of the surface is already visible.

Figure 2. Antony (18 months). The maxillary teeth erupted twelve month ago. Though #62 has proceeded to the next stage, the lesions in the other teeth are still reversible. A preventive approach can still achieve a maximum result.

Figure 3. Bronco (18 months), stage 2: while the parents are still waiting for the eruption of the lateral incisors, the central incisors are affected quickly.

Figure 4. Caldo (stage 3/4). Frontal view. The maxillary canines are affected. The #62 has been broken.

Figure 5. Maxilla (occlusal view). The first molars are deeply carious.

Figure 6. Mandibular (occlusal view). The teeth are affected in accordance with the eruption pattern, but the mandibular incisors remain intact.

Figure 7. Donovan (stage 4). Frontal view. The maxillary incisors simply fractured.

Figure 8. Maxilla. (occlusal view). The second molars are seriously affected. Possibly the sweetened comforter is no longer the single cause.

Figure 9. Mandible. (occlusal view). The size of the lesions in the first molars should not be underestimated, but the lesions in #75 and #85 are larger, possibly indicating causes other than the use of sugar nocturnally.

Figure 10. Arrested caries (stage 4), after ending the habit of ingesting a sweetened comforter.

the canines to incise, a diagnosis of nursing-bottle caries is highly likely.

☐ *Traumatic stage*. Neglecting all the previous symptoms, the teeth (starting with the maxillary incisors)

can become so weakened by caries that relatively small forces suffice to fracture them. If a child (toddler or preschooler) visits a dentist after having fractured one or several teeth cervically, a diagnosis of nursing-bottle caries is almost a certainty. Parents occasionally report an accident that occurred several months ago, leaving their child with only roots remaining. The loss of the teeth is erroneously attributed to the accident. A toddler learns to walk, when the protective reflexes (thrusting his hands forward) have not been fully developed. Thus the child can fall on its face, mouth or teeth, sometimes without the parents noticing, because the child gets up and totters to another object. In general, fractures of solid primary teeth are very rare. The direction of the trauma will cause a luxation, or more seriously, an intrusion or dilaceration, but very seldom a fracture. If a tooth is weakened by nursing-bottle caries, it will be inclined to fracture in the weakest spot. If teeth have fractured cervically, the reason most likely is weakening by dental caries (Figure 7). In case of fracture of a primary tooth, a thorough investigation of the remaining teeth is mandatory, difficult as this might be. A discussion of the child's eating pattern should also occur. The first maxillary molars are in the third stage (Figure 8). Pulpal problems in this situation are caused by caries in the first molars. The maxillary incisors already have become nonvital in most of the cases. The first mandibular molars are in the second stage of the process (Figure 9). The #53, #63, #55 and #65 might have lesions in the second stage.

☐ *Arrested caries.* In all the previous stages arrested caries might occur, when the cause of the dental caries is eliminated (Figure 10). During the full or partial remineralization, the lesion might get a typical dark-brown-to-black appearance.

PRESENTATION TO THE PARENTS

Since the first stage of nursing-bottle caries is difficult to detect for the dentist, it is nearly impossible for the parent, because of lack of training. Only later, in the second stage or third stage, when lesions become clearly visible or toothache occurs, or when the major cause has been removed and signs of arrested caries appear, will parents become alarmed. If caries or discolorations are accepted as unavoidable, parents will contact their dentist only when their child complains about toothache (stages three and four).

DISCUSSION

In the Netherlands the general practitioner sees most of the children with nursing-bottle caries only after serious lesions have developed, because children generally visit the dentist for the first time at the age of two. This might mean that the dentist is not the right person to initiate a preventive program and it might mean, further, that at this moment, the dentist is merely focused on the restorative aspect of the syndrome, in answer to the parents' demands. This should not distract the dental profession, however, from further research. Developmental research has clarified in which period a specific tooth is most vulnerable to the cariogenic stimuli of the sweetened comforter, and we should study the appropriate measures to be taken.[13] We must be aware that preventive advice is not always followed by parents, especially when this involves a change of habits.[12,14,15] We need to study other factors in the caries process that might possibly compensate for the acid attacks, and at which age such compensation might occur. We should look at behavioral, familial, and microbiological aspects, if in a family, the same eating pattern results in different dental conditions in brothers and sisters. Studies have shown that inappropriate eating habits (bottle or breast beyond the age of twelve months) will not always result in nursing-bottle caries.[13,15,16] Comparison with a habit like smoking is easy: studies do express the general risk, but on an individual basis, other rules apply. More detailed research is needed to provide information other than the stop-that-habit-advice on which we now rely so heavily. For nursing-bottle caries a more accurate classification in developmental stages might help to clarify the complexities of its origin and persistence.

SUMMARY

Early diagnosis of nursing-bottle caries is so difficult because its first stage is difficult to detect, and occurs at an age the child does not visit a dentist regularly. Also, the first stage does not appear alarming. If for the parents serious complaints from the child arise, irreversible defects already have developed. The developmental stages of nursing-bottle caries are clearly linked to the eruption pattern of the primary teeth. The maxillary primary incisors are affected first, followed by the maxillary first molars. In all stages, a stabilized condition, arrested caries, can occur, if circumstances change. A correct diagnosis of the etiology of caries in toddlers and preschoolers is mandatory as a basis for introducing proper preventive measures. Further study is mandatory to clarify the cause and effect of the disease-pattern.

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DELMOPINOL HCL REDUCES PLAQUE ACCUMULATION

The findings of this study were in accordance with other early studies in demonstrating that the daily use of 0.2 percent Delmopinol HCl mouthrinse is safe and effective in reducing plaque accumulation and reducing gingival inflammation. As distinct from the other studies which dealt with established gingivitis or plaque formation or gingivitis healing the current study focused on the establishment of gingivitis in a human model according to an established protocol. The retardation of the establishment of gingivitis from a healthy gingival condition following daily rinsing with Delmopinol means that Delmopinol can be safely used as a preventive agent as well as curative agent. The low antimicrobial profile of Delmopinol HCl further enhances its appeal as a long-term antiplaque agent without inducing a substantial microbial flora shift in the oral environment. Currently, long-term clinical studies are being carried out to evaluate the safety and efficacy of this agent.

Yeung, S. *et al:* The efficacy of Decapinol mouthwash 2 mg/mL in preventing gingivitis.
Australian Dent J, 40:220–225, August 1995.

HEALTH SERVICES

The delivery of dental and medical services in Canada

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

"Although dentists may be reimbursed for a few in-hospital services, such as consultations or specific surgical procedures, dental care generally is not covered by the national insurance plan."[1]

In many respects, there are significant similarities between dentistry practiced in the United States and Canada: in terms of training, procedures, practice settings, payment mechanisms, and needs for services. If our interest is in the development of an all inclusive national health system, however, why consider a review of a national health system in which dental care plays virtually no role? It is feasible because any program for national health insurance in the United States (for the foreseeable future) similarly will not include dental services, with the possible exception of minimal services for youngsters and the very poor. If this is to be our future, it behooves us to understand the workings of a national system for health care in a country (not too dissimilar from the United States) which maintains that dental services are a "nonessential component".

I wish to express my appreciation to the many practitioners, educators and students who assisted in the development of this report.

Dr. Waldman is Professor of Dental Health Services, Department of General Dentistry, School of Dental Medicine, State University of New York at Stony Brook, Stony Brook, NY 11794-8715.

SOCIETAL PERSPECTIVES AND GOVERNMENT STRUCTURE

There are particular and significant differences in the United States and Canada between the attitudes regarding one another and the perceptions of our respective governments.

"(T)he Canadian emphasis (is) on the group and the emphasis in the United States (is) on the individual."[2]

In Canada, momentary inconveniences (e.g. roadside stops of all cars by police looking for drunken drivers—without possible cause) are not looked upon as invasion of the rights of all nondrinking drivers, rather the inconvenience is weighed against the safety of the larger society. Similarly, Canadians wait in line more willingly than do Americans.[2]

Canada is a parliamentary democracy with no sharp separation of powers between the executive and the legislative branches of government. The prime minister holds office by virtue of the fact that he/she is the leader of the party that holds the majority of the seats in the House of Commons in the Canadian Parliament.

In addition to the two major parties, since the 1930s there has been a major third force (the Social Democratic Party) that has played a significant role in the Canadian Parliament and at various times has held the majority power in Saskatchewan, Manitoba, and British Columbia. Thus, for more than fifty years, there has been "pressure from the left" for change and development. In Canada, the provinces, and not the federal government, hold most powers related to health, education,

and welfare. Federal participation involves agreements between the provinces and territories.[2]

In addition, and most important, involvement in or partial ownership of national monopolies, such as radio, television, airlines, railways, telephones, and electric power by the federal and provincial governments is accepted as normal by most Canadians. "Canadians appear more trusting of these arrangements, and of government in general, than do Americans."[2]

NATIONAL HEALTH SYSTEM

Background

Actual reform has taken many years to accomplish. It took from 1919, when it was first a major plank in the platform of a political party, to 1961 to achieve universal entitlement to acute-care hospital insurance, and to 1971 to achieve universal entitlement to medical care insurance.

Hospital insurance, which at first was funded by individual premiums and provincial subsidy, evolved slowly, with its introduction in 1947 for the province of Saskatchewan. In 1957 the federal government agreed to share the costs of underwriting a national hospital insurance plan with all provinces, through the enactment of the Hospital Insurance and Diagnostic Services Act. Only the provinces of Alberta and British Columbia continue to require premiums to be paid.

In 1961 Saskatchewan expanded its medical care insurance program to include physician services; physician fees would be negotiated between the professional societies and the provincial government. In 1966 the federal government enacted the Medical Care Act, which provided a strong role in financing and planning of health care by establishing a publicly administered medical insurance program for all residents.

In 1984 the federal government passed the Canadian Health Act in an attempt to reduce rising costs. This act placed a ban on "extra billing" and required physicians to accept assignment.[3]

The coverage

To secure federal funds, the provincial plans must provide universal access to care with equal terms and conditions for all, must cover all services determined medically necessary by physicians, must provide province-to-province portability of benefits and must be administered publicly on a nonprofit basis.

Insured hospital service includes all inpatient services provided at a standard ward level and all necessary drugs, biologicals, supplies and diagnostic tests, as well as a broad range of outpatient services. The services of psychiatrists and mental hospitals are covered fully. There are no upper limits to the care provided, as long as it is medically necessary.

Acute care hospitals are paid on a prospective payment system based on a macrobudgeting process. At a given period, each hospital negotiates its overall budget for the coming year with the provincial government, based on historical trends and actual use and actual cost data for the most recent year. Capital costs are borne in general by the provinces and not shared by the federal government.

Residency training is built into the overall budgeting. More than half of Canadian physicians are family practitioners and all Canadian teaching hospitals and many community hospitals have major teaching programs in family medicine.

The insured services of physicians, who for the most part are paid on a fee-for-service basis, include all medically required services provided by licensed medical practitioners, regardless of whether they are provided in hospitals, clinics, private offices or elsewhere. Fees are negotiated by each province with its provincial medical association. In the late 1980s, physicians earned approximately $85,000, compared to $71,000 by dentists and $50,000 by accountants.[4] (Note: because of the greater number of hours worked by physicians, dentists actually earn greater incomes on an hourly basis.)

Paying for services

"(Canadians have) a deep-rooted suspicion of class-based systems of any kind."[5] Blue Cross and Blue Shield as well as other commercial insurers in Canada are prohibited by law from selling insurance or paying for care already covered by the provincial plans. They can sell amenity service coverage, such as private duty nursing, private room coverage, and other services not covered by the public plans. Of the more than twelve hundred hospitals in Canada, less than ten are for-profit institutions. Only in the field of nursing home services is there a sizeable component of investor ownership.

In Canada, public funds account for at least 75 percent of national health expenditures, which in the early 1990s represent approximately 9 percent of the gross national product.[2] In the mid-1980s, 0.1 percent of the gross national product was spent on administrative costs of health insurance, compared to 0.6 percent in the United States.[6]

Insurance overhead is low because of the single administrative structure of the provincial plans and because all funding for covered services is conducted through these plans. The Canadian system controls payments to physicians and hospitals through tightly negotiated fees and global budgeting.[2]

In addition, costs for health care are controlled by restraint on the distribution of various forms of technology. The provinces must approve the funding of new capital acquisitions and control the growth of outlays for labor, supplies, and equipment. There are sharp constraints on duplication of costly medical technologies. "It is impossible in Canada to have a private magnetic resonance imaging (MRI) unit around the corner from an MRI unit based in a teaching hospital."[2]

The federal government matching formula arrangements with provincial government expenditures provide the poor provinces with increased resources. The poorer provinces lack the financial resources, however, to provide extra services beyond those required to meet the minimums established by the federal government.

In addition

- ☐ "By traditional measures of health status, the overall health of Canadian citizens appears to be similar to that found in the United States."[7]
- ☐ "A (1980s survey) demonstrated that 80 percent of Canadian people were either 'very satisfied or quite satisfied' with the health insurance plans ... (compared to a study which) revealed that 89 percent of Americans surveyed felt that the U.S. health care system needed fundamental change."[8,9]

It must be emphasized that "Canada does not have socialized medicine."[10] Ninety-five percent of physicians, and almost all dentists, work for themselves. Almost all hospitals are owned by private nonprofit corporations with publicly funded operating budgets (major exceptions are federally owned and operated veterans' hospitals).

"What we have is a public-funded system that pays private providers, as opposed to a largely privately-funded system, which is what exists in the United States."[10]

Most Canadians had made extensive use of hospitals and medical care benefits under the national health insurance program. But lower income groups generate less spending on health services than higher income groups. Lower income families spend more of the total family income in out-of-pocket expenses for uninsured and other health services than families with higher incomes.

The supply of physicians continues to increase with a decrease in the number of Canadian medical graduates migrating to the United States. In the late 1980s there were four applications for every place in Canadian medical schools. More than 40 percent of medical students were female.[2] While current physician incomes are more than four times the national average income, they appear to be leveling off so that incomes of Canadian physicians are less than those of their U.S. counterparts.[3]

In the United States, health care often is rationed according to the patient's ability to pay and level of health insurance coverage. By contrast, Canada provides universal access to basic care with the more advanced tertiary care services provided on a regionalized basis. But, "As budget deficits grow and competition for public dollars increases, the agonizing decision of rationing health care will become more prominent."[3]

THE "NONSYSTEM" OF DENTAL CARE

The vast majority of Canadians receive dental care from private practitioners on a fee for service basis. Since the 1960s, the growth of dental insurance plans has provided practitioners with new sources of revenue. But dental care primarily is provided "...to a distinct segment of the Canadian population—the middle and upper class."[10] Dental services to some extent are available, however, for those on public assistance. In several provinces and territories, publically funded programs provide services to children and the elderly. Providers in these plans range from traditional fee for service private practitioners to salaried dental therapists and dental nurses. These auxiliaries are graduates from the equivalent of community colleges who prepare cavities and place restorations without direct supervision. In addition, denturists in almost all provinces provide dentures directly to the public in their private offices.[11] Despite these efforts, there are reports that significant proportions of the poor are not eligible for dental benefits, including many of the homeless, the unemployed, the unemployable, the working poor (those who are uninsured, nonunionized and in minimum wage positions), and many of the handicapped.[10]

DENTAL MANPOWER

In 1991, the administrators of McGill University (Montreal, Quebec) recommended the closure of the dental school on the grounds that, "there is a well documented decline in the need for dentists..."[12]

The effort to close and/or limit the class sizes of schools of dentistry in Canada is a reflection of the evolving pattern of dental disease, which is comparable to that in the

United States, and reports of decreasing practitioner busyness. Reports in the literature since the mid-1980s present, however, a confusing picture, in terms of the need and demand for dental care, of the projected availability of practitioners to meet the need for dental services.

Based upon the past and projected increasing use of dental services, writers have emphasized restraint in efforts to curtail the production of practitioners.[12-16] By contrast, other writers emphasize the evolving pattern of dental diseases, the difficulty of converting the need for care to a demand for dental services, and the potential excess in the numbers of practitioners.[17-20] Note: the types and functions of dental personnel in Canada, including dental hygienists and dental assistants, are similar to those in the United States. Some exceptions include the additional specialty of oral radiology, denturists, and dental therapists.

In mid-1980s, a profile of Canadian dentists indicated that 93 percent worked full-time, 10 percent were specialists, 9 percent were in salaried positions, 50 percent were under 40 years of age, and 8 percent were female.[11] Fourteen percent of practicing dentists are women. Currently, 40 percent of Canadian dental school graduates are women. It is projected that by the year 2000, women will represent approximately 35 percent of all Canadian dentists.[21]

About 57 percent of dentists were in solo practice, a reduction from 82 percent recorded twenty years earlier. The types of personnel employed in private practice included receptionists (by 88 percent of dentists) chairside assistants (by 83 percent) dental hygienists (by 56 percent), and intraoral dental assistants (by 28 percent). Only one percent reported no auxiliary help.[11]

Between the late 1970s and late 1980s, the number of licensed dentists increased by more than a third to somewhat more than 14,000 dentists. The annual number of dental graduates from the ten dental schools (there are no private schools) increased through the late 1980s and then reversed, as efforts to control the production of dentists were instituted. Many of the unsuccessful applicants to Canadian schools turned, however, to U.S. schools for training, thereby frustrating the efforts to hold down the numbers of dental practitioners.[11]

The relative distribution of dentists and of dental specialists varies widely among the provinces. Four of the five most populous provinces have the best population-per-dentist ratios, while two (New Brunswick and Newfoundland) have twice as many persons per dentists. There also are wide variations in relative dentist supply within provinces, and within counties and regions in each of the provinces.[11]

The supply of dental hygienists is growing more rapidly than that of dentists, with 1.8 dentists per hygienist in the late 1980s.[11] Because dental assistants are unlicensed, data for this category of personnel are limited. There are about 24,000 dental assistants or about two assistants per dentist. (Note: the limitations of available data on dental activities and personnel—frequently commented upon during interviews—were a continuing difficulty in attempts to review the dental system.)

There are about 365 dental therapists, the vast majority of whom are employed by provincial government programs (in Saskatchewan and Manitoba) and by the federal government in providing dental care directly to Canada's native people.[11] In the early 1990s, there were almost 2,000 denturists in active practice. Denturists are licensed to practice independently in ten of the twelve provinces and territories. In all ten regions they may provide legally complete dentures directly to patients. In some regions they may construct partial dentures under supervision, by prescription or by special licensure.[11]

The practice of dentistry is regulated at the provincial and territorial level. While dentists and dental hygienists must be licensed in the province or territory in which they practice, in most instances additional examinations are not required for movement between provinces.

SOME SPECIFICS OF THE EVOLVING DELIVERY SYSTEM

Disease patterns and the use of services

The decline in dental caries and greater tooth retention in children and young adults in developed countries, including Canada have been documented repeatedly.[22] In a single decade, DMFT values have dropped as much as 40 percent in children at various Canadian sites and more than 20 percent in Canadian army recruits.[17] Of particular significance have been the large decreases in the missing (M) component of the DMFT and in smooth surface decay, and the large increase in the percent of children who are caries-free.[17] Sixty percent of the population using municipally supplied water, 43 percent of the total population, receive fluoridated supplies—ranging from 75 percent of the population in Alberta to 8 percent in Newfoundland.[11] Despite the changes in dental disease patterns, it is interesting to note that four of five pediatric dentists reported no decline in income over the past five years. They do indicated comparable changes to those in the United States, regarding patient services: namely a trend toward more preventive services and less restorative care.[23]

The decline in dental caries is not uniform throughout the country. In particular, there are continuing reports that more than 90 percent of First Nation (i.e. Indian) and Inuit children had dental decay (compared to rates of less than 50 percent for nonnative children).[24] The need for and the difficulties in providing dental services to the widely separated communities in the northern communities are emphasized repeatedly in many writings.[24-26]

By contrast, reports on dentistry for military personnel and prisoners in various correctional facilities indicate favorable levels of care.[27,28]

Specific programs

A variety of special programs are or have been available for particular populations in some provinces.

☐ Alberta's Universal Dental Plan for the Elderly

Since 1973, the provincial government sponsored premium, free, comprehensive dental care by dentists and denturists for the elderly (those over sixty-four years of age).

Longitudinal studies indicate:

- ☐ High use patterns that raise questions of economic support and have resulted in a variety of mechanisms to curtail expenditures.
- ☐ A decline in surgical, restorative and removable prosthetic services, but with an increase in the use of denturist prosthetic services.
- ☐ Dramatic increases in periodontal care and other preventive services. Between 1978 and 1992, the periodontal-care share of all dental services increased from 3 percent to 22 percent.[29-31]

☐ Saskatchewan's program for care of children

In 1972 a province-wide, school-based program was established to provide dental services for children between ages three and twelve. (Saskatchewan is a large, sparsely-populated province in the center of western Canada.) The program, modeled after New Zealand's dental plan for children, provided dental health education, preventive services, and treatment services by teams of dentists; dental therapists, originally called dental nurses; and dental assistants.

The Saskatchewan government established a dental therapist/dental assistant training center. The two-year program for dental therapists (one year for dental assistants) taught the students how to diagnose tooth decay and restore primary and permanent teeth with silver amalgam and composite filling materials. Students also were trained to place stainless steel crowns and space maintainers, and to perform pulpotomies and extraction of primary teeth. The Saskatchewan program employed a number of supervising dentists to perform a variety of duties in close cooperation with the dental therapist teams.

In 1987, with the election of a more conservative government, the school-based program was dismantled and transferred to the private sector. As a result of a downturn in the province's economy in the late 1980s and early 1990s, all funding for the program was ended, but with plans for some future date to establish a limited effort to ensure that children of low-income families receive preventive and treatment services. A variety of other "denticare" plans similarly have been eliminated in British Columbia, Manitoba, and Newfoundland.[32,33]

☐ Services for the disabled in Manitoba

The private dental office is the primary location for providing dental care for the disabled. Practitioners provide a full range of services, with financial payment from the social assistance program. Dentists reported that they received adequate compensation, defined as their usual and customary fee, however, in only 50 percent of the cases for which they provide care.[34]

In addition, a variety of dental public health programs are provided for children, the elderly, and those on social assistance in each of the provinces.[35,36]

Commercialization and other potential changes

The competitive commercial environment for the delivery of health services has "invaded" the practice of dentistry in Canada. Alternative delivery systems, including PPOs, third-party corporation-clinics, salaried practitioners, and capitation systems have given rise to the admonition by the College of Dental Surgeons of British Columbia that, "... the alternative delivery systems generally introduce a type of corporate, institutional or bureaucratic control that may be primarily concerned with profitability and not with the clinical needs of the patients."[37]

As in the United States, concerns regarding potential changes in the delivery of care extend to the continued supervisory relationship between the more than 14,000 dentists and the approximately 8,000 dental hygienists.[20] The Board of governors of the Canadian dental Associations has established the principles of immediate and directional supervision (i.e. those duties which require the physical presence or immediate availability of the practitioner, vs. duties that require only direction). The Board has issued the statement that, "...(a)lthough Dental Hygienists, on the basis of their education, training and expertise cannot be viewed and are not recognized

as primary care health workers or providers, they are qualified and recognized as members of the oral health team providing a limited range of services under the supervision of a dentist."[38]

Practice profiles and oversight—an example

The development of practice profiles, collections of statistical data concerning the dental services that are delivered by a particular practitioner as compared to the delivery of those services by other practitioners, is a matter of policy for the College of Dental Surgeons of British Columbia, since the late 1970s. Computer programs of third-party billings have been developed to review:

- ☐ Number of service items delivered per patient.
- ☐ Number of any individual items delivered per patient.
- ☐ Costs of item rendered.
- ☐ Cost per patient of services rendered.
- ☐ Percentage of patients receiving any particular service.
- ☐ Analysis of other similar parameters. Reviews permit reviews of cases with questions of "over" and "under" services.[39]

Dental expenditures

In the late 1980s, $3.1 billion (or about 5.5 percent of all public and private expenditures for health expenditures) were spent on dental services. Between 1980 and 1990, there were limited changes in dentistry's share of health care expenditures (between 5.4 percent and 5.6 percent).[40] The overall increase in expenditures for dental services increased by 136 percent, however, which far exceeded the increase in both population (9 percent) and the effects of inflation (70 percent). Public funds account for between 13 and 15 percent of dental expenditures, but with great range between the different provinces and territories (from 3 percent, 4 percent and 5 percent, respectively, in Ontario, New Brunswick and British Columbia, to 33 percent in Saskatchewan, 38 percent in Newfoundland and 75 percent in the territories). Of particular note are

- ☐ The low levels of per-person expenditures in some of the regions.
- ☐ The wide range in per capita expenditures for dental services (from $33 in the territories and $41 in Newfoundland to $143 in Alberta and $145 in British Columbia).
- ☐ The limited increase in per-capita expenditures during the 1980s in the territories.[20]

Somewhat more than half (54 percent) of families report making out-of-pocket expenditures for dental services in 1990 (a decrease from 59 percent in the late 1970s).[20] In 1991, 41.7 percent of the population in Quebec had some form of insurance for dental care services.[41] General profiles of those with and without dental insurance indicate that the insured are younger, are in higher income families and have higher levels of education. As in the United States, those with insurance report higher dental service utilization rates.[18]

It should be noted that dental-fee schedules are developed by the profession on a relative value basis and serve as a general guideline for most practitioners. While third parties generally accept the relative value approach, generally payments by insurance companies and government agencies are paid at the levels below those suggested by the profession.

It is particularly significant that the annual direct cost for treating dental diseases in the mid-1980s, not including payments to denturists, as well as the costs of drugs or hospitalization associated with treatment of dental diseases, ranked third after cardiovascular diseases (heart and stroke) and mental disorders. Dental costs exceeded those for respiratory and digestive diseases, injuries and cancer.[20]

PRACTICE IN ONE OF THE DENTAL SPECIALTIES—NOT THAT DIFFERENT FROM THE UNITED STATES

A study in the late 1980s of the practice of pediatric dentists provides a general overview of one of the dental specialities.[23] Almost two-thirds of the 136 practicing pediatric dentists listed in the Canadian and/or American Academy of Pediatric Dentistry as practicing in Canada provided general information on personal and practice activities. While there are numerous pediatric dentistry training programs in the United States, there is only one program in Canada.

Almost two-thirds (63 percent) of the respondents practiced in Ontario (41 percent) and Quebec (22 percent). Most (58 percent) were in full-time practice and an additional 17 percent were in salaried positions (including academic positions). Three-quarters drew their patients from urban locations, while less than 5 percent had their practices in totally rural communities.

Eighty percent of the respondents had hospital privileges. Seventy-eight percent used nitrous oxide analgesia and/or other forms of sedation in their practices. Despite decreases in the rates of decay, there was a general ability to maintain practice income during the past

five years. However, respondents indicated a greater effort was needed to maintain income levels (including additional working hours, performing services previously delegated to auxiliaries, and increased attention to patient recall systems).

There were some indications that pediatric dentists were placing more sealants and composites and less amalgam and stainless steel crowns. In addition, they were performing fewer extractions and pulpotomies.

The majority of respondents emphasized the need to change pediatric dental training so as to diversify the practice to other areas of pediatric practice, with an emphasis on preventive and interceptive orthodontics.[23]

A review of Quebec's *Children in Need of Treatment Program*, an effort to provide dental care for children under fourteen years of age who are in urgent need of care but where the cost of treatment poses financial hardship, provides insight into general practitioner referral patterns.

Almost 80 percent of respondents reported that they referred some children under fourteen years of age to pediatric specialists. The average percent of children referred was 11.8 percent, 4.9 percent and 0.7 percent, respectively, for children less than four years of age, 5-9 years, and 10-14 years. The primary reasons for referrals were

- ☐ Behavioral management problems (85.6 percent).
- ☐ Medically compromised stated (6.6 percent).
- ☐ Specific conditions, e.g. bottle caries (4.8 percent).[42]

SOME FINAL THOUGHTS

Interviews with dental educators, practitioners, and students provided a picture of a system of dentistry that is quite similar to that in the United States. The evolving dynamics of dental disease patterns and the increased emphasis on preventive services, the strains of economics as the country passes through difficult financial periods, increasing overhead for practice, the inroads of commercialization and competition, the demands by auxiliaries, but with far fewer instances of malpractice litigation—all raise the underlying question of whether the profession and the general population would be better served, if dental services were incorporated within the general medical system (if such an opportunity was ever offered).

The position of the American Dental Association on this matter must be considered seriously.

"Merging dental and medical care plans is risky, especially within the context of global budgeting, argues (the) ADA. 'Once the money runs out, the services start getting rationed'...And dental services are always among the first to go."[43]

But as the Association raises concerns that dental care is not contained within the scope of Medicare services being provided to an every increasing older population, one must recall the Association's opposition in the mid-1960s to the inclusion of dentistry within the scope of the then planned Medicare program.[44]

The difficulties faced by the American and Canadian dental professions and the public they serve resemble the continued efforts of "mom and pop" stores to provide necessary services in an era of "mega-size" stores and "managed health care" services. Maybe there should always be a specialty store to provide services to particular segments of the public, as there should be a private sector in any health system. The "nonsystem" for the delivery of dental services in Canada and the United States does function effectively to provide high levels of care—at least for select segments of the population.

But after considering a single-payer Canadian medical and hospital system (yes, a system with its own difficulties), it seems that an organized approach to dental care delivery should not be discarded with the usual set of fears that somehow its priorities cannot be safely guarded.

If and when our country adopts some form of national approach to health insurance, will the dental profession once again (as it did in the mid-1960s) prefer to go its own way? I believe it will!

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RISK OF FLUOROSIS

The demonstration of increased risk of fluorosis in a population associated with a specific fluoride exposure contributes information needed for making rationally based recommendations for fluoride use. For example, the very strong association between fluorosis and inappropriate use of supplements illustrates the need to better educate all health professionals about the appropriate prescription of fluoride supplements. However, the influence that a particular fluorosis risk factor will have on the overall prevalence of fluorosis in a population depends, not only on the degree of increased risk associated with that specific exposure, but also on how frequently that exposure occurs in the population.

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CLINIC

Two-year results with box-only resin composite restorations

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The approach to the treatment of proximal carious lesions in posterior teeth has changed during the last few decades.[1,2] Preventive measures are expected to slow down or even halt the progress of caries, avoiding the invasive replacement of carious tissue. If prevention fails, restorative treatment may be necessary to eliminate the carious process. In agreement with the preventive approach, efforts to focus exclusively on the carious dentin to be removed and on the preservation of as much sound tooth tissue as possible have been reported. Suggested concepts of the preparation include *facial slot preparation*, *tunnel preparation*, and *box-only preparation*.[3-7] These cavity designs are thought to be suitable for both amalgam and resin-based restorative materials, although the adhesive nature of resin composites and glass ionomers in particular are considered to be beneficial.

When the carious lesion is situated cervically to the contact area, slot preparations aim to provide a buccal approach to the lesion and to preserve the integrity of the marginal ridge of the tooth involved.[3,8] Hunt suggests that if the lesion is larger than expected and the caries must be removed in a more conventional way, the buccal entry becomes excessive.[4] Tunnel preparations do not have this disadvantage. The application of both of these techniques, however, is assumed to be difficult because of the limited access and visibility.[2,4,9,10] Omitting the occlusal dovetail of a conventional Class II restoration, the use of a box-only cavity design for amalgam restorations is likely to offer good visibility; but from the conservative point of view, the need for retentive grooves, as described by others, could be a drawback.[11-13]

Adhesive restorative materials could provide an alternative to treatment using the box-only approach, since macromechanical retention, such as retentive grooves, may not be necessary.[2,7] Once indicated for primary molars only, the application to new lesions in permanent teeth now seems appropriate. The combination of a glass ionomer base and a resin composite as an enamel substitute was used in the present study. This paper describes the results of box-only (or box-without-step) restorations in terms of treatment times and postoperative sensitivity. Marginal adaptation and radiographic findings are described for a two-year period.

MATERIAL AND METHODS

Among the participants in a longitudinal trial on Class II resin composite restorations, teeth exhibiting proximal carious lesions, but free of occlusal caries, were selected for this study.[14] Seventy-one premolars and first molars in which the extent of the caries indicated that the cervical extension should not extend beyond the cemen-

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Table 1 □ Distribution of the restorations according to the type of tooth and the kind of resin-composite material used.

Resin composite	Premolar		Molar		
	Mesial	Distal	Mesial	Distal	Totals
Herculite XR	1	18	2		21
Clearfil Ray P.	2	20		1	23
Visiomolar	5	18		1	24
Totals	8	56	2	2	68

toenamel junction were treated with the box-only Class II restorations. The preparations should include the occlusal surface limited to the fossa triangularis. Given these criteria, sixty-eight restorations in forty-eight patients (mean age: 22.2 years (s.d. 5.6)) met the requirements of the study: thirty-three patients received one restoration; twelve received two; two patients, three, and one received five restorations. Three resin composite materials[a] were used, randomly allocated to the teeth to be restored. Table 1 shows the distribution of the restorations for the teeth and materials. Four dentists constructed twenty-one, thirteen, twenty-six, and eight restorations, respectively.

The restorative procedure corresponds to that used for Class II resin composite restorations in the longitudinal study mentioned.[14] In brief, proximal box preparations were made and cavity angles were rounded (Figure 1). If possible, the buccal and lingual margins were required to remain in minimal contact with the adjacent tooth. Using rubber dam, the remaining carious dentin, and enamel not supported by dentin, were removed. A $Ca(OH)_2$ lining was applied to deeper areas of the cavity and the removed dentin was replaced by a self-curing glass ionomer cement.● After coloring the margins with red nail polish, a bevel was made, thus exposing the proximal margins buccally and lingually.

Acid-etching of the enamel and application of a bonding agent★ preceded the incremental filling and light-curing of the filling material against a translucent matrix. The restorations were finished with x-fine diamonds and rubbers. If necessary, finishing strips were used for finishing the cervical margin. Polishing was performed at a later appointment.

During the restorative procedure, treatment-time recordings were made by the dental assistant, as described earlier.[15] At follow-up visits, patients were asked about

[a]Herculite XR (Kerr)
Clearfil Ray Posterior (Cavex Holland / Kuraray)
Visiomolar (ESPE)

●Life (Kerr); Fuji lining cement (GC)

★As prescribed by the manufacturers

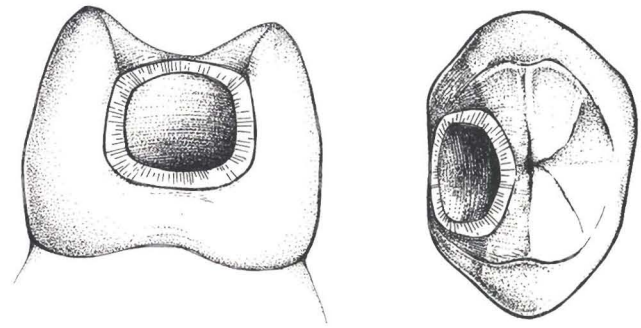

Figure 1. The box-only cavity design.

any postoperative sensitivity.[16] Assessments of the restorations were planned at baseline and annually thereafter. Clinical evaluations were made, using modified USPHS-criteria (Table 2).[14,17] Furthermore, impressions were made of the restorations. The impressions were photographed using a shadowing technique, and the marginal adaptation as marked on the photographs was assessed by two observers, using a sectional approach (Table 2).[18] The occlusal outline of a box-only restoration is divided in three sections: buccal, lingual and central-occlusal sections. The mean of these three ratings represents the mean marginal adaptation per restoration and a mean of 1 indicates an excellent marginal adaptation.[19] Radiographs were made, using a standardized technique, and assessments were done according to a method as described previously.[20] In this study the items are rated in accordance with the criteria shown in Table 3 (also see Figure 2).

Assessments were independently performed by two observers; and joint-decision making was used, if ratings differed by more than one scalepoint. During previous studies Kappa interobserver-agreements for items of marginal adaptation and radiographic evaluations appeared to be .87 on average.[18,20] Baseline evaluations were made with delays of four months between placement of the restorations and making the recordings, on average (s.d. 4; maximum: 14 months). Due to irregular distribution, influences of the individual dentist and the type of tooth cannot be explored. Also, mesial and distal box-only restorations are clustered in the description of the data.

RESULTS

Baseline results

The stages of the treatment procedure with their average treatment times are presented in Table 4, with four

Table 2 □ Characteristics and evaluation criteria.

Characteristic	Rating	Criteria
Marginal discoloration (discolored sections)	0	No marginal discoloration
	1	One or more discolored sections
Color match	0	Restoration matches a standard measure in color
	1	Mismatch is within acceptable range
	2	Mismatch is outside the acceptable range
Anatomic form	0	Restoration is continuous with existing form
	1	Discontinuous with existing form; missing material not sufficient to expose dentin or base
	2	Sufficient material has been lost to expose dentin or base
Surface texture	0	The surface of the restoration is smooth
	1	The surface is slightly rough
	2	The surface is slightly pitted
	3	The surface is slightly rough and pitted
	4	The surface is rough
	5	The surface is pitted
	6	The surface is rough and pitted
Marginal adaptation (photographic shadowing technique)	1	Margin not or slightly visible (shadowing/reflection* less than 0.5 mm)
	2	Margin visible (shadowing/reflection between 0.5 and 1 mm)
	3	Margin clearly visible (shadowing/reflection between 1 and 2 mm)
	4	Margin and crevice highly visible (shadowing/reflection more than 2 mm)

*'Shadowing/reflection' = width of the shadowing or reflection line

Table 3 □ Radiographic characteristics and evaluation criteria.

Characteristic	Rating	Criteria
Cervical marginal adaptation	0	The cervical marginal adaptation is good
	1	The cervical marginal adaptation shows a defect
Voids in the material	0	No detectable voids
	1	Uncertain whether voids are present
	2	Detectable voids
Radiolucencies adjacent to the restoration	0	No detectable radiolucencies
	1	Uncertain whether radiolucencies are present
	2	Detectable radiolucencies
Adaptation to the occlusal enamel	0	The adaptation is good
	1	The adaptation is poor

observations missing. Compared to the overall average treatment time of 32.3 minutes, the time needed to perform the preliminary work forms a large percentage of the overall treatment time. The standard deviation of the times recorded is considerable. The dentist with the fastest working speed needed 28.5 minutes on average to perform the treatment, the slowest needed 37.8 minutes. Postoperative sensitivity was reported by four patients, each with a single restoration (5.8 percent of the total restorations). All of the complaints disappeared within two weeks after placement of the restorations.

The mean marginal adaptation was recorded as 1.24 (s.d. 0.31). Excellent adaptation to occlusal margins was observed in thirty-nine of the restorations (57.4 percent), while the balance showed minor deficiencies of the margins, not necessarily related to the material used (Chi-square, $p > .05$). Most of the deficiencies, with five of them rated as 3 (Figure 3), appear in the central occlusal section.

Baseline radiographs of sixty-six restorations were available. In 13 percent, deficiencies in adaptation to the cervical margins were observed (margins that cannot be evaluated due to overlap are disregarded). Voids in the material were observed in 9 percent of the restorations; and in 21 percent of the cases there was uncertainty about the presence of voids. A radiolucency in the adjacent dentin was observed in one restoration (1.5 percent). Regarding adaptation to the occlusal enamel, no deficiencies were revealed in the radiographs. No differences in radiographic characteristics were observed among the three restorative materials (Chi-square, $p > .05$).

Two-year results

The mean age of the restorations varied, due to the spread in patient appointments: mean age was 2.2 years (s.d. 0.3). No failures were observed and at this moment of evaluation, no complaints of sensitivity were reported.

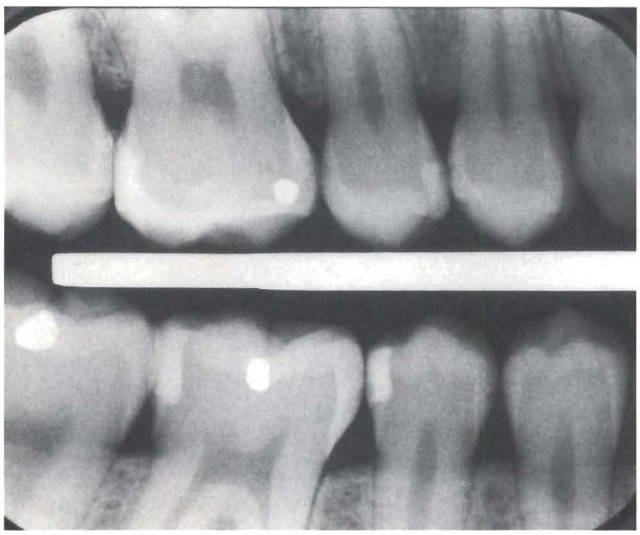

Figure 2. Radiograph of a box-only restoration in tooth 45.

Table 4 □ Average treatment times (standard deviations in parentheses), in minutes (N = 64).

Treatment stage	Mean treatment time (s.d.)
1. Preparation	6.3 (2.3)
2. Preliminary work	12.1 (3.3)
5. Application	4.7 (1.5)
6. Finishing	6.5 (2.3)
7. Polishing	2.6 (1.2)
Total	32.3 (7.5)

The mean marginal adaptation was 1.61 (s.d. 0.47), with eleven restorations rated as having excellent marginal adaptation. Figure 3 shows the frequencies of the three sections of the restorations at baseline, and after one and two years. In fourteen restorations rating 3 emerged at two years (rating 3 presumably matches rating Bravo of the USPHS-scale). Here the five sections at baseline rated as 3 did not shift, but fourteen sections shifted from 1 or 2 to rating 3. In Figure 4, the section with most deficiencies (the central occlusal section) is divided according to the three composites (baseline and two years), where all show a similar trend in marginal adaptation.

The surface texture at baseline was, in the case of the Herculite restorations, smooth; and with the other two materials slightly rough. After two years, three of the smooth surfaces showed some pitted irregularities; the other surfaces did not change. The color match shifted one scale point in two cases (from matching color to a slight mismatch).

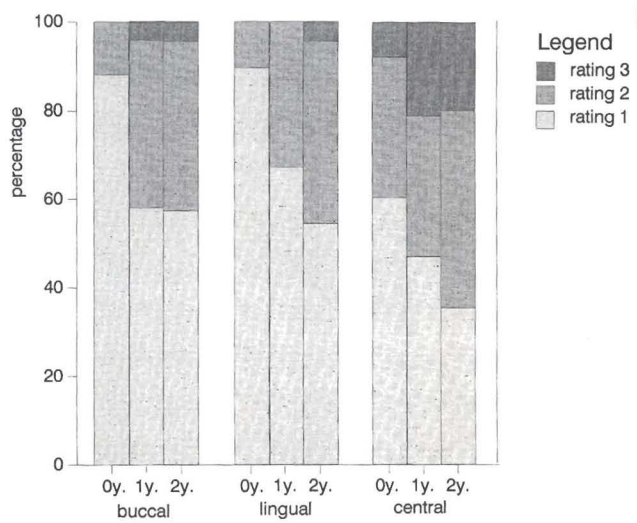

Figure 3. Frequencies of the marginal adaptation of box-only, resin-composite restorations, in percentages, divided into the three sections of the occlusal outline. Baseline (0y.), one-year, and two-year data.

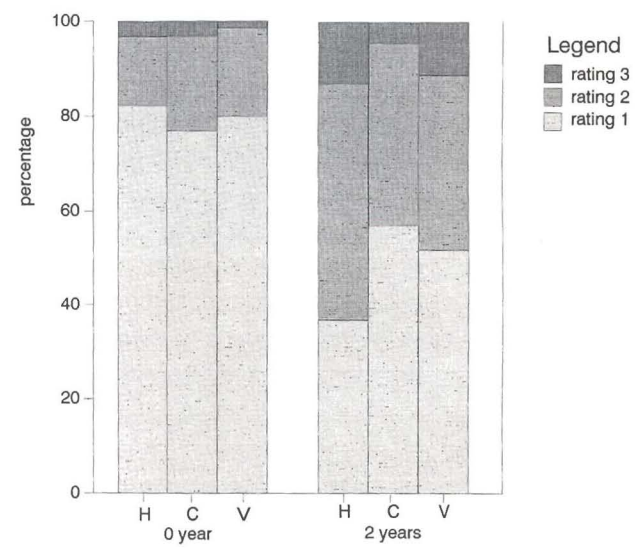

Figure 4. Frequencies of the marginal adaptation of box-only, resin-composite restorations, in percentages, for the central occlusal section, in accordance with the three materials (H = Herculite XR, C = Clearfil Ray Posterior, V = Visiomolar). Baseline and two-year data.

Radiographically, 14 percent of the cervical margins showed deficiencies. Voids, or the suspicion of voids, were observed in 35 percent of the restorations. Two distinct radiolucencies (3 percent) in the adjacent dentin

were observed; whereas in 27 percent there was uncertainty about radiolucencies. No deficiencies in adaptation to the occlusal enamel were revealed in the radiographs. The sufficiency or deficiency of marginal adaptation, when assessed radiographically, did not appear related to the material used (Chi-square, $p > .05$).

DISCUSSION

In order to facilitate finishing, and to provide access for oral hygiene, it was decided to place the buccal and lingual margins of the box just free of the proximal contact area. The cavity is encompassed by enamel and by beveling the margins, the adhesive surface area is enlarged. In addition the nonbeveled part of the cervical enamel floor may increase its role in resisting occlusal shear forces. It is our experience that a cavity preparation with a rounded box and designed to take the greatest advantage of the adhesive qualities of a filling material is difficult to accomplish. The carious lesion is located gingivally of the contact area, which is also its deepest point of penetration into the dentin, from where it spreads buccolingually. A conical form of the box, with the widest end located gingivally, and with rounded internal angles, was in most cases the most favorable objective. The box-only design is, however, conflicting with its most essential objective, namely no sacrifice of sound tissue. The occlusal marginal ridge, that is often not involved in the carious lesion, is removed and bevels are made. The need for extending the outline of the cavity preparation to allow adequate visibility and for increased adhesiveness most likely requires an approach similar to the one presented here. Furthermore, the saucer-shaped cavity form, as described by others, is not applicable because the carious lesions were deeper into the dentin and had spread horizontally farther than described in the articles cited.[21,22]

The considerable differences in treatment times can be attributed to differences in the practice experience of the four dentists. It is not likely that the skewed distribution of restorations across dentists will increase this effect unevenly, since the fastest and the slowest dentist placed twenty-one and twenty-six restorations, respectively. The average treatment time required for these proximal restorations is roughly ten minutes less than that required for conventional two-surface resin-composite restorations in our longitudinal study mentioned previously (approximately 40 minutes).[15] Treatment time can be reduced, when restorative procedures are made less extensive. For instance, the glass ionomer cement applied in this study can be replaced by a light-cured material, in order to reduce setting time.

Postoperative sensitivity was seldom observed, and the complaints lasted for only a short period. In a previous study we traced these complaints to the effect of trauma during the cutting of tooth substance, rather than to the material characteristics of resin composites and/or microleakage.[16] The low frequency of postoperative complaints observed in the present study would support this view. The favorable surface texture of the Herculite restorations can be attributed to the filler particles of the material. No differences in the clinical handling of the materials can account for the differences between the surfaces of the composites.

The baseline results of the indirect, photographic evaluation of the marginal adaptation and of the radiographic assessments can be influenced by the differences in the time that elapsed between placement and assessment of the restorations. Deficiencies found, however, were evenly distributed across the different evaluation periods. The marginal adaptation, based on the mean marginal adaptation, shifted moderately during the two-year period. Of the individual sections of the restorative outlines, the central occlusal section showed at baseline the largest number of deficiencies in marginal adaptation. This is an indication that the margin located near the central fissure is difficult to finish smoothly. Simonsen in 1978 proposed to cover-up the untreated occlusal surface with composite material to protect it from caries.[7] In order to prevent an under- or overextended margin at the central fissure, Surmont proposed sealing of the occlusal surface with amalgam, box-only restorations.[13] Whatever concept is chosen, it can easily be applied to box-only, resin-composite restorations, provided additional time is allowed.

CONCLUSION

Although applied to a limited number of teeth in this study, the results indicate that the box-only, resin-composite restorations show a reasonable degree of agreement with conventional Class II, resin-composite restorations, in terms of their clinical characteristics. This treatment concept requires little working time, with minimal removal of tooth tissue. The box-only restorations may make a contribution, therefore, to the restorative techniques that save tissue. The two-year results without failures seems promising for this restorative approach.

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RESIN-MODIFIED GLASS-IONOMER CEMENTS

In 1992, resin-modified glass-ionomer cements were introduced. These materials are glass-ionomers that have been modified with a light-polymerized resin component. Along with the traditional acid-base hardening reaction, an initial light-curing takes place within 60 seconds of exposure to a visible light beam. The hardened resin "skeleton" serves as a matrix for completion of the long-term glass-ionomer–hardening reaction. Incorporation of the resin component significantly improves most physical properties of the cement without diminishing the favorable properties of glass ionomer cements. Resin-modified glass-ionomer cements do the following:

1. Chemically bond to dentin and enamel.
2. Release fluoride ions to associated tooth structure, without degrading the cement.
3. Have a coefficient of thermal expansion similar to that of tooth structure.
4. Come in varying shades.
5. Harden initially within 60 seconds of light beam exposure.
6. Have much greater fracture strengths than traditional glass-ionomers. Other physical properties are also much improved.

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Dental caries and its determinants in 2-to-5-year-old children

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In dental literature the number of longitudinal studies, focussing on dental caries and its determinants in preschool children is limited, in comparison to older age-groups.[1] Longitudinal studies performed are mostly restricted to bacteriological variables.[2] As a part of a caries risk study in preschool children, caries prevalence and several determinants of dental caries have been longitudinally recorded in 2-to-5.5-year-old children.[3] This paper describes on a group level caries prevalence and various determinants of dental caries, during the three-year observation period.

Materials and methods

Between October 1985 and June 1987 parents of all new patients, younger than three years of age, and visiting the child dental health center in Nymegen, The Netherlands, were asked for permission to enroll their children in the study (n = 291). Two hundred and fifty-two children, with an average age of 2.3 years (range 1.9 to 2.8 years), participated (49 percent boys and 51 percent girls). At the age of five years, 193 children were still in the study (Table 1). During the study, dental treatment was provided according to the standard protocols of the clinic: at every check-up, information about diet, use of fluoride at home, and oral hygiene procedures were given to children and parents. If clinical signs of initial caries lesions were present, a fluoride varnish was applied topically (49.2 percent of the children received the varnish). In the three-year observation period, the children were examined at six-month intervals until the age of five years. Final examinations took place between 1988 and 1990.

Data were collected by interviewing the accompanying adult and by performing intraoral examinations of the child and the parent. At the final examinations, bitewing radiographs were taken.

Social background of the child was based primarily on the level of education of the mother. Only when the father of the child was the primary caretaker, was the level of education of the father used. The level of education was divided into three categories (low level: primary school or elementary vocational training; middle level: secondary or high school education; high level: university training).

At six-month intervals, the dietary habits of the child were recorded, based on a twenty-four-hour recall methodology, while a seven-day diet diary was kept at base-

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Table 1 ☐ The various age-groups and number of children belonging to each group.

Group	Age range	Average age in years	Number of children
Group 1	1.92-2.49	2.2	182
Group 2	2.50-2.99	2.7	183
Group 3	3.00-3.49	3.2	197
Group 4	3.50-3.99	3.8	195
Group 5	4.00-4.49	4.3	197
Group 6	4.50-4.99	4.7	195
Group 7	5.00-5.50	5.2	193

line.[4,5] The daily number of times food was ingested were counted, and special note was made of those (including beverages) containing fermentable carbohydrates. When the interval between food ingestions was less than twenty minutes, they were scored as one.

The use of fluoride at home (in tablets or toothpaste, based on information received from the parents) was recorded at each examination. Although all parents were given the same instructions, personal interpretations of those instructions were expected to vary. Type and amount of toothpaste used per brushing was recorded (no toothpaste at all, toothpaste without fluoride, toothpaste with a low concentration (0.025 percent) of fluoride, toothpaste with fluoride (0.1-0.15 percent) but only a small amount (< 1gr), and toothpaste with fluoride (0.1-0.15 percent) equal to or more than 1 gr). Additionally the number of brushings per day as well as the total daily ingestion of fluoride tablets was recorded. Assuming that about a third of the toothpaste will be ingested, the total daily intake of fluoride was calculated by multiplying the intake from toothpaste with the brushing frequency and adding the daily fluoride ingestion from the tablets.[6]

Caries was assessed by visual examination, using a mirror and probe. After drying the teeth with an airstream, each tooth surface was assessed and the observations recorded, according to the following criteria: no signs of caries, white spot with intact enamel, dark (yellow/brown) discoloration of intact enamel, discoloration accompanied by loss of surface continuity of enamel, cavity in the dentin without visible loss of enamel, cavity progressing into dentin, restoration, tooth not yet erupted, or missing due to extraction. White discolorations in the enamel, developmental in origin, were frequently present in the study population and hampered the diagnosis of white spot lesions. The white spot lesions were separately recorded in order to prevent an overestimation of caries activity. Bitewing radiographs were taken under standardized conditions at the age of five years (final examination). Caries on the bitewing radiographs was independently diagnosed by two experienced dentists and scored according to criteria recorded by Marthaler.[7] In case of a difference in diagnosis, consensus was obtained by re-examining the bitewing radiographs. In this paper, the diagnosis "carious lesion" is presented separately for three evidential categories:

d_a = Dark discoloration, loss of enamel surface continuity or lesions into the dentin.

d_b = Loss of enamel surface continuity or dentinal lesions.

d_c = Lesions into the dentin.

On the basis of these observations $d_a$mfs, $d_b$mfs and $d_c$mfs scores were calculated.

The oral cavity of the parent who was most involved with the education of the child (usually the mother) was visually inspected and the DMFT status recorded according to the WHO criteria[8]

Presence of plaque and gingivitis were scored in a simplified modification of the Suomi-Barbano-index and the plaque-index by Silness and Löe.[9,10] Four sites in the mouth were examined: in the maxillary arch, the buccal surfaces and in the mandibular arch, the lingual surfaces of the most distal molars, respectively.

The plaque scores were defined as: 0 = no plaque present, 1 = a thin layer of plaque adhering to the marginal gingiva and the joining tooth surface (plaque becomes only visible when using a probe), 2 = soft debris visible on the gingiva and tooth surface. Gingivitis was scored as: 0 = no signs of inflammation, 1 = mild discoloration but no bleeding after probing, 2 = discoloration accompanied by bleeding, spontaneous or after a gentle contact with a periodontal probe. The average scores for the four sites were calculated.

The data regarding the 198 children were re-grouped. Each group represented a half-year age-interval. From the children entering the study (n = 252) 182 were present in group 1 (range 1.9 to 2.5 years) and 70 started the study in age-group 2 (range 2.5 to 3.0 years).

Analysis of the data was accomplished with the Spearman rank correlation.

RESULTS

The average numbers of food and sugar ingestions per day (according to the twenty-four-hour recall results) for various age-groups are presented in Figure 1. No significant age effect on the dietary habits was found. The total daily number of food ingestions (including meals, drinks and snacks) showed a range of four to fourteen, while the number of sugar-containing food ingestions

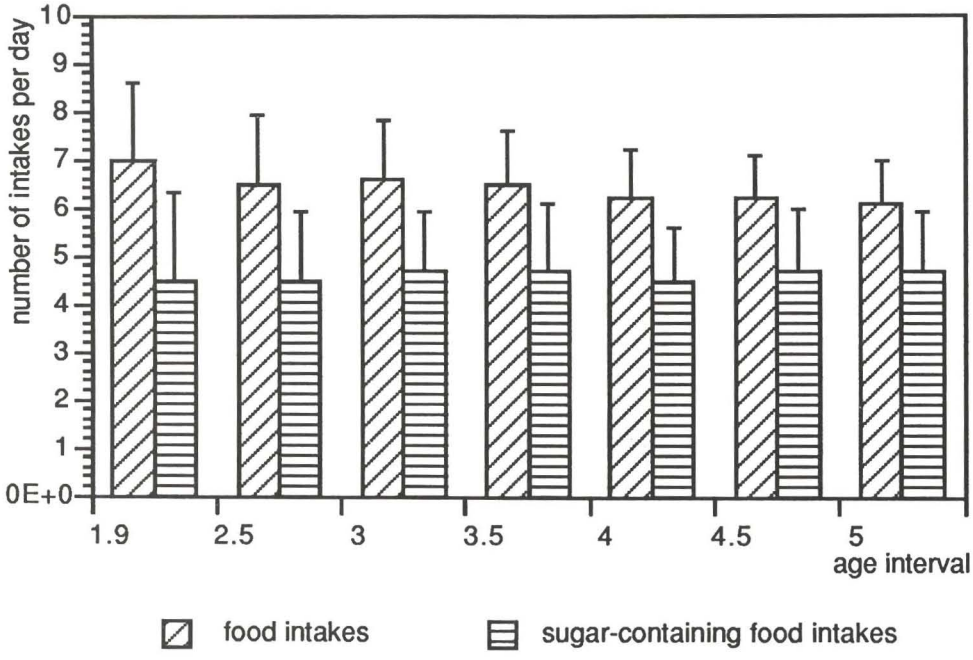

Figure 1. Average number and standard deviation of food ingestions and sugar containing food ingestions per day at various ages.

ranged from one to ten. In every age-interval, statistically significant ($p < 0.01$) correlations between the daily number of food intakes and the number of sugar-containing food ingestions were found (range .45 to .55). At baseline the dietary information obtained with the twenty-four-hour recall method was compared to the information obtained from the seven-day diet diary. The twenty-four-hour recall method showed an average number of daily food ingestions of 7.0 (SD = 1.6, range 4 to 13) and an average number of daily sugar ingestions of 4.6 (SD = 1.7, range 1 to10). Similar results were obtained with help of the seven-day diet diary: all food ingestions on average 6.9 (SD = 1.5, range 4 to 12), sugar ingestions on average 4.5 (SD = 1.5, range 1 to 9). The correlation between the information collected with the diet diary and that collected with the twenty-four-hour recall method was low ($r = .43$ for the food ingestions; $r = .52$ for the sugar intakes), but statistically significant ($p < 0.05$).

Use of fluoride, administered in tablets or toothpaste, is presented in Figures 2 and 3. The percentages of children using no fluoride tablets were low, but remained fairly constant (10-20 percent). The percentages of children using no toothpaste gradually decreased with increasing age. Fewer than 40 percent of the children used "toddler" toothpastes with a low fluoride content. The frequency of brushing increased slightly with increasing age; a small percentage of the children had their teeth brushed three times daily (Figure 4). As a result of the increase in the daily number of fluoride tablets and in the brushing frequency, using fluoride-containing toothpastes, the total fluoride ingestion with increasing age from 0.4 to 0.75 mg fluoride daily.

The average dmfs-scores (visual examination only) for the different age-groups are shown in Table 2. The percentages of caries-free children in the various age-groups are shown in Table 3. Combining the results of clinical and radiographical examination, the average $d_b$mfs score and $d_c$mfs score became 2.1 and 1.8, respectively. Only 51 percent of the children were free from d_b - type lesions and restorations; 57 percent of the children had a $d_c$mfs score of zero.

Average plaque- and gingivitis scores, which may vary from 0 to 2, are presented in Figure 5.

At every age significant negative correlations were found between the level of education of the mother and the daily number of food ingestions (range .19 to .24, $p < 0.05$) and the number of sugar-containing food ingestions (range .20 to .33, $p < 0.01$) of their child. The low correlations ($r \leq -.20$) between the level of education and the oral hygiene variables of the child, expressed by average plaque and gingivitis scores, were only of bor-

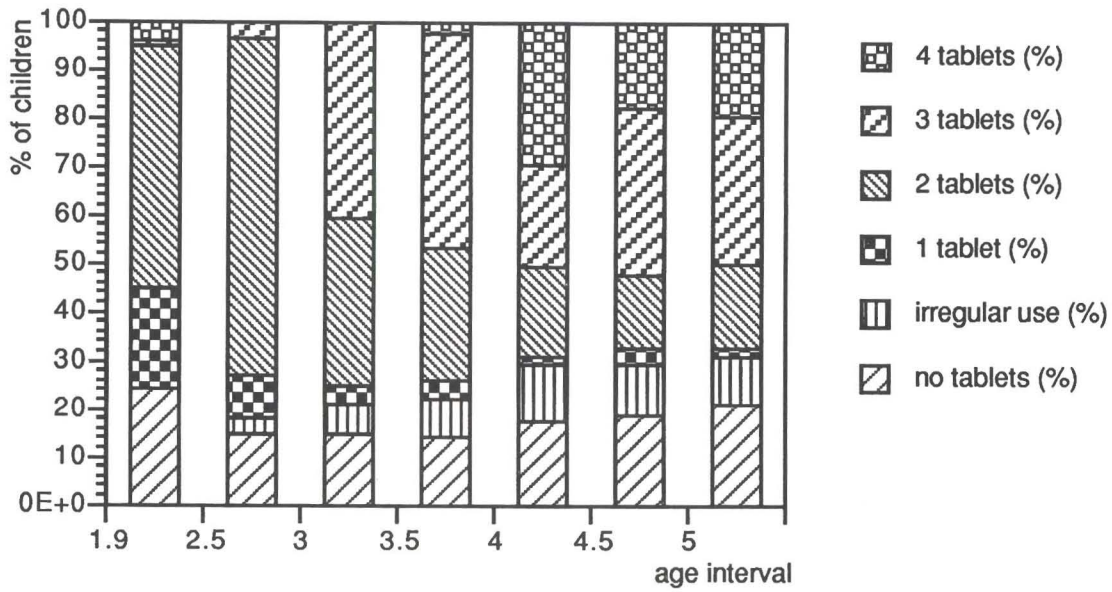

Figure 2. Use of fluoride tablets (% of the children) by number of tablets per day.

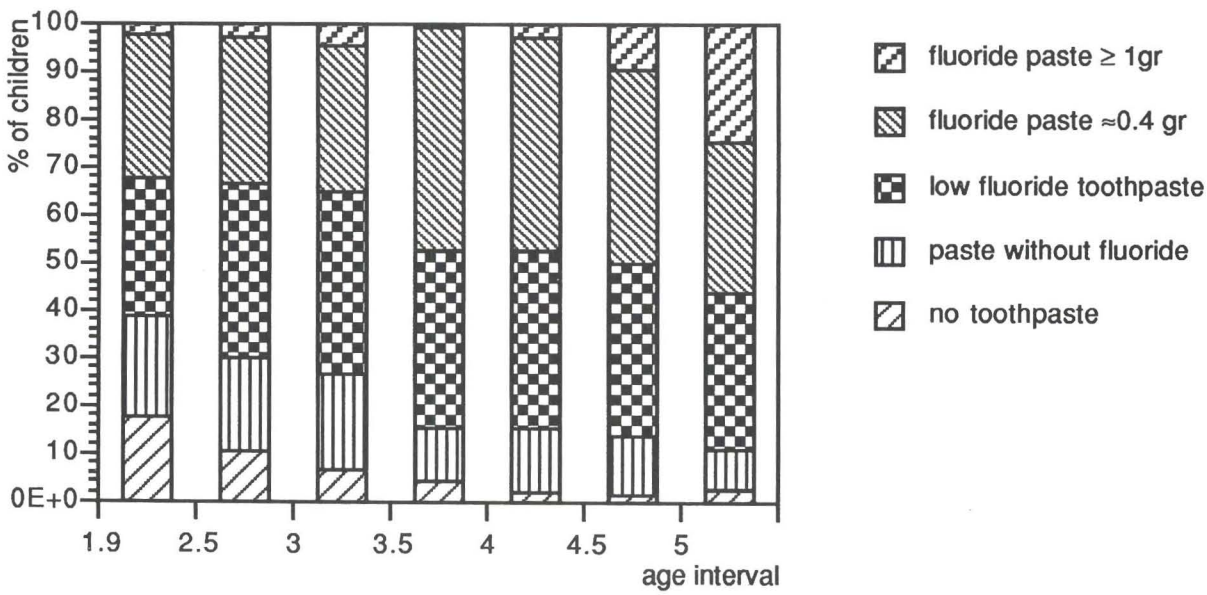

Figure 3. Use of toothpaste (%) at various ages.

derline significance ($p < 0.05$) at the elder age-intervals. The level of education and the DMFT score of the mother measured at baseline, were correlated with the d_bmfs score of the child and shown in Figure 6. Between the level of education of the mother and the d_bmfs score of the child, a negative correlation was found, which became stronger with increasing age of the child. This effect was not observed for any of the other combined variables.

The correlations between the daily number of food ingestions and sugar-containing-food ingestions and the d_bmfs scores at the various age-intervals never exceeded .23 ($p < 0.01$).

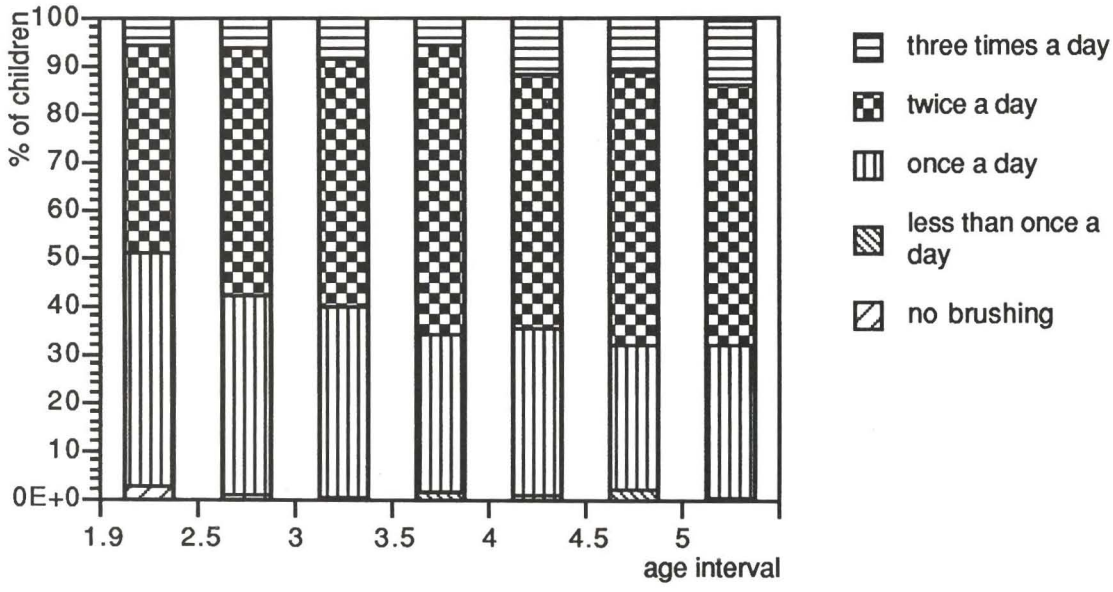

Figure 4. Percentage of children by tooth-brushing frequency at various ages.

Table 2 ☐ The average clinical dmfs-scores and standard deviations at various age-intervals.

Age interval (yrs)	$d_a$mfs	SD	$d_b$mfs	SD	$d_c$mfs	SD
1.92-2.49	.18	.83	.01	.15	.01	.15
2.50-2.99	.50	1.70	.14	.72	.03	.21
3.00-3.49	1.01	2.36	.27	1.07	.11	.51
3.50-3.99	1.23	2.58	.37	1.46	.27	1.16
4.00-4.49	1.66	3.00	.57	1.80	.45	1.53
4.50-4.99	2.16	3.56	.88	2.46	.69	1.98
5.00-5.50	2.54	3.98	1.17	3.02	1.00	2.68

Table 3 ☐ Percentage of caries-free children (dmfs = 0) upon visual examination according to average ages.

Group	$d_a$mfs = 0	$d_b$mfs = 0	$d_d$mfs = 0
1.92-2.49	92.7	99.4	99.4
2.50-2.99	85.4	94.1	97.3
3.00-3.49	70.9	91.3	94.4
3.50-3.99	66.7	90.4	92.9
4.00-4.49	56.3	82.7	86.3
4.50-4.99	50.8	77.7	79.8
5.00-5.50	47.8	71.9	75.9

No statistically significant correlations were found between the amount of fluoride ingested or the frequency of tooth brushing and the $d_b$mfs score.

Between plaque and gingivitis scores and the $d_b$mfs score, significant ($p < 0.05$) correlations never exceeded 0.21.

DISCUSSION

In preschool children, measured at the group level, very few showed other than minimal changes in their diet habits with increasing age. Nevertheless, the composition of the diet may have changed, but this information cannot be accurately determined from the twenty-four-hour recall method, because one has to rely on the memory of the parent, which may lapse because of a distraction or absence from home. This will result in an underestimation rather than an overestimation of the actual food ingested. The underestimation will probably increase when the child gets older, as it will spend more time away from the parent. On a group level, a close agreement between the diet diary and the twenty-four-hour recall findings was found, in contrast to the correlation on an individual level. Low correlations were

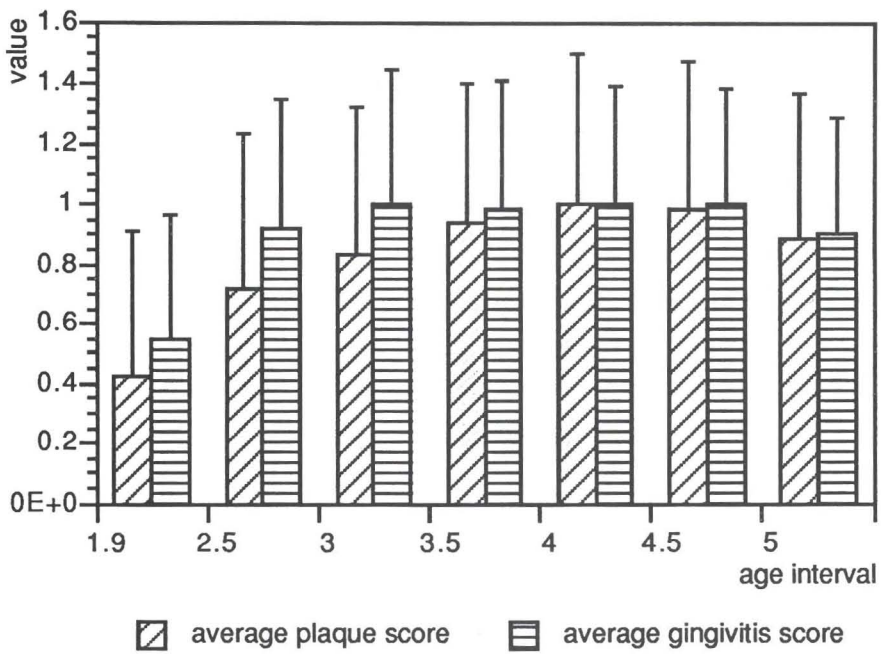

Figure 5. Average plaque and gingivitis score and standard deviations according to the age-interval.

found between the diet scores (according to the twenty-four-hour recall method) and the $d_b$mfs scores. The importance of the diet is demonstrated, however, in several human studies.[11-14] There are several explanations for the low correlations between the diet data and the $d_j$mfs scores in the present study. The correlations between the diet habits and the caries prevalence will be low, when the caries prevalence is low and the differences in diet habits are small.[15] The low correlations may also be partially explained by a low validity of the diet data.

It can be estimated that the total daily ingestion of fluoride from toothpaste and fluoride tablets increased with increasing age, and to the age of 3.5 years statistically significant differences ($p < 0.01$) existed. The number of children who were irregular users or used no fluoride at all remained fairly constant. With increasing age more fluoride tablets per day were used. In the youngest age-group almost 40 percent of the children did not use a fluoridated toothpaste. The consumption of toddler toothpaste (with a low fluoride content) did not increase. To parents who preferred to have one type of toothpaste for all the members of the family, instructions were given to reduce the volume of toothpaste applied to the brush of the young children. We assumed that most of the children received very small doses of fluoride from their toothpaste compared to the amount received from fluoride tablets. The use of fluoride containing toothpastes by 60 percent of the children was low when compared to 88 percent of the five-to-six-year-old children in another study in The Netherlands.[16] The frequency of tooth brushing was relatively low and only a small number of children brushed three times a day. In case of a low frequency of brushing in combination with a small amount of toothpaste, it is doubtful that the ingestion of fluorides would be optimal without ingestion of fluoride tablets. On a group level, the variable fluoride ingestion demonstrated no statistically significant correlation with the caries score, probably as an effect of the high level of fluoride ingestion in the total study population. The percentage of children using no fluoride at all was low and especially in this group the parents should have been aware of the importance of the diet in the development of dental caries.

Until the age of 3.5 years, the plaque and gingivitis scores increased; but statistically significant differences were found only between the youngest age-group and the other age-groups. Possible explanations may be less control by the parents of the oral hygiene of the children or changes in the number of teeth present in the mouth. After eruption of the second primary molars, their posterior location in the mouth may hamper the effectiveness of tooth brushing. The correlations of the plaque and gingivitis scores with the $d_b$mfs score were very low. This was probably the result of the lower caries preva-

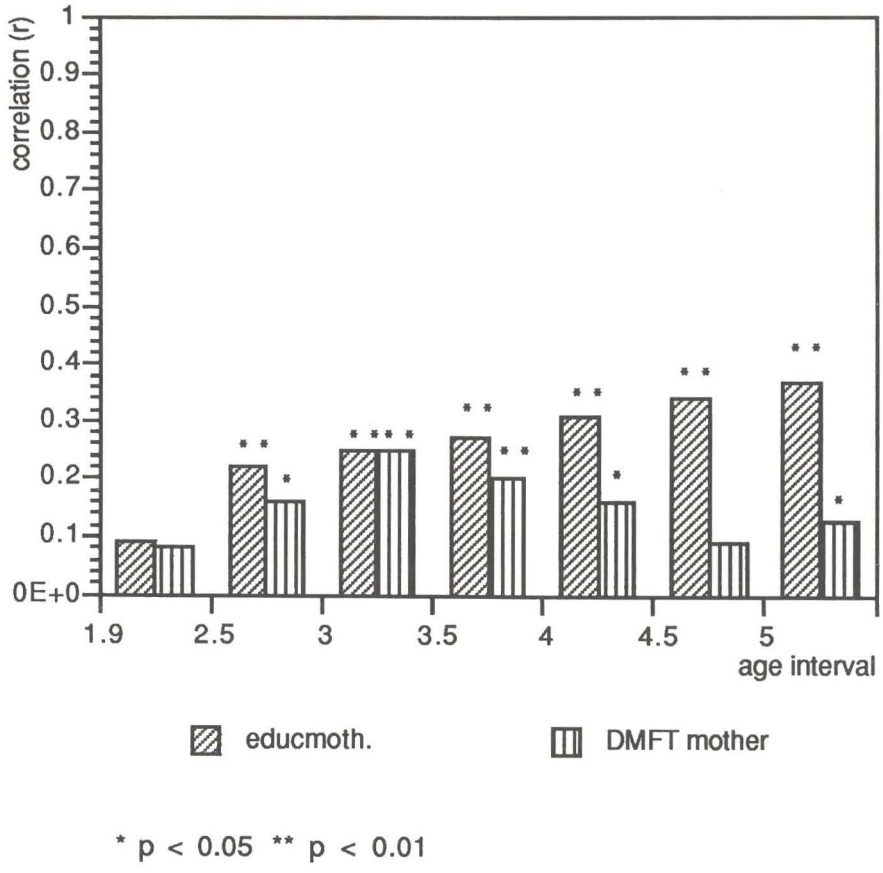

Figure 6. Spearman correlations between the $d_b$mfs score of the child, depending on the age of the child, and the level of education and DMFT score of the mother.

lence and high level of fluoride ingestion. Higher correlations between caries and oral hygiene have been found by Stecksén-Blicks and Gustafsson (1986).[17] In three-year-old children the presence of clean teeth, irrespective of diet habits, and children with suitable diet habits (provided they were free of general gingivitis with bleeding) were regarded as low caries risks.[13]

The caries experience ($d_c$mfs score) was low in comparison to other studies performed in The Netherlands.[18,19] Truin *et al* (1991) found about 60 percent of the five-year-old children to be caries free.[19] He found, however, the average $d_3$mfs score to be twice as high. In the present study large differences were also found between the percentages of children considered to be "caries free" according to the $d_b$mfs score or $d_c$mfs score. These results confirm the conclusions of Rimmer and Pitts (1991) that variations in the diagnostic thresholds influence the percentage of subjects who are considered to have sound teeth.[20] In their study, especially the inclusion of initial caries lesions (dark discoloration without detectable loss of substance) resulted in scores that are significantly different from the caries scores excluding this type of defect.

The relation between the socioeconomic status and the caries experience in young children was demonstrated in several studies.[21-26] A possible explanation for the correlation between the caries experience in the child and the education of the parents could be that more highly educated people demonstrate a more dental minded behavior: they eat less sweets, brush their teeth more often and visit their dentist more regularly.[27] Granath Kinnby *et al* (1991) found that the level of education of the parents did not influence their knowledge about oral hygiene, diet, and use of fluorides, but did affect their ability to put the knowledge into practice.[28] The level of education was statistically significantly higher among parents of healthy children, therefore, than among those of diseased children. Similar findings were

observed in the present study. At every age-interval, the level of education was negatively correlated with the number of daily food ingestions and sugar-containing food ingestions in particular. Grytten *et al* (1988) found no relationship between the level of education of the mother and the intake of fluoride tablets by three-year-old children. A low but significant relationship was found, however, between the number of missing teeth of the mother, her dental attendance pattern and her level of education, and the caries experience in her child.[25] In the present study, the level of education of the mothers showed a higher (negative) correlation with the caries experience of the children than the DMFT score of the mothers. With increasing age of the child, the correlation between the level of education of the mother and the caries score of the child gradually increased. This is probably the result of the children being subjected to unfavorable conditions for a longer period of time. The relatively low correlations of most of the variables with dental caries will be partially explained by the cross-sectional analysis and the fact that the determinants of the caries process at present should be searched for in the past. In a cross-sectional study the factor exposure time is not taken into account. At the time that caries is clinically present in the mouth, the causative factors may have altered.

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Modifications of the palatal crib habit-breaker appliance to prevent palatal soft tissue embedment

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Chronic digit-sucking is a difficult problem that confronts the dentist who treats children. Infante reported the habit to be prevalent in nearly one-fifth of all five-year old North American children.[1] In addition to the social stigmata associated with finger or thumb sucking, a variety of significant dentofacial alterations may develop, if the habit continues into the mixed dentition.[2-6] Digit-sucking encourages increased overjet, posterior crossbites, openbite, and an increased incidence of Class II occlusion.[7-9] Postural and functional changes in the tongue and lips may result in tongue thrust and lisping speech.[2,7,8,10]

The appliance commonly used to help eliminate digit-sucking is the palatal crib.[3-7,9-15] The palatal crib acts as a reminder to make the child aware of the habit. It also breaks the digit-to-palate seal that sucking creates.[16] The appliance is passive, but digital or resting tongue pressures can cause it to become embedded in the palatal tissues (Figure 1).[15] This palatal displacement causes infection, discomfort, increased anxiety, and bilateral mesial tipping of the banded molars. Removal of the embedded appliance often requires local anesthesia and possibly incision of the overlying mucosa.

Two simple modifications of the palatal crib appliance may prevent its palatal soft tissue embedment. These modifications include the use of heavier palatal wires and an acrylic palatal button.

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DESIGN OF THE COMBINATION PALATAL CRIB/BUTTON APPLIANCE (Figure 2)

Preformed stainless steel bands are placed on either the first permanent or primary second molars. An alginate impression of the maxillary arch is made with the bands seated. An opposing cast is recommended as a reference, to position the palatal crib properly. A palatal arch wire is formed and soldered to the bands. Heavy stainless steel wire (.036, .040, or .045 inch) is recommended to make the appliance rigid.[5,7] Shorter lengths of wire are positioned and soldered to the arch wire to form a smooth, rounded crib. Sharp spurs or "Hay rakes" are not recommended. Wires should be passive with 0.5 to 1 mm of relief from the palatal tissues.[13] The appliance is removed from the cast, cleaned, and polished. Orthodontic acrylic is added to the palatal area and around the palatal arch wire to form a palatal button similar to that formed for a Nance holding arch appliance. The acrylic is cured under pressure, trimmed and polished.

Positioning of the crib and button is critical for appliance success. The crib should be positioned in the intercanine area, extending beyond the occlusal plane and covering the extent of the anterior open bite. It should not interfere with the mandibular teeth in ex-

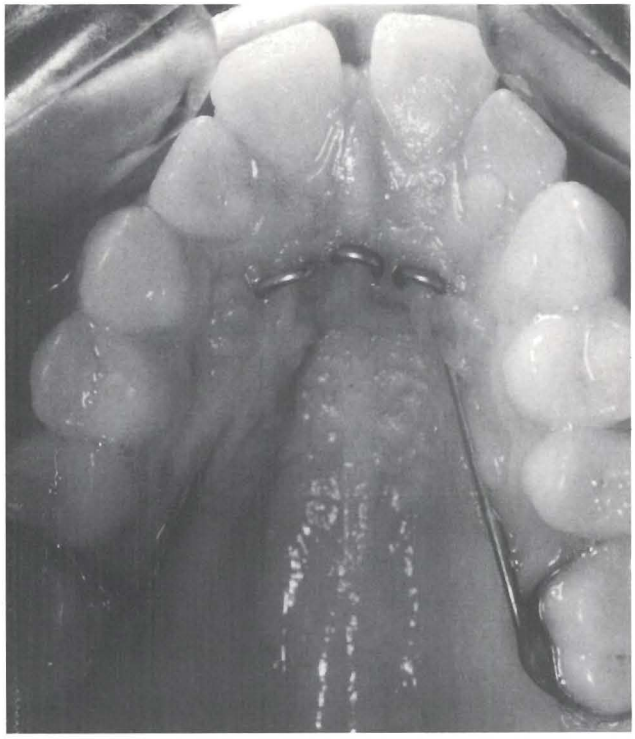

Figure 1. This palatal crib became embedded in the palatal soft tissues.

cursive movements, nor with palatal tipping of flared maxillary incisors. The crib should restrict access to the palate by the digit and screen any tongue thrusting. Occlusal interferences in mandibular excursive movements, including the maximum retruded position, can result in functional repositioning of the mandible. Damage to the dentition could occur from parafunctional habits or following a blow to the mandible.

DISCUSSION

The palatal acrylic button modification

The palatal button should be large enough to provide adequate resistance to digit and tongue forces, and yet not interfere with palatal tipping of flared maxillary incisors. Larson and DaSilva reported that muscular forces of the lips may aid in closing the bite once the unbalanced forces of the digit and/or tongue have been screened by the appliance.[13,14]

The modified habit-breaker appliance has several advantages over other designs. In addition to reducing the likelihood of palatal embedment, it is not readily removed by the child, and may also be used as anchorage for orthodontic retraction of flared maxillary incisors. A Hawley-type removable acrylic appliance with a palatal crib would

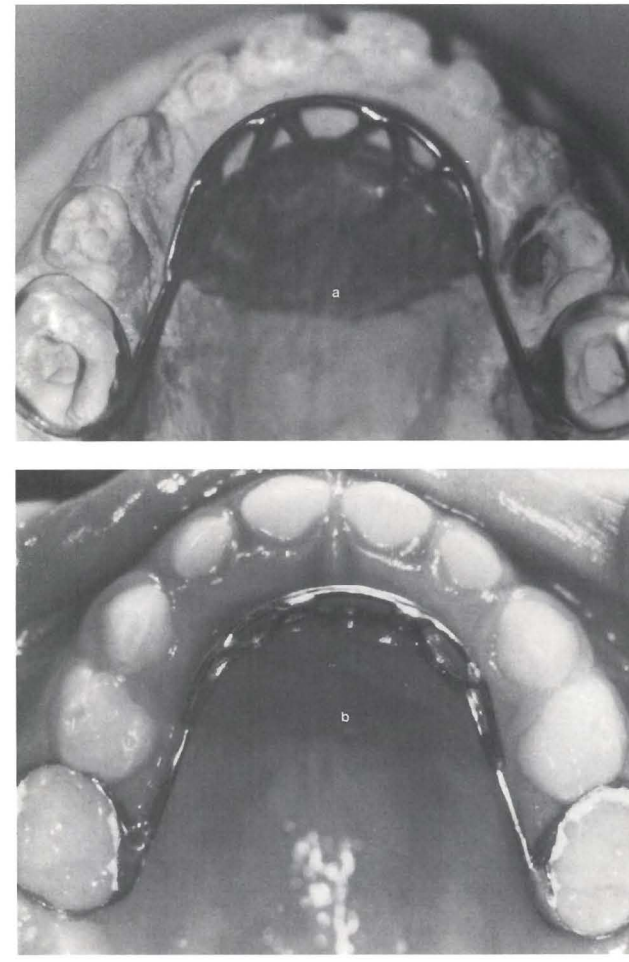

Figure 2. Combination palatal crib/button appliance. (a) On cast. (b) Inserted intraorally.

prevent the problem of palatal embedment by complete palatal coverage, but removable appliances are usually compromised by poor compliance, loss, or breakage.[5,6]

The disadvantage of the palatal button appliance is that it is less hygienic than a simple crib. A consistent schedule of appliance monitoring must be ensured to provide positive reinforcement and monitor the patient's oral hygiene and progress toward cessation of the habit. If poor oral hygiene and significant inflammation in the palatal button area persists, coupled with continued heavy digital pressure, it is not impossible that the modified appliance could embed. In such cases removal of the habit appliance is indicated.

Modification in palatal wires

Strength is the measure of a wire's resistance to deformation from external forces such as digital or tongue pressures. For round wires, it varies with respect to di-

Table ☐ Relative strengths of palatal wires

Palatal wire sizes (inches)	.036	.040	.045
Ratio of diameters	1	1.11	1.25
Ratio of increased strength	1	1.37	1.95
Cantilever, no palatal button	1	1.37	1.95
Cantilever, with palatal button	2	2.74	3.90

Reference Value of .036 inch wire = 1

ameter, length, and attachment, and is independent of the wire's composition.[6]

The typical palatal wire in the habit-breaker appliance is a cantilever beam, unsupported against loading forces where it arcs near the palate. Rigid support is provided only at each abutment band. To compare different round wire sizes for cantilevered beams, strength changes as a cubic function of the ratio of the larger to the smaller wire diameters:

$$\Delta \text{ Strength} = \left(\frac{d_v}{d_R}\right)^3$$

for any (N) new wire and (R) reference wire.[6,17] The typically used palatal wire size is .036 inches and represents the reference wire for calculating relative increases in strength (see Table). It is readily seen that a modest increase in wire diameter to .040 or .045 inches nearly doubles the palatal wire's resistance to digital or tongue pressures.

Length of wire and location of attachment affect the strength of a palatal wire. By placing an acrylic palatal button, the cantilever effect is greatly reduced. As strength varies inversely to the ratio of change in length, the effect of halving the length of a cantilever beam doubles its strength.[17] For the .045 inch palatal wire with an acrylic palatal button, the habit-breaker appliance is nearly four times stronger than the typical .036 inch cantilevered appliance. The actual increase in strength will relate differentially to palatal button support, with strength increasing along with button palatal surface area and mucosal resistance.

CONCLUSION

To treat a digit-sucking habit successfully, the dentist must consider appliance design and the motivation of the patient and parents. Before starting digit-sucking habit-cessation treatment, it is essential to establish that the child wants to stop the sucking habit and accepts the clinician's assistance.[5,7,15,18] Appliance therapy should be performed in conjunction with behavior modification procedures, such as positive reinforcement, contingency contracting, and differential reinforcement of other behaviors.[7,18-20] Parents should be counseled to refrain from using any negative or punitive measures.[11,12]

When habit therapy includes appliance wear, the appliance should be designed to be nonpunitive, unobtrusive, and nondamaging to oral soft and hard tissues.

Adding an acrylic palatal button in conjunction with .040 or .045 inch palatal wires are simple, quick, and inexpensive modifications of the palatal crib that can reduce the likelihood of the crib becoming embedded in the palatal soft tissues.

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Abnormalities of the maxillary incisors in children with cleft lip and palate

Marco Vichi, MD, DDS
Lorenzo Franchi, DDS, PhD

Dental abnormalities in children with cleft lip and/or palate have been carefully examined by many authors because both dentitions are affected more frequently than in the normal population.[1-22]

The interest has been focused on dental abnormalities in the cleft area (especially the lateral incisor) and their etiology. Nevertheless, dental abnormalities outside the cleft area also occur more frequently than in noncleft children.[4,5,7,8,11,13,16,20,21]

The purpose of the present study is to analyze the prevalence of dental abnormalities in number, size, and shape of the primary and permanent maxillary incisors in children affected by unilateral or bilateral clefts of the lip and alveolar process, with or without involvement of the palate.

MATERIAL AND METHODS

Seventy-seven patients (forty-seven male and thirty female), ages three to sixteen, affected by unilateral or bilateral clefts of the lip and alveolar process, with or without involvement of the palate were selected from the files of the Department of Orthodontics of the University of Florence. Fifty-four patients (70 percent) were affected unilaterally: twenty-eight on the right side and twenty-six on the left; the remainder (twenty-three patients) were affected bilaterally. Diagnosis of dental abnormalities was done at the time of the clinical examination, on radiograms (orthopantomograms, lateral and posteroanterior cephalometric films and intraoral radiographs of the incisor region) and on study casts. Boys and girls were not studied separately since previous studies pointed out that there are no statistically significant differences between the two sexes with respect to dental anomalies in the cleft area.[7,17]

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RESULTS

The prevalence of dental abnormalities in the regions of the primary and permanent maxillary incisors is reported in Tables 1-6.

DISCUSSION

Congenitally missing teeth (Tables 1 and 2)

Our results confirm that the permanent lateral incisor is the tooth missing most frequently in the cleft area (Figure 1), as pointed out by other authors.[7,8,11,17] The prevalence of congenitally missing permanent lateral incisors on the cleft side (42.9 percent; 22.1 percent in unilateral clefts and 20.8 percent in bilateral clefts), corresponds to that reported by Bohn (45.9 percent of 281 cases with unilateral and bilateral cleft lip and palate). If we consider only the cases with unilateral cleft lip and/or palate (fifty-four cases) the prevalence (31.5 percent) is lower

Table 1 ☐ Prevalence of congenitally missing primary and permanent lateral incisors in children affected by unilateral and bilateral cleft lip and/or palate. The percentages reported in this table and in all the following ones are calculated on the entire material (77 cases) or on those cases presenting unilateral clefts (54 cases) and those presenting bilateral clefts (23 cases).

Congenitally missing lateral incisors	Unilateral clefts (54 cases)				Bilateral clefts (23 cases)	
	Cleft side		Noncleft side			
	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
52 and 12	2	3.7	—	—	2	8.7
62 and 22	3	5.5	—	—	—	—
52,62 and 12,22	—	—	—	—	1	4.3
12 or 22	12	22.2	1	1.8	7	30.4
12 and 22	—	—	—	—	6	26.1
Total Congenitally missing primary lateral incisors	No. subjects 5	% 54 cases 9.2 % 77 cases 6.5	No. subjects —	% 54 cases — % 77 cases —	No. of subjects 3	% 23 cases 13 % 77 cases 3.9
Total Congenitally missing permanent lateral incisors	No. subjects 17	% 54 cases 31.5 % 77 cases 22.1	No. subjects 1	% 54 cases 1.8 % 77 cases 1.3	No. of subjects 16	% 23 cases 69.6 % 77 cases 20.8

Table 2 ☐ Prevalence of congenitally missing primary and permanent central incisors in children affected by unilateral and bilateral cleft lip and/or palate.

Congenitally missing central incisors	Unilateral clefts (54 cases)				Bilateral clefts (23 cases)	
	Cleft side		Noncleft side			
	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
51,61 and/or 11,21	2	3.7	—	—	—	—
Total Congenitally missing primary central incisors	No. subjects 1	% 54 cases 1.8 % 77 cases 1.3	No. subjects —	% 54 cases — % 77 cases —	No. of subjects —	% 23 cases — % 77 cases —
Total Congenitally missing permanent central incisors	No. subjects 2	% 54 cases 3.7 % 77 cases 2.6	No. subjects —	% 54 cases — % 77 cases —	No. of subjects —	% 23 cases — % 77 cases —

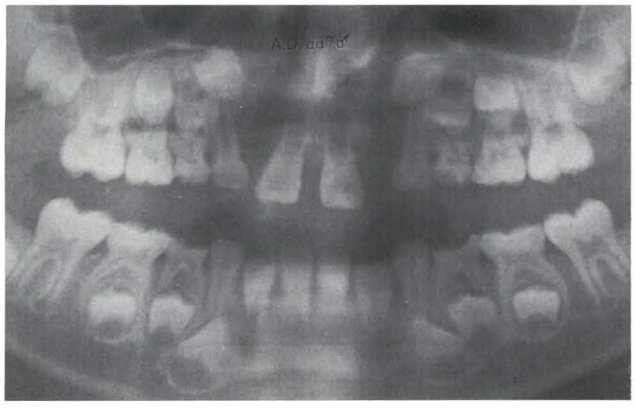

Figure 1. Panoramic radiograph of a patient with bilateral cleft lip and palate showing the congenital absence of the maxillary permanent lateral incisors.

than that reported by Weise and Erdmann (45.3 percent of seventy-five children with unilateral cleft lip and palate); by Hellquist *et al* (42.6 percent of 172 cases with unilateral cleft lip and/or palate); and by Ranta (38.6 percent of eighty-three children with unilateral cleft lip and palate).[11,15,20]

In eight cases (10.4 percent) the lateral incisor was missing from both dentitions. In twenty-five cases (32.5 percent) only the permanent lateral incisor was missing. As Ranta has pointed out, the tooth germ of the permanent lateral incisor, however, is more susceptible to injuries than its primary predecessor.[22] From a clinical point of view, our results show that the congenital absence of a primary lateral incisor is always associated with the congenital absence of the corresponding permanent tooth; on the contrary, however, the presence of the primary lateral incisor on the cleft side may be associated with the congenital absence of the permanent lateral incisor.

As for the missing permanent central incisor on the cleft side, the prevalence (2.6 percent) corresponds with that reported by Bohn (2.8 percent); if we consider only the cases presenting unilateral clefts (fifty-four cases), our prevalence (3.7 percent) is somewhat higher than

Table 3 ☐ Prevalence of supernumerary primary and permanent lateral incisors in children affected by unilateral and bilateral cleft lip and/or palate.

Supernumerary lateral incisors	Unilateral clefts (54 cases)				Bilateral clefts (23 cases)	
	Cleft side		Noncleft side			
	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
52 or 62	5	9.2	—	—	4	17.4
52 and 62	—	—	—	—	2	8.7
52 and 12	1	1.8	—	—	2	8.7
62 and 22	—	—	—	—	—	—
52,62 and 12,22	—	—	—	—	1	4.3
12 or 22	11	20.4	—	—	2	8.7
Total	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
Supernumerary primary lateral incisors	6	11 % 77 cases 7.8	—	— % 77 cases —	9	39.1 % 77 cases 11.7
Total	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
Supernumerary permanent lateral incisors	12	22.2 % 77 cases 15.6	—	— % 77 cases —	5	21.7 % 77 cases 6.5

Table 4 ☐ Prevalence of supernumerary primary and permanent central incisors in children affected by unilateral and bilateral cleft lip and/or palate.

Supernumerary central incisors	Unilateral clefts (54 cases)				Bilateral clefts (23 cases)	
	Cleft side		Noncleft side			
	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
11 or 21	2	3.7	—	—	1	4.3
Total	No. subjects	% 54 cases	No. subjects	% 54 cases	No. of subjects	% 23 cases
Supernumerary permanent central incisors	2	3.7 % 77 cases 2.6	—	— % 77 cases —	1	4.3 % 77 cases 1.3

those reported by Hellquist *et al* (1.7 percent) and by Ranta (1.0 percent).[7,16,20]

The etiology of congenitally missing teeth on the cleft side seems to be related to a deficiency in the mesenchymal support to the tooth bud in the cleft region or to an inadequate blood supply, which could be congenital or secondary to the tissue destruction resulting from surgery.[2,7,8] Hellquist *et al* stated that surgical procedures in the cleft area should be considered, however, of minor importance as an etiologic factor.[20]

Supernumerary teeth (Tables 3 and 4)

The prevalence of supernumerary lateral incisors was found to be greater in the permanent dentition (seventeen cases or 22.1 percent) than in the primary dentition (fifteen cases or 19.5 percent). Our data do not completely confirm the observation made by other authors that a supernumerary primary lateral incisor is more frequent than a permanent supernumerary tooth; whereas the absence of the permanent tooth is more common than the absence of the primary tooth.[3,7,17]

In the present investigation the frequency of supernumerary permanent teeth (22.2 percent) in the cleft area in children with unilateral cleft lip and/or palate (fifty-four cases) is in close agreement with the findings reported by Hellquist *et al* (20.9 percent); but is considerably higher than that quoted by Weise and Erdmann (6.7 percent).[11,20] Our frequency does not vary (22.1 percent: 15.6 percent in unilateral clefts and 6.5 percent in bilateral clefts), if we also consider that the cases affected by bilateral cleft lip and/or palate showed a very similar prevalence in our study. In eleven cases (five with unilateral and six with bilateral cleft) the supernumerary lateral incisor was present only in the primary dentition (Figure 2). In four cases (three with bilateral and one with unilateral cleft) supernumerary teeth were present in both dentitions (Figure 3). A practical consequence of these results is that the presence of a supernumerary primary lateral incisor cannot be considered a predictive sign for the presence of a supernumerary tooth in the permanent dentition.

The prevalence of supernumerary permanent central incisors on the cleft side was found to be 3.9 percent (2.6 percent in unilateral clefts and 1.3 percent in bilateral clefts).

As far as the etiology of this anomaly is concerned, Mathis believed that an extra tooth could originate from

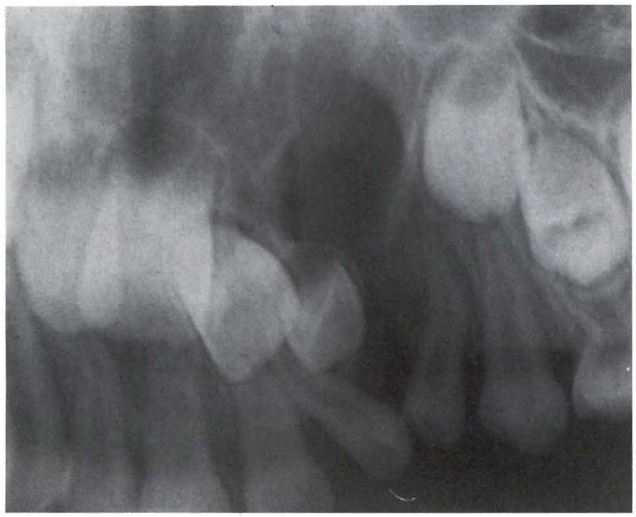

Figure 2. Panoramic radiograph (detail) of a patient with unilateral cleft (on the left side) presenting a primary supernumerary maxillary lateral incisor.

a lengthening of the precanine section of the oral epithelium produced by the cleft with a consequent extension of the dental lamina.[4] Other authors observed that, due to its position across the nasopalatal sulcus, the tooth bud of the lateral incisor could be divided into two portions by the cleft.[1,6]

It is interesting to note that in all cases presenting a supernumerary lateral incisor, in both dentitions, the normal and the supernumerary teeth were localized mesially and distally to the cleft, respectively. The consequence is that the clinician may decide which tooth has to be removed, especially in those cases where the supernumerary tooth presents a normal morphology and size.

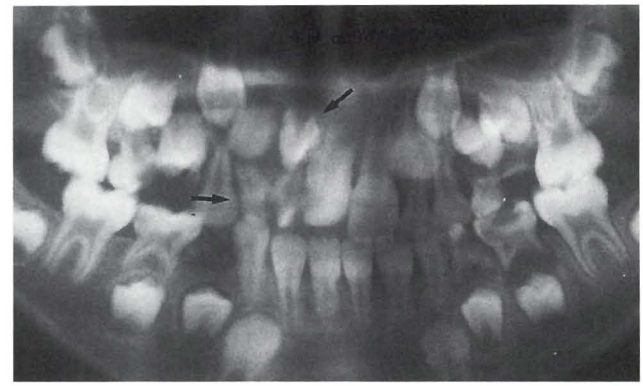

Figure 3. Panoramic radiograph of a patient with unilateral cleft (on the right side) showing a supernumerary maxillary lateral incisor both in the primary and permanent dentitions.

Anomalies in size and shape (Table 5) and enamel hypoplasia (Table 6).

In twenty-eight cases (36.4 percent: 28.6 percent in unilateral clefts and 7.8 percent in bilateral clefts), the permanent lateral incisor on the cleft side was found to present some degree of deformity in size or shape (Figure 4); only four cases (5.2 percent: 3.9 percent in unilateral clefts and 1.3 percent in bilateral clefts) presented a malformed central incisor. On the other hand enamel hypoplasia (Figure 5) was found to affect the permanent central incisor more frequently (32.5 percent: 24.7 percent in unilateral clefts and 7.8 percent in bilateral clefts). Also this tooth was subject frequently to delayed eruption and caries. Our data on the prevalence of malformed maxillary lateral incisors on the cleft side, in children with unilateral cleft (40.7 percent) are in agreement with the findings of Weise and Erdmann (40

Table 5 ☐ Prevalence of anomalies in size and shape in permanent lateral and central incisors in children affected by unilateral and bilateral cleft lip and/or palate.

Anomalies in size and shape	Unilateral clefts (54 cases)						Bilateral clefts (23 cases)			
	Cleft side			Noncleft side						
	52or62	12or22	11or21	52or62	12or22	11or21	12and22	11and21	12or22	11or21
Microdontism	1	20	2	—	4	—	—	—	4	—
Macrodontism	—	—	—	—	1	1	—	—	—	1
Dysmorphism	—	2	1	—	—	—	1	—	1	—
Total Malformed permanent lateral incisors	No. subjects 22	% 54 cases 40.7	% 77 cases 28.6	No. subjects 5	% 54 cases 9.2	% 77 cases 6.5	No. of subjects 6		% 23 cases 26.1	% 77 cases 7.8
Total Malformed permanent central incisors	No. subjects 3	% 54 cases 5.5	% 77 cases 3.9	No. subjects 1	% 54 cases 1.8	% 77 cases 1.3	No. of subjects 1		% 23 cases 4.3	% 77 cases 1.3

Table 6 ☐ Prevalence of enamel hypoplasia in permanent lateral and central incisors in children affected by unilateral and bilateral cleft lip and/or palate.

Enamel hypoplasia	Unilateral clefts (54 cases)						Bilateral clefts (23 cases)			
	Cleft side			Noncleft side						
	52or62	12or22	11or21	52or62	12or22	11or21	12and22	11and21	12or22	11or21
	—	1	19	—	—	—	—	3	—	3
Total Permanent lateral incisors with enamel hypoplasia	No. subjects 1	% 54 cases 1.8 % 77 cases 1.3		No. subjects —	% 54 cases — % 77 cases —		No. of subjects —		% 23 cases — % 77 cases —	
Total Permanent central incisors with enamel hypoplasia	No. subjects 19	% 54 cases 35.2 % 77 cases 24.7		No. subjects —	% 54 cases — % 77 cases —		No. of subjects 6		% 23 cases 26.1 % 77 cases 7.8	

Figure 4. Lateral intraoral view of a patient with unilateral cleft: the maxillary lateral incisor on the cleft side is peg-shaped.

Figure 5. Frontal intraoral view of a patient with unilateral cleft: the maxillary central incisor on the cleft side is affected by enamel hypoplasia.

percent).[11] Hellquist *et al* reported a higher prevalence of malformations (49.4 percent). A lower prevalence was quoted by Bohn (35 percent).[7] Dixon suggested that surgical procedures could play an important role in the etiology of enamel hypoplasia in children with clefts of the lip and alveolus.[13]

In five of fifty-four cases with unilateral cleft (9.2 percent) a degree of malformation of the permanent lateral incisor on the normal side was detected: these anomalies could be interpreted as possible microforms of cleft lip and/or palate as suggested by other authors.[9,10,12,14,18]

In conclusion, it is still difficult to understand the role played by genetic and by postnatal environmental, nutritional, and surgical factors in the etiology of dental abnormalities in children with cleft lip and/or palate. The high prevalence, however, of dental anomalies and their variability should be emphasized, since, from a clinical point of view, they represent an additional complication in treatment planning. Moreover, early recognition of tooth abnormalities during the primary dentition phase is of major importance for a successful interceptive treatment of potentially severe problems.

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EXTERNAL LIP/NOSE DEFORMITY

In many patients with clefts, unilateral or bilateral, upper lip and nasal deformities may exist. The nasal deformities involve the septum as well as the external nasal bones, upper and lower lateral cartilages, adjacent supporting bony structures, and overlying soft tissues. After lip repair in the unilateral cleft lip/palate, the anterior nasal spine remains deviated toward the noncleft side, and the alar cartilage are also distorted. Often the nares have an oblong shape with less support of the ala on the cleft side. Columellar length is usually shorter on the cleft side and slanted toward the noncleft side. The nasal dome is usually deviated away from the cleft side because the noncleft dome is often elevated and more prominent. The anterior dorsal septum most often leans toward the cleft side. In the previously repaired bilateral lip deformity, residual nasal defects include a severely shortened columella, wide and poorly projecting nasal tip, asymmetries, poorly supported ala, and oblong nares, with an underdeveloped anterior nasal spine and poor premaxillary support to the nose.

Residual esthetic and functional deformities of the upper lip can exist. Lip scars, asymmetries, vertical excess or deficiency, horizontal deficiency (tight lip), muscle malalignment, and functional and cosmetic defects in the vermilion and/or lip area are commonly seen in repaired unilateral cleft lip cases. Bilateral cases include the above but also have unique residual defects including philtrum abnormalities, vermilion deficiency, and buccal sulcus abnormalities.

At the end-stage reconstruction, corrective rhinoplasty and nasal tip reconstruction, as well as lip revisions (including Abbé flaps), are ideally done secondarily.

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MANPOWER PLANNING

Planning for the children of your current pediatric dental patients

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

The U.S. Bureau of the Census projects that between 1993 and 2020 there will be an increase of 8.1 million children (a 14.2 percent increase) less than 15 years of age.* The changes in the numbers of children will not be uniform throughout the country, ranging from decreases of 135,000 children in Pennsylvania and 89,000 children in Massachusetts and Ohio, to an increase of 1.1 million children in Texas and 3.2 million children in California (Table 1).

The variations in the changing numbers of children will be a component of the overall changes that the Bureau of the Census projects for the general population. For example, during the next two and a half decades, the population growth in Florida, Texas, and California will far surpass the numerical growth in each of the other states, increasing by 5.7, 7.6, and 16.6 million residents, respectively (Figure).

In addition, the population changes will vary by race and Hispanic origin (the latter may be of any race). Between 1993 and 2020 California will have the largest numeric increases of white, Asian-American, and Hispanic populations. Florida will have the largest numeric increases of African-Americans. Arizona will have the largest increase of American Indians. By 2020, California will have the largest white, Asian-American, and Hispanic populations. New York will have the largest African-American population and Arizona will have the largest American Indian population (Table 2).

The overall increases in the general and child populations will be occurring at a time of marked decreases in the numbers of dentists, which will result in the lowest ratios of dentists-to-population that have been recorded throughout the 20th century.[2]

Providing dental services for the evolving distribution and overall increases in the numbers of children (particularly the increasing numbers of minority children for whom there have been limitations in the delivery of needed dental services**) requires a review of the projections of the future availability of dental personnel, in particular, pediatric dentists.

Earlier retrospective presentations in the *Journal of Dentistry for Children* by this writer considered the changing number and distribution of pediatric dentists in 1982, 1987, and 1991.[6,7]

The following presentation will relate the Bureau of the Census population projections to available data from the American Dental Association on the numbers, age, and distribution of pediatric dentists in private practice.[8] The intent will be to develop an estimate of the number of pediatric dentists needed to replace the current population of pediatric dentists and to provide for the 8.1

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*Throughout this presentation, unless otherwise specified, the reference to children will include all youngsters less than fifteen years of age. This age cohort was selected to follow the format used by the Bureau of the Census in its published projections.[1]

**See previous presentations in the *Journal of Dentistry for Children* for detailed reviews regarding the unmet needs of minority group children.[3-5]

Table 1 ☐ Number of children less than 15 years of age, by region and state: 1993, 2020.[1]

Region & State	1993	2020	Change 1993-2020
	(in thousands)		
New England	2,677	2,598	−78
Connecticut	665	680	15
Maine	256	248	−8
Massachusetts	1,191	1,102	−89
New Hampshire	241	250	9
Rhode Island	200	194	−6
Vermont	122	123	1
Middle Atlantic	7,806	7,761	−45
New Jersey	1,608	1,761	153
New York	3,781	3,720	−61
Pennsylvania	2,416	2,281	−135
South Atlantic	9,499	10,941	1,442
Delaware	150	168	18
Dis. of Columbia	97	94	−3
Florida	2,692	3,123	431
Georgia	1,551	1,883	332
Maryland	1,081	1,303	222
North Carolina	1,422	1,604	182
South Carolina	802	897	95
Virginia	1,351	1,548	197
West Virginia	354	322	−32
East South Central	3,389	3,628	239
Alabama	909	1,060	151
Kentucky	803	809	6
Mississippi	623	624	1
Tennessee	1,054	1,135	81
East North Central	9,478	9,681	203
Illinois	2,594	2,761	167
Indiana	1,233	1,273	40
Michigan	2,138	2,238	100
Ohio	2,383	2,294	−89
Wisconsin	1,129	1,116	−13
West North Central	4,061	4,185	124
Iowa	615	578	−37
Kansas	581	650	69
Minnesota	1,033	1,056	23
Missouri	1,144	1,182	38
Nebraska	372	385	13
North Dakota	143	143	—
South Dakota	174	191	17
West South Central	6,666	7,973	1,307
Arkansas	527	564	37
Louisiana	1,042	1,130	88
Oklahoma	722	794	72
Texas	4,375	5,484	1,109
Mountain	3,547	4,444	897
Arizona	917	1,160	243
Colorado	789	917	128
Idaho	274	347	73
Montana	190	219	29
Nevada	300	399	99
New Mexico	406	543	137
Utah	553	720	167
Wyoming	116	148	32
Pacific	9,700	13,696	3,996
Alaska	166	230	64
California	7,442	10,660	3,218
Hawaii	256	379	123
Oregon	656	866	210
Washington	1,181	1,561	380
United States	56,824	64,908	8,084

Note: totals may differ due to rounding

million additional children: in effect maintain the 1993 pediatric dentist-to-children ratios in each state in the year 2020.

NOTES ON PROCEDURES AND ASSUMPTIONS

The most recent published study by the American Dental Association (ADA) on the number, age (divided into less than forty years of age and forty plus years) and distribution of pediatric dentists is for 1991. The most recent publication by the Bureau of the Census on future population changes is based on estimated populations for 1993. An estimate of pediatric dentist-to-children ratios by age for each state and region was developed using the 1991 ADA data and the 1993 Bureau of the Census data.

- ☐ The assumption was made that while the pediatric dentist-to-children ratio was not ideal in any particular state, it at least could serve as a starting point for manpower planning purposes.
- ☐ The assumption was made that essentially all pediatric dentists forty years of age and older in 1991 will no longer be in practice in 2020, having died or reached the age of sixty-nine or more years and will have retired.
- ☐ The assumption was made that "all" pediatric dentists less than forty years of age in 1991 will continue to be in practice in 2020. Thus, if we are to maintain the estimated 1993 ratios of pediatric dentist-to-children, in 2020, only "replacements" would be necessary for pediatric dentists who were forty years of age or more in 1991, plus any additional dentists needed to meet the child population increases (or fewer dentists in cases of child population decreases).

In actuality, the assumption that all practitioners less than forty years of age in 1991 would continue to be in practice in 2020 is counter to the reality of early part-time or full retirement and the death of practitioners at earlier ages. Thus more "replacement" pediatric dentists would be required. The process chosen will reflect conservative estimates of the dental manpower needs at the state and regional levels to maintain the 1993 pediatric dentist-to-children ratios in 2020. (See below for assumptions regarding nonprivate-practice pediatric dentists and graduates from pediatric dentistry training programs.)

CHANGING NUMBERS OF CHILDREN

Regional level

Between 1993 and 2020, the number of children less than fifteen years of age will decrease in the New England Region and in the Middle Atlantic Region. In the

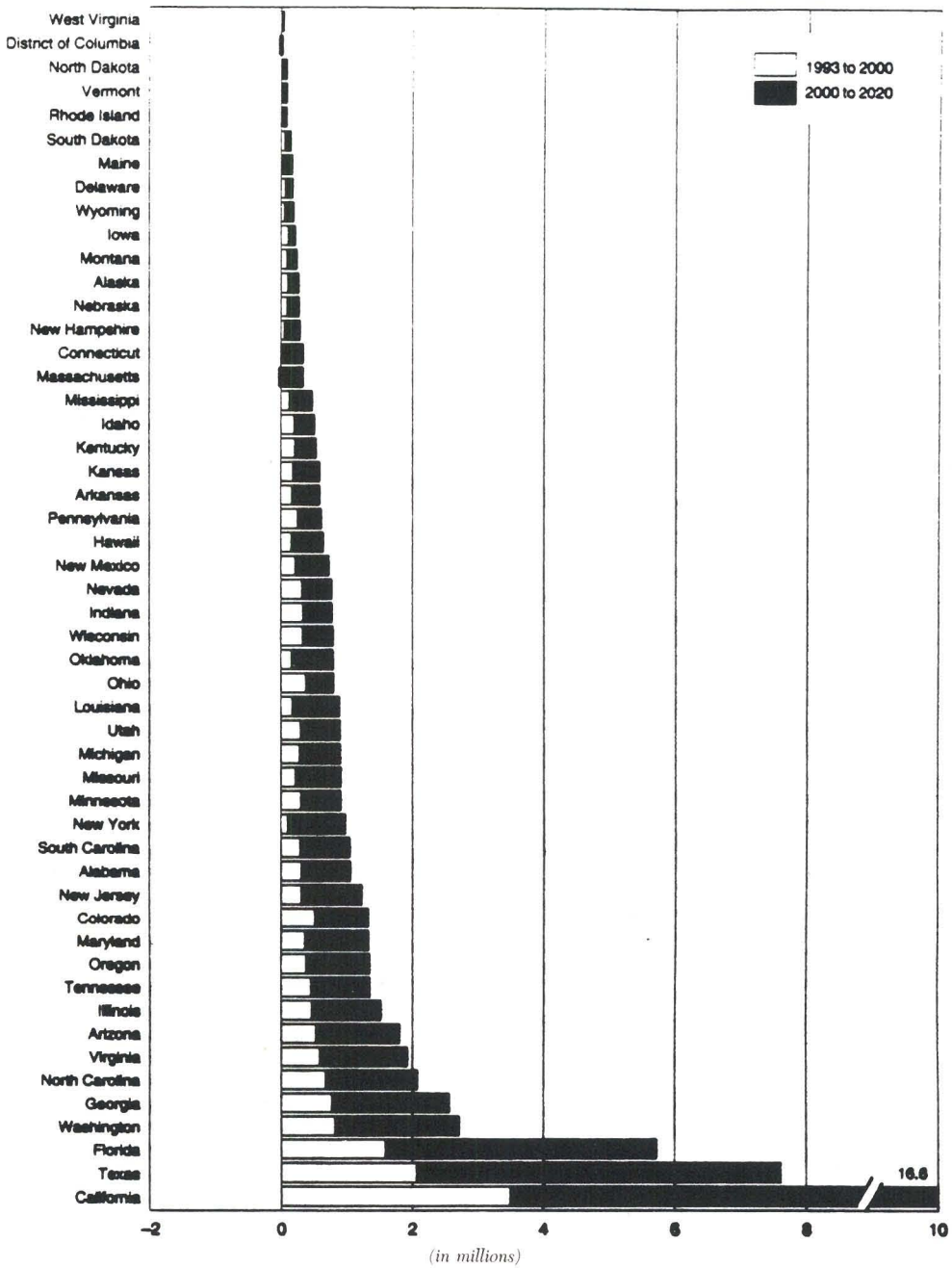

Figure. Net population change, by state: 1993 to 2020.[1]

Pacific Region, the projected increases of almost four million children represents half (49.4 percent) of the total projected national increase. The South Atlantic Region (with an increase of 1.4 million children) and the West South Central Region (with an increase of 1.3 million children) represent 17.8 percent and 16.2 percent, respectively, of the total national increase in the number of children (Table 1). (Note: see Table 1 for a listing of the states in each region.)

State level

The number of children will decrease in the District of Columbia and nine states (Iowa, Maine, Massachusetts,

Table 2 ☐ States with the largest population and population change ranked by race and Hispanic origin: 1993 to 2020.[1]

	White		African-Americans		American Indians		Asian-Americans		Hispanics*	
					(Numbers in millions)					
	State	Pop.	State	Pop.	State	Pop.	State	Pop.	State	Pop.
Largest population	California	34.1	New York	4.0	Arizona	.4	California	9.7	California	17.5
Net change ranking										
1.	California	8.9	Florida	1.5	Arizona	.2	California	6.2	California	8.9
2.	Texas	5.9	California	1.4	New Mexico	.1	New York	.8	Texas	5.4
3.	Florida	3.8	Texas	1.1	Alaska	<.1	Texas	.8	Florida	2.4
4.	Washington	2.0	Georgia	.9	California	<.1	Washington	.6	Illinois	1.1
5.	Georgia	1.4	New York	.8	Oklahoma	<.1	Illinois	.5	Arizona	1.0

* May be of any race

New York, Ohio, Pennsylvania, Rhode Island, West Virginia, and Wisconsin). By contrast, the increase of 1.1 million children in Texas and 3.2 million children in California will represent 13.6 percent and 38.5 percent, respectively, of the overall national increase in the numbers of children.

Fifteen to seventeen year old children

Projections for the changing number of children fifteen to seventeen years of age are provided only at the national level by the Bureau of the Census. State or regional projection data for this age-cohort are not available. Between 1993 and 2020 the number of children in this age-cohort will increase from 10.3 to 12.7 million (an increase of 2.4 million children).[8] The number of pediatric dentists needed to provide services (at the national level) to all children less than eighteen years of age are considered in a following section of this presentation.

NUMBER OF PEDIATRIC DENTISTS

In 1991, there were 3,463 professionally active pediatric dentists, including private practitioners (2,948), educators, administrators and researchers.[9]

Pediatric dentists less than forty years of age

The report by the ADA on the number of pediatric dentists provides age distribution information only for dentists in private practice. In 1991, 825 or 27.9 percent of the 2,948 pediatric dentists in private practice were less than forty years of age, ranging from none in Vermont and Wyoming to sixty-seven in Texas, seventy-five in New York and eighty-seven in California (Table 3).

For purposes of determining the numbers of "new" dentists needed at the national level to replace nonprivate-practice pediatric dentists, it was assumed that the percent of pediatric dentists in nonprivate-practice positions, who were less than forty years of age, was comparable to those in private practice (27.9 percent). Of the 515 pediatric dentists not in private practice, 371 would be forty years of age or greater.

ESTIMATED PEDIATRIC DENTIST-TO-CHILDREN RATIOS

Children less than fifteen years of age

Nationally in 1993, there were 5.2 private-practice pediatric dentists per 100,000 children, ranging from 4.0 per 100,000 children in the Mountain Region to 8.7 per 100,000 children in the North East Region. At the state level, the ratio ranged from 2.0 per 100,000 children in West Virginia, and 2.8 per 100,000 children in North Dakota to 10.5 per 100,000 children in Hawaii, 12.0 per 100,000 children in Delaware, and 15.4 per 100,000 children in the District of Columbia (Table 3).

Children less than eighteen years of age

Nationally in 1993, there were 4.4 private practice pediatric dentists per 100,000 children less than eighteen years of age. There were 5.1 professionally active, pediatric dentists (including nonprivate-practice dentists) per 100,000 children.

NUMBER OF PEDIATRIC DENTISTS NEEDED TO MAINTAIN 1993 RATIOS IN 2020

Children less than fifteen years

Based upon the need to "replace" all current pediatric dentists, forty years of age and older, and practitioners

Table 3 ☐ Total number of private practice pediatric dentists, number less than 40 years of age in 1991, ratio per 100,000 children less than 15 years of age and numbers needed in 2020 by region and state[1,9]

	1991		1993	2020	
Region & State	Total number	Number under age 40	Number pediatric dentists per 100,000 children	Total number ped. dentists needed to maintain 1993 ratio	Number of "new" pediatric dentists needed
New England	232	62	8.7	225	163
Connecticut	71	21	10.7	73	52
Maine	9	3	3.5	8	5
Massachusetts	121	32	10.2	111	79
New Hampshire	11	3	4.6	11	8
Rhode Island	14	3	7.0	13	10
Vermont	6	0	4.9	6	6
Middle Atlantic	449	152	5.8	446	294
New Jersey	110	32	6.8	120	88
New York	196	75	5.2	192	117
Pennsylvania	143	45	5.9	135	90
South Atlantic	460	128	4.8	529	401
Delaware	18	3	12.0	20	17
Dis. of Columbia	15	7	15.4	14	7
Florida	131	37	4.9	152	115
Georgia	73	20	4.7	88	68
Maryland	81	22	7.5	98	76
North Carolina	49	13	3.4	55	42
South Carolina	34	7	4.2	38	31
Virginia	62	19	4.6	71	52
West Virginia	7	1	2.0	6	5
East South Central	188	54	5.5	201	147
Alabama	50	8	5.5	58	50
Kentucky	44	14	5.5	44	30
Mississippi	24	7	3.9	24	17
Tennessee	69	25	6.5	74	49
East North Central	445	134	4.7	454	320
Illinois	125	4	4.8	133	129
Indiana	82	21	6.7	85	64
Michigan	63	17	2.9	66	49
Ohio	117	38	4.9	112	74
Wisconsin	59	16	5.2	58	42
West North Central	178	54	4.4	183	129
Iowa	38	11	6.2	36	25
Kansas	17	2	2.9	19	17
Minnesota	41	12	4.0	42	30
Missouri	47	15	4.1	49	34
Nebraska	25	9	6.7	26	17
North Dakota	4	2	2.8	4	2
South Dakota	5	3	2.9	5	2
West South Central	313	94	4.7	374	280
Arkansas	26	9	4.9	28	19
Louisiana	55	14	5.3	60	46
Oklahoma	27	4	3.7	30	26
Texas	205	67	4.7	257	190
Mountain	143	40	4.0	179	139
Arizona	29	6	5.5	31	25
Colorado	52	16	6.6	60	44
Idaho	9	2	3.3	11	9
Montana	7	2	3.7	8	6
Nevada	13	5	4.3	17	12
New Mexico	13	3	3.2	17	14
Utah	16	6	2.9	21	15
Wyoming	4	0	3.4	5	5
Pacific	541	109	5.6	763	654
Alaska	5	1	3.0	6	5
California	418	87	5.6	598	511
Hawaii	27	8	10.5	40	32
Oregon	39	8	5.9	51	43
Washington	52	5	4.4	69	64
United States	2,948	825	5.2	3,362	2,537

Note: - Totals may differ due to rounding
- Number of pediatric dentists and number less than 40 years of age are as presented in the ADA publication

needed for the addition of 8.1 million children less than fifteen years of age, between 1993 and 2020, 2,537 "new" pediatric dentists would be required (2,123 to "replace" current practitioners and 414 for the added numbers of children) (Table 3).

At the regional level, the need for "new" pediatric dentists would be smallest in the West North Central Region (129 needed) and the Mountain Region (139 needed) and greatest in the South Atlantic Region (401 needed) and the Pacific Region (654 needed).

At the state level, the greatest number of "new" pediatric dentists would be needed in Florida (115 needed), New York (117 needed), Illinois (129 needed), Texas (190 needed) and California (511 needed) (Table 3). The need for 1,062 "new" pediatric dentists (or 41.8 percent of all required practitioners) in these five states, to maintain the 1993 ratio, must now overwhelm, however, the recognition of the need for additional pediatric dentists in each state and the District of Columbia. Whether the need is for less than ten pediatric dentists in each of eleven states and the District of Columbia, or the dozens and even scores of pediatric dentists in the other state jurisdictions, there is a continuing need for "replacement" and additional practitioners in each jurisdiction.

All children less than eighteen years of age

At the national level, in 2020, 3,414 pediatric dentists in private practice would be needed to maintain the 1993 ratio of pediatric dentists per 100,000 children, less than eighteen years of age, including:

- ☐ 825 current pediatric dentists less than forty years of age.
- ☐ 2,123 "new" practitioners to "replace" all current pediatric dentists forty years of age and older.
- ☐ 466 "new" practitioners for the added numbers of children.

Private and nonprivate-practice pediatric dentists

At the national level, 3,958 pediatric dentists would be needed in 2020, including:

- ☐ 3,414 pediatric dentists in private practice.
- ☐ 144 current nonprivate-practice dentists less than forty years of age.
- ☐ 371 "new" pediatric dentists to "replace" all current nonprivate practice dentists, forty years of age and older.
- ☐ 29 "new" nonprivate-practice pediatric dentists for the added numbers of children.

PROJECTING THE AVAILABILITY OF NEW PEDIATRIC DENTISTS

Between 1984 and 1993, there were a total of 1,518 graduates from pediatric training programs, or an average of 151.8 graduates per year.[10] Assuming that this average number of graduates is maintained between 1994 and 2020, there would be a total of 4,098 graduates from pediatric dental programs. Not all pediatric dental training program students are, however, residents of the United States. Many foreign graduate dentists receive their advanced training in the United States and then return to provide services in their native countries. In 1991, 28.9 percent of the applicants to pediatric dentistry programs, through the Post Doctoral Support Service (PASS) program, were not residents of this country.[11] The ADA Survey Center reports that between 1989 and 1993, 243 graduates (or 31.2 percent of all graduates) from pediatric dentistry training programs were not residents of this country.[12] Data are not available, however, to determine the number of these graduates who remained or eventually will return to this country to practice dentistry.

For purposes of determining the available manpower for the year 2020, it was assumed that 30 percent of the graduates from the pediatric-dentistry programs (or 1,229 graduates) would not remain and/or eventually practice in this country. Between 1994 and 2020, of the prospective 4,098 graduates from the pediatric programs, 2,869 graduates would, therefore, be available in the United States. This would be 120 graduates fewer, however, than the number of pediatric dentists needed in 2020 for the conservative estimate necessary to maintain the 1993 professionally active pediatric-dentist-to-children ratio (Table 4).

FEMALE PRACTITIONERS

No discussion of pediatric-dentist manpower projections for the next generation of children could be complete without a review of the dramatic increases in the numbers of women entering the dental profession, in particular, pediatric dentistry. For example,

- ☐ In the 1993-94 academic year, women represented 36.9 percent of the total dental school student body.[13]
- ☐ Between academic years 1983-84 and 1992-93 female representation in pediatric training programs increased from 45 percent to 62 percent.[14]

But the findings from a recent ADA report indicate that female dentists work fewer hours per year treating patients than their male counterparts.

Table 4 ☐ Pediatric dentist requirements: 2020.[1,8,9]

	Private practice pediatric dentists		Professionally active pediatric dentists
	Children <15 yrs	Children <18 yrs	Children <18 yrs
Private practice			
Number needed to replace 40 yrs + pediatric dent.	2,123	2,123	2,123
Number needed for additional children	414	466	466
Number pediatric dent. < 40 yrs*	825	825	825
Subtotal	3,362	3,414	3,414
Nonprivate practice			
Number needed to replace 40 yrs + pediatric dent.			371
Number needed for additional children			29
Number pediatric dent. < 40 yrs*			144
Total	3,362	3,414	3,958
Number of "new" pediatric dentists needed	2,537	2,589	2,989
Number of "new" pediatric dentists available			2,869
Additional number required to meet conservative estimate of requirements			120

* No replacements needed

Table 5 ☐ U.S. population and dentist projections: 1987-2020.[1,17]

	Population	Number of professionally active dentists	Dentists per 100,000 population
	(in millions)		
Actual			
1987	244	137,809	56.6
Projections			
2000	276	142,379	51.5
2010	300	137,197	45.7
2020	326	128,329	39.4

"About 77 percent of males and 48 percent of females indicated they spent between 1200 and 2000 hours per year treating patients."[15]

No specific adjustment factor is available to modify manpower needs to compensate for the different work patterns of male and female dentists. Thus by using a straight numeric "replacement" by an increasing percent of female pediatric dentists in 2020 could once again understate the need for increased numbers of pediatric dentists.

FINAL THOUGHTS

Again, it should be stated that,

- ☐ The overall number of practitioners required to maintain the current ratio is a conservative estimate based upon the assumption that all pediatric dentists less than forty years of age in 1991 will continue in full-time practice until 2020.
- ☐ One cannot assume that new pediatric dentists will distribute themselves in a uniform manner, comparable to the distribution of current practitioners or in some manner that would be in line with the increasing numbers of youngsters projected by the Bureau of the Census.

While this review of dental manpower needs for the children of today's children suggests a decreased availability of pediatric dentists, it does not consider the need and/or demand for services, increasing special patient populations, nor the reality that a major component of dental services for youngsters is provided by general dentists. For example, in 1992, 16.7 percent of solo, general-practitioner patients and 17.9 percent of nonsolo, general-practitioner patients were less than fifteen years of age.[16]

The projections are for a continuing decline in the overall dentist-to-population ratio, however, from a peak in 1987 of 56.6 per 100,000 population to 39.4 dentists per 100,000 population in 2020 (Table 5). Surely one must consider this overall change, when reviewing the availability of both pediatric and general dentists to serve the needs of an increasing general population (projected to increase from 257.9 million in 1993 to 325.9 million in 2020) including an additional 10.5 million children less than eighteen years of age.[1]

No doubt for many current practitioners the idea of planning for the dental services for the year 2020 seems far beyond their own professional horizons. But the reality is that the increase in the number of children will not happen suddenly at the end of the second decade of the next century. Rather it will take place throughout the next twenty-five years. Similarly the "loss" in the numbers of pediatric dentists forty years of age and older will continue throughout the period.

Yet changing the "production" of pediatric dentists is not analogous to turning a water spigot on (or off). Because of the long lead time necessary to produce graduate pediatric dentists, manpower planning is necessary to determine whether the combination of 1) evolving dentist-to-population ratios, 2) increasing numbers of female pediatric dentists, 3) evolving dental disease patterns, 4) demand for services, and 5) evolving third-party payment mechanisms, warrant changes in the "production" of pediatric dentists to ensure adequate services in the many regions and states of our country.

As you provide care to your next pediatric patients, you may feel it seems almost foolish to consider the

needs of their children and availability of practitioners to provide the necessary care. But is it?

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DENTAL HEALTH EDUCATION

To do something about social and health inequalities, we have to understand what exactly it is about being deprived that leads to the poor outcomes. In an attempt to explain social inequalities in dental health Petersen suggests a model combining materialist or structuralist explanations with cultural/behavioural explanations. The model stresses primary effect of material and structural factors and secondary importance of normative factors. The empirical findings of this study fit the model remarkably well. Caries experience was primarily determined by socio-economic factors and secondarily by behavioural factors.

It thus follows that traditional dental health education as a means to remove inequalities in dental health in itself is inadequate. Health promotion which represents a mediating strategy between people and their environments appears to be a more effective solution. An oral health promoting strategy to reduce inequalities in dental health would include: 1) the use of a range of social and health policy measures, such as legislation or fiscal policy to reduce population exposure to risk factors by making the environment healthier; 2) identification of populations at increased risk and targeting of those areas for additional resources; and 3) adopting specific service interventions for use with deprived populations.

If we want to see dental services becoming more, not less, relevant to health needs, the determining factors for inequalities in health as found in the present study must be acted upon.

Schou, L. and Uitenbroek, D.: Social and behavioural indicators of caries experience in 5-year-old children. Community Dent Oral Epidemiol, 23:276-281, October 1995.

Correction and update: Interest in pediatric dentistry

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

A presentation in the July-August 1992 issue of the *Journal of Dentistry for Children*, "Increasing interest in pediatric dentistry?" concluded that "increasing numbers of senior dental students are showing an interest in postdoctoral programs in pediatric dentistry."[1] The material was based upon reports from the annual Senior Dental Survey compiled by the American Association of Dental Schools for the period between 1978 and 1991. Major changes in the report presentation format were instituted in 1988. In the 1992 writing by this author in the *Journal*, efforts were made to reconcile the format differences.

In the course of revisiting these data for a possible update presentation, it was noted that the transformation of the data between the earlier two periods required additional calculations. Data for the period 1988 through 1991 (as reported previously) were compared incorrectly, therefore, to the data for the 1978 to 1985 period. (Information for 1986 and 1987 are not available.) The following presentation corrects this error and updates (through 1993) the interest of dental school graduates in pediatric dentistry training.

DEVELOPMENTS SINCE THE LATE 1980s

- ☐ Between 1988 and 1993, there has been a progressive decrease in the number of dental school graduates (from 4,581 to 3,778). This trend represents a continuing decrease since 1983 when there were 5,756 graduates.[3]
- ☐ Reflecting the general downturn in the numbers of graduates, since 1989 there has been a general decrease in the overall numbers planning on specialty training. Since the late 1980s, the percent of graduates interested in specialty training varied to a limited extent (between 19 and 23 percent).
- ☐ The percent of seniors with plans for specialty training who applied to pediatric dentistry programs remained relatively constant between 1989 and 1992 (11.6 to 13.4 percent). In 1993, "the largest increase occurred in the (specialty) of Pediatric Dentistry...", 19.2 percent of the seniors planning on applying to specialty programs were interested in pediatric dentistry.
- ☐ In 1993, 168 seniors (4.5 percent of all dental school graduates) planned on pediatric dentistry training (Table).

COMPARED TO EARLIER PERIODS

- ☐ During the first half of the 1980s, there was a general decrease in the number of seniors planning on pediatric dentistry training.
- ☐ Despite continued decreases in the number of dental school graduates, since 1989 the number of seniors planning pediatric dental training increased to the higher levels reported in the late 1970s. In 1993, the number of seniors planning pediatric dentistry training (168) was the highest reported since the late 1970s (Figure 1).

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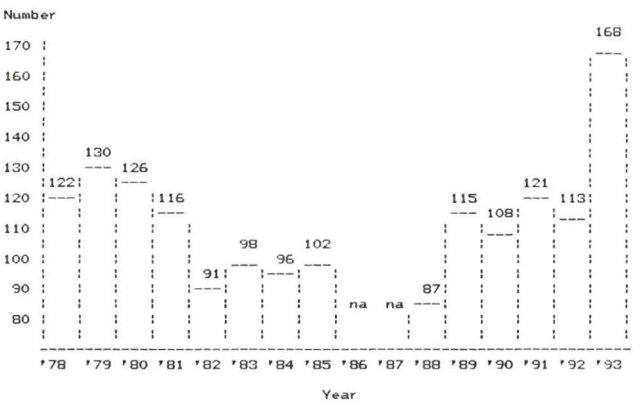

Figure 1. Number of senior dental students who plan on pursuing graduate education in pediatric dentistry: 1978-1993.[2,3]

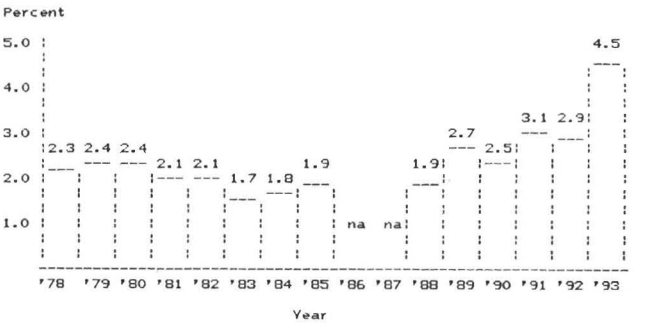

Figure 2. Percent of senior dental students who plan on pursuing graduate education in pediatric dentistry: 1978-1993.[2,3]

☐ Since the late 1980s, the percent of dental school graduates planning on pediatric dentistry training, increased to and beyond the levels reported in the late 1970s and early 1980s (Figure 2).

SUMMARY

Correcting and updating the data on senior dental student plans for pediatric dentistry training indicates that there is a continuing and increasing interest in pediatric dentistry specialty training. Except for 1993, compared to the earlier period, this increase was at a slower rate, however, than that reported previously in the *Journal*.

Table 1 ☐ Dental school graduates and their plans for specialty training: 1988–1993,[2,3]

Year	Number of dental school graduates	Have plans for specialty training		Percent with plans for specialty training who applied to pediatric dentistry programs	Have plans for ped. dentistry training	
		Number	Percent		Number	Percent
1988	4,581	866	18.9%	10.1%	87	1.9%
1989	4,312	957	22.2	12.0	115	2.7
1990	4,233	927	21.9	11.6	108	2.5
1991	3,955	902	22.8	13.4	121	3.1
1992	3,918	874	22.3	12.9	113	2.9
1993	3,778	876	23.2	19.2	168	4.5

Note: Throughout this presentation, all years refer to the beginning of the academic year.

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PAIN RELIEF

Even when their pain is obvious, children frequently receive no treatment, or inadequate treatment, for pain and painful procedures. Numerous studies have documented that children receive far fewer doses of analgesic medication than adults do for similar pain problems. Procedure-related pain (eg, intravenous catheter insertion, bone marrow aspiration, lumbar puncture, etc) requires special attention because it is among the most difficult types of pain to deal with, both by the patient who experiences it and the health care professionals who must inflict it. Unfortunately, the most frequent response of physicians and nurses to procedure-related pain is denial, which is made easy because children can be physically restrained, are not routinely asked if they are in pain, and are unable to withdraw consent to stop a procedure. Indeed, for many children with chronic disease (eg, cancer), the pain of medical procedures is the worst part of their disease.

Yaster, M.: Pain relief. Pediatrics, 95:427, 428, March 1995

ABSTRACTS

Veerkamp, J.S.J. and Weerheijm, K.L.: Nursing bottle caries: The importance of a developmental perspective. J Dent Child, 62:381-386, November-December 1995.

The decline of caries in very young children seems to have levelled out in recent years. This effect is attributed to a feeding habit, the use of sweetened comforters, especially during the night. In this article a definition is presented, based on the eruption-linked appearance of nursing-bottle caries, and a classification in four developmental stages, based on the clinical appearance, is given. Related to these stages, a general practitioner might be better able to manage the problems connected with nursing-bottle caries. Since he sees the children too late, it is questioned whether the general practitioner is the right person to provide early preventive information. Research should focus on the developmental aspects of nursing-bottle caries.

Caries; Eating habits; Early diagnosis

Kreulen, C.M.; van Amerongen, W.E.; Akerboom, H.B.M. *et al*: Two-year results with box-only resin composite restorations. J Dent Child, 62:395-400, November-December 1995.

One of the restorative alternatives in the treatment of proximal carious lesions is the box-only approach. This paper describes baseline and two-year results with 68 box-only resin composite restorations in a clinical study. The restorations were made using a glass ionomer cement as a dentin replacement and a bevelled outline. In terms of treatment time (32 minutes) and postoperative sensitivity (4 cases), the box-only restorations show favorable properties in comparison to conventional Class II resin composite restorations. At the two-year assessment no failures were observed, with fair results regarding clinical characteristics. It is concluded that, although applied to a limited number of teeth, the results indicate that the box-only approach with resin composites may make a contribution to the tooth-tissue-saving, restorative techniques.

Clinical study; Box-only restoration; Resin composite

Gawlik, John A.; Ott, Norman W.; Mathieu, Gregory P.: Modifications of the palatal crib habit-breaker appliance to prevent palatal soft tissue embedment. J Dent Child, 62:409-411, November-December 1995.

The authors recommend the use of an acrylic palatal button and .040 to .045 inch palatal wires as modifications to the palatal crib appliance. By enhancing the strength of the wire, and providing anterior support, these modifications can reduce the likelihood of the crib becoming embedded in the palatal soft tissues.

Palatal crib; Modification

Vichi, M. and Franchi, L.: Abnormalities of the maxillary incisors in children with cleft lip and palate. J Dent Child, 62:412-417, September-October 1995.

Dental anomalies of the maxillary anterior teeth were studied in seventy-seven children affected by unilateral and bilateral clefts of the lip and alveolar process, with or without involvement of the palate.

As for the permanent lateral incisor in the cleft area, our results show that its congenital absence is the most frequent abnormality followed by anomalies in size and shape and supernumerary teeth. Enamel hypoplasia was found to affect the permanent central incisor on the cleft side more frequently.

Early recognition of tooth abnormalities during the primary dentition phase for an interceptive treatment of potentially severe problems was emphasized.

Clefts; Congenital absence of maxillary incisors; Anomalies of size, shape, and number of teeth; Hypoplasia

Waldman, H.B.: Manpower planning for the children of your current pediatric dental patients. J Dent Child, 62:418-425, November-December 1995.

Projections by the Bureau of the Census indicate that there will be an additional 8.1 million youngsters less than 15 years of age living in this country by the year 2020. Estimates are developed for each state and region of the needed numbers of pediatric dentists to maintain current practitioner levels. The availability of needed practitioners is considered in terms of the number of graduates from pediatric dentistry training programs.

Child population growth; Pediatric dentists needed