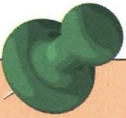


# ASDC

AMERICAN SOCIETY OF  
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MAY-JUNE 1994



... the interests of children themselves will not be fully met as long as they are regarded principally as objects of adult concern. Children are not objects; they are not our creation. They are not ours; they are us. No society can claim to do its best for children as children unless what it does is based on acceptance of children as people. Accepting children as people does not mean treating them as if they were adults. Children are small and vulnerable so they need special consideration and services from their societies; they are apprentices in the business of growing up so they need protection, nurturance and teaching from individual adults.

Nobody would wish to remove the rights to have their "childish" needs met that children have been given through laws concerning child support, child labor and education, and through innumerable exemptions from the responsibilities borne by adult citizens. But societies originally gave those special privileges to children within "the empire of the father" and by virtue of their incompetence to act outside it. Wives were once within that empire too, but the modern world that has recognized women as competent legal persons has not similarly recognized that "children are people too," and as such entitled to the same human rights as everybody else — rights that belong to them in their own right as individuals rather than as appendages of parents or guardians who have a right to own them.

—Penelope Leach

THERE IS NO FINER INVESTMENT FOR ANY  
COUNTRY THAN PUTTING MILK INTO BABIES.  
—Winston Churchill



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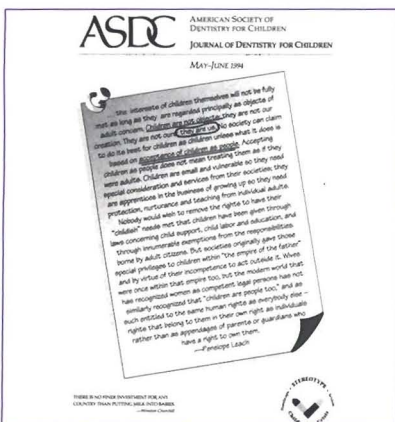
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Penelope Leach asks that children be accorded as people and that they be accorded the same human rights as everybody else.

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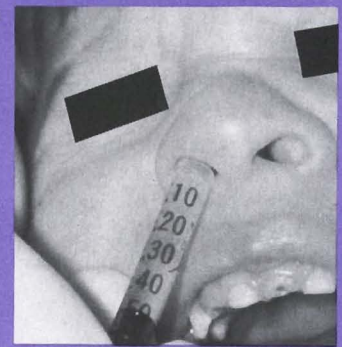
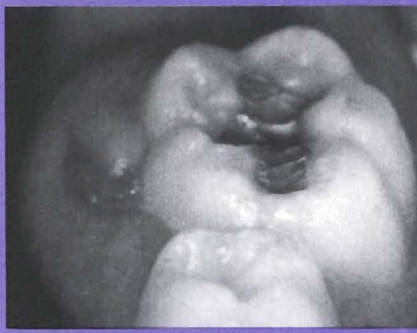
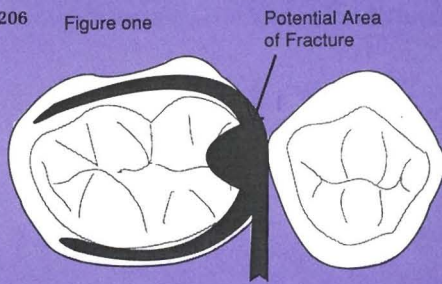
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### 209 Peripheral odontoma: Report of case and review of literature

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*There are almost 600,000 children of migrant workers in the United States at some time during the year.*

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# For the busy reader

## **Physical restraint, child abuse, informed consent: Sociolegal concerns for the nineties—page 169**

The authors consider the nature and professional and legal ramifications of some of the generally accepted child-management techniques, all of which are coming under closer scrutiny. For instance, when does physical restraint become battery or abuse and how does the procedure of informed consent fit into the overall picture? These are hard questions that must be considered by any practitioner who hopes to survive in this litigious society.

Requests for reprints should be directed to Dr. Raymond L. Braham, Box 0438, School of Dentistry, University of California, San Francisco, San Francisco, CA 94143.

## **An evaluation of oral and nasal midazolam for pediatric dental sedation—page 175**

Midazolam is a new benzodiazepine that is now being used extensively in medicine and dentistry. It may provide dentists with an alternative sedative drug for short procedures. The authors report on the use of midazolam in children and on the drug's efficacy via the oral and nasal routes. No long-term adverse effects were reported, and full or partial amnesia was evident in 90 percent of the procedures.

Requests for reprints should be directed to Dr. Robert E. Primosch, Department of Pediatric Dentistry, University of Florida college of Dentistry, P.O. Box 100426, Gainesville, FL 32610-0426.

## **The use of hypnosis for smooth sedation induction and reduction of postoperative violent emergencies from anesthesia in pediatric dental patients—page 182**

Although pharmacological sedation has been used for many years with well-established safety and efficacy for dental applications, hypnosis has the advantage of not suppressing the patient's vital signs. Results are unpredictable, however, and not all patients can be hypnotized.

Requests for reprints should be directed to Dr. Dominic P. Luc, Department of Dentistry, Dental Clinic, Lehigh Valley Hospital, 17th and Chew Street, Allentown, PA 18105-7017.

## **Practice characteristics of dual trained pediatric dentistry and orthodontic specialists—page 186**

The authors surveyed specialists with dual training in pediatric dentistry and orthodontics, and report the demographics, amount of time spent in different areas of clinical practice, and the amount of time that dual-trained specialists wish to spend in the different areas. Of the 146 dentists to whom the surveys were sent, 115 responded (79 percent).

Requests for reprints should be directed to Dr. Joseph R. Jedrychowski, Professor, Section of Pediatric Dentistry, School of Dentistry, University of California, Center for the Health Sciences, Los Angeles, CA 90024-1668.

## **Radiographic assessments of class II resin composite inlays—page 192**

The indirect inlay may permit a better adaptation of the cervical margin, because the inlay is produced on a cast. Because it is produced on a cast, the homogeneity of the material may be improved. A disadvantage of the technique is that the luting cement may be easily dispersed during cementation of the inlay.

Requests for reprints should be directed to Dr. C.M. Kreulen, Department of Pediatric Dentistry, Academic Centre for Dentistry, Amsterdam (ACTA), Louwesweg 1, 10066 EA Amsterdam, The Netherlands.

## **The dilemma of treating severely decayed first permanent molars in children: To restore or to extract—page 199**

If these teeth are unrestorable, one has only the choice to extract them. If the selected treatment could result in restored teeth with good prognosis, it becomes the treatment of choice. The dilemma occurs when the teeth

are restorable, but the achievable result will leave a questionable prognosis.

Requests for reprints should be directed to Dr. Benjamin Peretz, Department of Pediatric Dentistry, Hadassah Faculty of Dental Medicine, P.O. Box 1172, Jerusalem, Israel.

### Mechanical assessment of interocclusal clearance—page 206

It is critically important to adjust a clasp to be as close to the occlusal surface of the teeth as possible, in order to maintain an occlusion free of interferences. The wire should fit into the interproximal space to avoid occlusal trauma from opposing teeth. This can be accomplished by using a simple occlusal gauge, described by the author.

Requests for reprints should be directed to Dr. Norman P. Martinez, Department of Pediatric Dentistry and Orthodontics, Southern Illinois University, School of Dental Medicine, 2800 College Avenue, Alton, IL 62002.

### Peripheral odontoma: Report of case and review of literature—page 209

Odontomas are most generally diagnosed as a result of a radiographic survey in which they appear as an irregular mass of calcified material surrounded by a narrow radiolucent band with a smooth outer periphery. Intraosseous odontomas may lie superficially in bone,

facilitating their eruption into the mouth.

Requests for reprints should be directed to Dr. Glen Houston, Department of Oral Pathology, Wilford Hall Medical Center, Lackland, AFB, TX 78236.

### And the children get poorer—page 214

Although the percentage of elderly who are poor is decreasing, the percentage of children who are poor has been increasing.

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

### Invisible children: The children of migrant farm workers—218

Forty-two percent of the approximately two million U.S. crop farm workers are migrants. (Note: not all migrants actually follow the corps. Some remain in particular locations for varying periods of time.) Of those, 60 percent are immigrants and 31 percent are parents accompanied by an average of approximately two children (or about 587,000 children) during 1990.

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

### CORRECTION

In the March-April, 1994 issue, tables 2 and 3 (page 111), in *Effects of ethnicity and birth month on localized enamel hypoplasia of the primary canine* by Mark F. Skinner *et al*, errors occurred. The corrected tables appear here.

Table 2. □ Relationship between mean monthly hours of sunshine and occurrence of localized enamel hypoplasia of the primary canine among Vancouver children<sup>a</sup>.

	LHPC	Mean hours of sunshine <sup>b</sup> in birth month		SE	t value	Probability	
		SD	SE			2 tail	1 tail
Present	55	141.7	75.7	10.2			
Absent	93	169.4	79.1	8.2	-2.09	.0383	.0191

<sup>a</sup> Combined data from this study and ref. 5

<sup>b</sup> From ref. 9

Table 3. □ Intake of select nutrients among mothers from Healthiest Babies Possible Program 1986-88 (Vancouver).

Nutrient	LHPC	Mean	SE	Prob. (2-tail)	RNI*
KCalories	Yes	1819.4	141.3	NS	2203
	No	1832.6	82.6		
Protein (gm)	Yes	61.8	4.9	NS	60
	No	76.1	5.3		
Number milk tickets	Yes	18.82	2.91	.0348	
	No	28.38	2.44		
Calcium(mg)	Yes	844.91	69.36	NS	1300
	No	1045.90	75.98		
Servings fruit/veg	Yes	3.46	4.27	.0525	
	No	4.98	.522		
B-Carotene(RE)	Yes	352.89	76.0	.0474	?
	No	735.54	134.7		
Retinol(RE)	Yes	825.22	104.07	.0433	8-900
	No	1300.55	161.91		
Folic acid (µg)	Yes	343.0	44.4	NS	432
	No	297.5	28.2		

\* RNI = Recommended Nutrient Intake for a pregnant female, age 28 years, weight 54 kg, height 1.57m at referral with light activity level (mean values of subjects in this study (after Food Processor II))

## BEHAVIOR

# Physical restraint, child abuse, informed consent: Sociolegal concerns for the nineties

Raymond L. Braham, BDS, LDSRCS, MScD  
Tomoyuki Tsuchiya, DDS, PhD  
Kazuo Kurosu, DDS, PhD  
Osamu Fukuta, DDS, PhD

Pediatric dentists and general dentists who treat significant numbers of children frequently encounter the hysterical, aggressive, or resistant child who cannot be treated without resort to behavior modification, physical restraint, sedation or treatment under general anesthesia. For many years the accepted principles of pharmacologic and nonpharmacologic approaches to the management of recalcitrant dental patients were reasonably cut and dried. The main reason for this was that the opinion of the dentists was usually unquestioned by the public. The past decade has seen a revolution in public and professional attitudes toward the management of children, however, and the specific areas of sedation and nonpharmacologic patient management have come under intense public scrutiny. The topic of sedation has been comprehensively reviewed in a recent paper, to which one of the present authors (RLB) contributed.<sup>1</sup> This paper addresses the present-day controversies surrounding the subject of nonpharmacologic patient management and discusses current medicolegal pitfalls in pediatric dental patient management.

Dr. Braham is Clinical Professor and Director - Predoctoral Pediatric Dentistry, Department of Growth and Development, Department of Pediatrics, University of California, San Francisco, CA 94143-0438, U.S.A.

Dr. Tsuchiya is Associate Professor and Vice-Chairman; Dr. Kurosu is Professor and Chairman; Dr. Fukuta is Assistant Professor, Department of Pediatric Dentistry, School of Dentistry, Aichi-Gakuin University, Chikusa-ku, Nagoya 464, Japan.

Until relatively recently, most dentists trained in the generally accepted child-management techniques would have had little hesitation in utilizing one or more of the acknowledged forms of physical restraint. This might include tapping on the patient's sternum with one's forefinger, use of the Papoose board or Pedi-wrap, or Hand-over-mouth in one or other of its forms. The past ten years or so have seen a considerable shift in parental, legal and dental professionals' attitudes toward dental behavioral management techniques, however, and it is the nature and professional and legal ramifications of some of these techniques that we are considering in this paper: Specifically, (1) when physical restraint borders on or becomes battery, or even outright child abuse, and (2) the manner in which the procedure of informed consent fits into the overall picture.

Two terms, often misconstrued, that need to be defined, are *Child abuse* and *Battery*.

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### **Abuse**

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*Child abuse* may be defined as "the finding of inflicted, nonaccidental injuries." All that is necessary is the suspicion that the injuries one sees were not self-inflicted nor the result of an accident.

Child abuse is usually classified into three categories - *physical, sexual and emotional abuse*.<sup>2</sup> *Emotional abuse* is very prevalent in our society, although it remains the least defined form of abuse, impinging as it does

on parents' rights to rear children as they see fit. Reporting of emotional abuse is included in the reporting laws of many states but as a practical matter only the most flagrant and severe forms of emotional abuse are reported at the present time.

In regard to *physical abuse*, the lines between discipline, punishment, and child abuse are very vague. Corporal punishment is accepted by society and practiced in many homes and school jurisdictions, albeit much less than it used to be. Clearly, however, the infliction of severe injuries, breaking of bones, or drawing of blood is not tolerated by society and is considered to be abuse. Ultimately, the line is drawn in each individual case by child protection and law enforcement agencies.

*Sexual abuse* is not germane to the present discussion.

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## Battery

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*Battery* may be defined as an unprivileged touching of another person's body.

Treatment of patient without consent long has been recognized as technical *battery*.<sup>3,4</sup> A dentist will commit a battery, if, for example, he extracts a patient's tooth without first obtaining the patient's or parent's consent to the extraction. Such consent must be concise; for example, consent to extract a second primary molar does not permit the dentist to extract a lateral incisor. If a patient, with full knowledge of all the normal risks of the procedure, consents to its performance, however, there are no grounds for subsequent allegation that the dentist has committed a *battery*.<sup>5</sup>

Having defined the conditions, it now is possible to consider whether or not the various forms of physical restraint available to the dentist may be construed as child abuse. The use of physical force of any kind has long been a controversial subject in dentistry. When used as a technique, it must be approached with extreme caution and rational consideration. Restraint takes many forms. These may include placing the hands on the child's shoulders, tapping on the screaming child's sternum with a finger, devices such as the Papoose board or Pedi-wrap and different forms of the Hand-over-mouth technique. Whichever form of restraint is

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## Informed Consent

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used, the dentist must obtain specific *informed consent*. Probably the simplest approach is to say that, if the dentist anticipates any form of resistance from the

child patient, an *informed consent* to use *minimal* physical restraint should be signed by the parent or guardian. Taking it to its logical extent, this might be included in the preliminary consent that usually constitutes a part of the initial demographic form completed by the parent/guardian when first visiting a given dental office. Should the parent ask why the dentist requires such a consent, we would recommend total candor in replying that current medicolegal trends are such that this course of action is merely to protect all concerned. The specific topic of *informed consent* will be discussed in detail later in this paper.

The pros and cons of the different techniques:

- Pulling on the child's shoulders*—Few reasonable people would argue that this is anything more than a minimal form of physical restraint in getting the child to settle back in the dental chair. The preliminary consent should cover it.
- Tapping on the sternum with a finger*—The rationale behind this technique is that it startles the screaming child sufficiently to stop the yelling for a moment, which enables the dentist to get in a few rational words. It is the personal experience of the present authors that it does not work very well. Unless one is extremely cautious, it tends to leave bruises and the child invariably complains to the parent that "the dentist hit me in the chest," which usually brings in the father spoiling for a fight! All in all, it is a technique which is fraught with legal danger and there is no reason for its continued use in contemporary pediatric dentistry. For these reasons it generally has been abandoned as a patient management technique and is not within the Standards of Care for Patient Management of the American Academy of Pediatric Dentistry.<sup>6</sup> Accordingly the dentist who uses it is laying himself or herself wide open to a law suit.
- Papoose Board/Pediwrap*—As Wright has commented, many very young children do not understand the need to sit still and keep their hands away from the operating field. Sudden movements of the hands or head can lead to major injuries caused by syringe needles, high speed dental burs or even scalpel blades.<sup>7</sup> There is no way in which use of the Papoose Board\* or Pediwrap\*\* can be construed as physical abuse, pro-

\*Olympic Medical Corp., Seattle, WA

\*\*Clark Associates, Charlton City, MA.

vided that specific *informed consent* has been carefully obtained and due consideration is given to the complexity and length of the procedure that is being undertaken. While the literature is replete with descriptions of numerous sheet wrapping techniques, most pediatric dentists and many pediatricians now use the Papoose Board or Ped-wrap. Basically, the Ped-wrap is a mesh cloth with Velcro fasteners. While confining the child's arms and legs it still permits wriggling. The Papoose Board consists of a moderately flexible board to which are attached cloth restraints with Velcro fasteners. It comes in various sizes, which even permit its use with older mentally and physically handicapped patients. For reasons not fully understood, many very young children actually quiet down when wrapped in one or other of these devices—possibly the overall effect is that of a blanket or comforter. Without specific and detailed *informed consent*, however, use of the Papoose Board or Ped-wrap will most assuredly leave the clinician open to a complaint of *battery*. One recent modification of these authors' clinical practice has been to have the parent or guardian assist in placing the child in the Papoose Board (this is the only restraining device we use). We then give the parent or guardian the choice of remaining in the operatory or leaving. If they remain, they are asked to remain seated in the corner and not try to intercede, and the entire process is carried out in the presence of a responsible dental assistant (witness).

Now we come to the most controversial of pediatric dental patient management techniques. Even the dental profession is fiercely divided concerning its use, so it should be considered in detail.

□ Hand-over-mouth (HOM) technique—Numerous authors have written thousands of words about this procedure. The technique was first described in the 1920s by Dr. Evangeline Jordan who wrote: "If a normal child will not listen but continues to cry and struggle...hold a folded napkin over the child's mouth... and gently but firmly hold his mouth shut. His screams increase his condition of hysteria, but if the mouth is held closed, there is little sound, and he soon begins to reason."<sup>8</sup> It was called *emotional surprise therapy* by Lampshire, hand-over-mouth exercise (HOME) by Levitas, and *aversion* by Kramer<sup>9-11</sup> Lenchner and Wright, in calling it aversive conditioning, held that it fitted the laws of learning theory, as held

in 1975, whereby maladaptive acts (fighting, kicking and screaming) were linked to restraint, while cooperative behavior brings about removal of the restriction and use of positive reinforcement.<sup>12</sup>

The profession is by no means united as to its benefits. While Levy and Domoto held it to be a form of punishment, Craig and Davis and Rombom took precisely the opposing position.<sup>13-15</sup> Davis and Rombom further contended that correctly used aversive conditioning is a *flooding* technique that requires the child patient to accept treatment. McAuley and McAuley, and subsequently Ross, described *flooding* as a behavior modification strategy that eliminates a child's attempts to avoid what it perceives as an undesirable situation.<sup>16,17</sup>

Very briefly, HOM consists of the dentist placing a hand over the child's mouth in order to cut off excessive noise. A modification of the technique is to close simultaneously the airway by lightly pinching the nostrils for a maximum of fifteen seconds (this goes under the acronym of HOMAR - Hand-over-mouth with airway restricted). Although there is little doubt that this technique sometimes succeeds where HOM does not, these writers have never condoned its use under any circumstances. It is our contention that its dubious success is simply due to the discomfort of airway restriction, causing the child to gasp for breath. Our personal feelings are that it is fraught with all manner of potential problems, including the extremely remote possibility of precipitating a seizure due to sheer panic. We see it as little better than the old and barbaric technique known as *towel*ing in which a towel was used to close off simultaneously the child's nose and mouth. The theory behind airway restriction is that the child will quiet more quickly in order to try to breathe and the screaming will be lessened sufficiently for the dentist to proceed to the next HOM stage of speaking quietly and firmly into the child's ear, indicating that the hand will be removed if the child becomes quiet. Ideally the youngster acquiesces and all proceeds normally, with the dentist acting as though nothing abnormal had taken place.

There is no doubt that HOM is widely practiced in pediatric dentistry. Craig, in 1971, reported on a poll of Indiana pediatric dentists in which 80 percent of the respondents used HOM.<sup>14</sup> A 1972 poll of the Association of Pedodontic Diplomates reported that 80 percent of the respondents indicated that they would use physical contact with the face and airway in selected cases.<sup>18</sup> A similar survey in 1981 indicated that 90 percent of the respondents use HOM with the airway open, while 54 percent occasionally used HOMAR.<sup>19</sup> The most



recent survey of pediatric dental diplomates, reported by Allen *et al.* in 1990, showed 73 percent of respondents using HOM for disruptive children, so the number of pediatric dentists using the technique is definitely dropping. The same survey further revealed that more than 70 percent of respondents had concerns about ethical, legal, or safety issues related to the use of traditional management techniques such as physical restraint, hand-over-mouth, and sedation.

In theory the possibility of having to use aversive conditioning will be revealed at the time of the initial examination. Many children are quite well behaved, however, until the time comes to administer a local anesthetic, at which time there is a sudden eruption and HOM may have to be used as a last resort in order that the injection may be safely administered. In short every effort should be made to have the child cooperate of its own, as Levitas stated in 1974, by cajoling, begging, urging, pleading and plain voice intonation before turning to HOM.<sup>10</sup>

In using HOM, certain factors must be borne in mind: the parent must give *informed consent* (this is difficult unless the parent is actually present at the time needed, since to try to justify the necessity beforehand requires extreme persuasive ability on the part of the dentist). Even with the parent's consent the child has the right to refuse in some states and the dentist could still be sued for *assault and battery* should the parent and child so decide. Although HOM does work on the three to six year old child it must be borne in mind that, as Levitas wrote in 1974, for the very young, the immature, those with serious physical handicaps or those who are mentally and/or emotionally affected, special procedures are often needed and HOM is unacceptable.<sup>10</sup> The technique must only be used under strictly controlled conditions and with absolutely no sign of anger or frustration in the dentist's tone of voice or behavior. If the dentist cannot meet these conditions then resort should be made to other management techniques. As one of the present authors (RLB) has long said, "my personal feelings are that the technique has outlived its usefulness in that the potential problems do not justify the means to the end".<sup>20</sup>

Probably the greatest potential for trouble with this technique is that there is always a remote chance of causing some injury to the child. It has been known for a child to try to pull away from the dentist's hand and receive a small scratch from the dentist unwisely having overlong finger nails (such an accident is much less likely to occur with present-day infection control precautions such as routine use of rubber gloves). The

technique should never be practiced with a ring on the finger—this might result in a bruised or split lip. Another possibility, as reported by Wright, is that a child may violently swing its head from side to side and cause a slight capillary break on the surface of the skin.<sup>7</sup> No matter how slight such an injury, the dentist must always be totally open and frank in pointing this out to the parent. The discussion should be witnessed by a reliable assistant, fully documented in the patient's record and co-signed by the dentist and witness. Failure to comply with these precautions will leave the dentist wide open to a charge of *battery* and/or *child abuse*.

Apart from the above it is hard, if not impossible, to imagine any reason for causing injuries to any other part of the body. For example, sudden loss of personal control on the part of the dentist in which he or she might try to push the child's head back in the chair, accidentally miss the mouth and grasp the neck, leaving a resulting contusion, would be nothing less than *battery* and *child abuse*. This latter was part of a police report which the senior author was asked to review.

Having considered the major types of physical restraint and their potential problems we may now turn to the issue of *Informed Consent*.

As pointed out by Hagan *et al.*, in 1984, the fact that continued success and professional approval support the various techniques of physical restraint does not necessarily mean that parental attitudes are in agreement.<sup>21</sup> Murphy *et al.* (1984) found that health professionals can no longer assume parental approval for some of the most routine techniques of behavior management, no matter how appropriate their use may seem.<sup>22</sup> As a result of changes in the law, increasing patients' rights with expansion of legal requirements for informed consent, and several surveys indicating that certain behavior management techniques meet with general disapproval on the parts of parents, it is patently clear that express parental consent is mandatory for the use of these behavior management techniques. The trouble is that prior consent for many specific procedures in dentistry has been an issue that most dentists have tended to neglect: perhaps the real reason is that dental educators have tended to be complacent and have not placed sufficient stress on legal issues in dental education. Informed consent is particularly relevant with respect to the techniques traditionally used for behavioral management in pediatric dentistry and it is imperative that dental educators instill this aspect of professional responsibility in all present and future dental students. Likewise, every effort should be made to encourage present practitioners to adopt the prac-

tice. It is no excuse for practitioners to say that explaining procedures to the parent will restrict or change the nature of their practices. Attitudes and times are changing and the profession must move with them. In effect complying with the laws of informed consent places very little restriction on our practices and we have yet to encounter a single parent who reacts negatively.

In short the legal requirement of *Informed consent* demands that a health care provider inform the patient (or parent or legal guardian, in the case of a minor) as to the nature of the intended treatment, the benefits and risks of such treatment, possible alternative methods of treatment and the pros and cons of not receiving the treatment.

It must be borne in mind that a teenager has the right to refuse treatment and consent/assent for the treatment is a joint parent-child decision.<sup>23</sup>

Even more complicated and, as yet, not fully resolved is the level of risk that should be disclosed. Fortunately, serious occurrences including death are very rare when using these techniques. These authors agree with Musselman (1991) who holds that "Dentists do not serve the public if the public is scared away from receiving care."<sup>24</sup> As he further states, "resolution of this issue probably rests on the side that informs the parent of all reasonable risk". Until relatively recently most American states followed the *professional community* standard of informed consent. This held that a patient's or parent's consent was considered to be legally informed if the doctor had made those disclosures that a reasonable practitioner would make under the same or similar circumstances. Under the *professional community* standard a doctor can be held liable only if the standard of professional practice is violated by failing to disclose the information at issue.

The past two decades have seen American courts switching to an alternative standard of informed consent. This is known as the *reasonable patient* standard and it addresses the "informational requirements of the average, reasonable patient" rather than using professionally established guidelines. This standard states that a practitioner may be held liable, if a patient, parent or guardian has not received all information essential to the decision of whether to accept or reject treatment. This *reasonable patient* standard clearly brings in the issues of implied versus express consent. *Informed consent* encompasses both implied and express consent. *Informed consent* encompasses both implied and express consent.

*Implied consent* is that which arises by reasonable inference from the patient's or parent's actions even

though no specific consent was given: for example, if general consent is given for an oral examination, it is implied that the dentist may touch the face and use a mouth mirror and explorer. A treatment plan including administration of local anesthetic, pulp therapy, placement of stainless steel crowns, extractions and possibly the use of physical restraint most certainly requires, however, detailed *informed* and *express consent* to the separate procedures by the parent, no matter what the professional community believes as to their acceptability. One other point that is of great importance, but not always realized, to be *informed* the consent must be understood by the patient or parent, and that may well mean bringing in an interpreter.

In the writers' clinics all new patient forms have been designed to encompass both the *implied* and *express* aspects of informed consent: the Personal Information and Preliminary Consent Form (demographic data) permits us to perform all diagnostic work-ups, while the detailed Informed Consent Form takes into account our total treatment plan and specific patient management techniques, such as the use of the Pa-poose Board.

In summary, it is clear that general public and parental attitudes have undergone a radical change, in that the "professional opinions" of the dentist, and indeed other health professionals, are no longer sacrosanct. Legal definitions are changing and the dental practitioner who treats large numbers of children should bear in mind that *Informed consent* is absolutely essential before undertaking any aspect of patient care that might be open to misinterpretation. No matter what the present levels of discussion, it is clear that the more controversial techniques of nonpharmacologic patient management are undergoing a rapid and radical reassessment and change.

This paper represents the current philosophies of clinicians who, although they serve on the faculties of two geographically and internationally widely separated dental schools, have developed a strong collaborative working relationship based on mutual respect and a desire to provide the finest standards of care for the children who make up their patient populations.

#### REFERENCES

1. Braham, R.L.; Bogetz, M.S.; Kimura, M.: Pharmacologic patient management in pediatric dentistry: An update. *J Dent Child*, 60:270-280, July-October 1993.
2. Grossman, M.: Child Abuse and Neglect, Chapter 15, in *Textbook of Pediatric Dentistry*, eds. Braham, R.L. and Morris, M.E., 2nd edition (revised reprint), Philadelphia and Toronto, B.C.: Decker, 1988, p 313.

3. Prosser, W.L.: *Handbook of the law of torts*. 4th. ed. St. Paul: West Publishing Co., 1971, pp. 28-37.
4. President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research: *Making Health Care Decisions*, Vol. 3, Washington, D.C.: U.S. Government Printing Office, 1982 pp 1-35, 63-81, 117-142, 193-251.
5. Morris, W.O.: *Dental litigation*, 2nd. ed. Charlottesville: The Michie Co., 1977, pp 27-47.
6. American Academy of Pediatric Dentistry Quality Assurance Criteria: Section I: Behavior Management. *Pediatric Dentistry*, 15 Special issue: Reference Manual, 85-88, November 1993.
7. Wright, G.Z.; Starkey, P.E.; Gardner, D.E.: Management of extremely uncooperative young children, Ch. 20, in Wright, G.Z., Starkey, P.E. and Gardner, D.E., editors, *Managing children's behavior in the dental office*, St. Louis: C.V. Mosby Co., 1983, p 226.
8. Jordan, M.E.: *Operative Dentistry for Children* New York: Dental Items of Interest Publishing Co., 1925, p 9.
9. Lampshire, E.L.: Paper presented to the American Society of Dentistry for Children, 1962, French Lick, Indiana.
10. Levitas, T.C.: HOME-Hand over mouth exercise, *J Dent Child*, 41:178-182, May-June 1974.
11. Kramer, W.S.: Aversion - A Method for Modifying Child Behavior. Presented at the American Academy of Pedodontics Annual Meeting, Los Angeles, 1973.
12. Lenchner, V. and Wright, G.Z.: Nonpharmacotherapeutic approaches to behavior management. In Wright, G.Z., editor, *Behavior management in dentistry for children*, Philadelphia: W.B. Saunders Co., 1975, pp 103-112.
13. Levy, R.L. and Domoto, P.K.: Current techniques for behavior management: a survey, *Pediatr Dent*, 1:160-164, September 1979.
14. Craig, W.: Hand over mouth technique. *J Dent Child*, 34:387-389, November-December 1971.
15. Davis, M.J. and Rombom, H.M.: Survey of the utilization and rationale for hand over mouth (HOM) and restraint in postdoctoral pedodontic education. *Pediatr Dent*, 1:87-90, June 1979.
16. McAuley, R. and McAuley, P.: Child behavior problems. An empirical approach to management. New York: Macmillan, Inc., 1978, pp 131-132.
17. Ross, A.O.: *Child behavior therapy: principles, procedures and empirical basis*. New York: John Wiley and Sons, Inc., 1981, pp 93-95.
18. American Association of Pedodontic Diplomates: Technique for behavior management - A survey. *J Dent Child*, 39: 68-372, September-October 1972.
19. American Association of Pedodontic Diplomates: Survey of attitudes and practice in behavior management. *Pediatr Dent*: 3:246-250, September 1981.
20. Braham, R.L.: Control of behavior and anxiety in the child patient. In McDonald, R.E.; Hurt, W.C.; Gilmore, H.W.; Middleton, B.S., editors: *Current therapy in dentistry*, Vol 7. St. Louis: C.V. Mosby Co., 1980, p 333.
21. Hagan, P.P.; Hagan, J.P.; Fields Jr., H.W. *et al*: The legal status of informed consent for behavior management techniques in pediatric dentistry. *Pediatr Dent*, 6:204-208, December 1984 .
22. Murphy, M.G.; Fields Jr., H.W.; Machan, J.B.: Parental acceptance of pediatric dentistry behavior management techniques. *Pediatr Dent*, 6:193-198, December 1984.
23. Hirsch, A.C. and Gert, B.: Ethics in dental practice. *J Am Dent Assoc*, 113:599-603, October 1986.
24. Musselman, R.J.: Considerations in behavior management of the pediatric dental patient. *Pediatr Clin N Am*, 38:1309-1324, October 1991.

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#### PATIENTS UNDERGOING REPETITIVE OR CONTINUOUS TREATMENT

Effort would be unnecessarily wasted and the consent process partially compromised if a fully informed authorization to repetitive forms of care were required. Procedures such as allergy desensitization, renal dialysis, chemotherapy, and cobalt treatment fall into this category. However, some degree of communication and exchange with the patient is necessary.

Keeping the performance of the procedure the same obviates the need for going through with the entire consent process every time. This is not the case if any changes are introduced that alter the risks, benefits, or discomfort involved or introduce new side effects that may hamper the patient's ability to carry out daily activities. Then a new consent is necessary.

At any point in a continuous treatment process the patient may pose questions relating to treatment. These inquiries should be encouraged and answered before treatment is provided: the responses may cause the patient to withhold his consent to further care. Any such decision to withdraw consent should be an informed one, and it is the duty of the provider of services to alert the patient to the consequences of the decision. A patient's persistence in refraining from further care should be documented, either in his chart or in a form that recounts the facts leading to the decision and the information disclosed.

Rozovsky, Fay A.: *Consent to treatment*.  
Boston: Little, Brown and Company, 1990, pp 127, 128.

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# An evaluation of oral and nasal midazolam for pediatric dental sedation

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For years, pediatric dentists have searched for the ideal sedative drug that would allow for the safe control of the patient's behavior, provide adequate time for the desired treatment to be performed, and allow for return to a pretreatment level of consciousness by the time the patient was discharged. Many drugs have been utilized as sole agents or in combination, including hypnotics such as chloral hydrate; narcotics, such as alphaprodine and meperidine, tranquilizers such as phenergan, hydroxyzine, and benzodiazepines; and many others. Unfortunately, no single or combination of sedative drugs via the oral route has produced the "ideal" regimen, providing optimum effectiveness and safety for the pediatric dental patient.

Diazepam is often used for dental treatment as an oral antianxiety agent in both children and adults.<sup>1-3</sup> Oral diazepam has, however, some undesirable properties. The onset of action for oral diazepam is 45-90 minutes, with a duration of action of two to four hours. Diazepam has two active metabolites, with a half-life of 20-100 hours, that produce prolonged sedative effects.<sup>4</sup> For short dental procedures in young children, such as extractions or limited restorative procedures, diazepam is not an ideal drug of choice because of its long half-life. Midazolam (Versed®, Roche Laboratories, Nutley, NJ) is a new benzodiazepine that is now

being used extensively in both medicine and dentistry, and may provide pediatric dentists with an alternative sedative drug for short procedures. The authors of this paper intend to review the scientific literature on the use of midazolam in pediatric patients and to report on its efficacy via the oral and nasal routes in a pediatric dental population.

Oral midazolam is absorbed rapidly from the gastrointestinal tract, with peak plasma levels achieved within an hour. Due to extensive first-pass hepatic metabolism, however, only 40-50 percent of the administered dose reaches the systemic circulation.<sup>5</sup> Payne *et al* reported that peak plasma levels of midazolam in pediatric patients, ages 3-10 years, occurred at fifty-three minutes after oral administration, and that bioavailability was only 27 percent using an oral dose of 0.15 mg/kg, and even less (15 percent) using higher doses (0.45 mg/kg and 1 mg/kg).<sup>6</sup> They concluded that the metabolic turnover of midazolam is more rapid in children than in adults, and that the oral route of administration at triple the dose gave equally reliable plasma levels as the intramuscular route. There were no reported differences in the rate of absorption and clearance of midazolam between intramuscular and submucosal routes, but the submucosal route was not recommended because of prolonged pain at the injection site.<sup>7</sup> Rectally administered midazolam at 0.3 mg/kg produced maximum plasma levels between nine and twenty-nine minutes after administration.<sup>8</sup> For the intranasal route, peak plasma concentrations of 72.2 ng/ml were reported at ten minutes (57 percent that of IV

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levels) in children, ages fourteen months to five years.<sup>9</sup> The rate of elimination for midazolam is rapid through hepatic degradation and is independent of the route of administration.<sup>5</sup>

Midazolam has little effect on hemodynamic stability. Rodrigo *et al* demonstrated a higher incidence of cardiac dysrhythmias with IV midazolam conscious sedation compared with local anesthesia alone, for removal of third molars in young healthy Chinese patients.<sup>10</sup> The majority of dysrhythmias, however, were unifocal ventricular ectopies, which did not present a clinical problem.

Respiratory effects of midazolam depended upon the route of administration, the sedative/anesthetic technique used, and characteristics of the individual patient. Midazolam produced respiratory depression in a dose-related fashion when given IV for induction of general anesthesia, by causing a significant decrease in the ventilatory response to carbon dioxide. Low sedative doses of midazolam, however, given IM or slowly titrated IV, produced no clinically significant respiratory depression.<sup>11</sup> Forster *et al* reported that IV midazolam directly depressed the central respiratory drive, but the ventilatory response curve to carbon dioxide was not shifted to the right as seen with narcotic administration.<sup>12</sup>

Sievers *et al* evaluated the safety and recovery conditions utilizing IV midazolam for conscious sedation during pediatric oncology procedures.<sup>13</sup> They found that hypoxemia was related to total midazolam dose and may occur with normal respiratory rates. All cases of hypoxemia resolved with verbal stimulation or face-mask oxygen without specific airway maneuvers or ventilation assistance. Hemodynamic stability was seen with regard to heart rate and blood pressure in all cases. No long-term adverse effects were reported, and full or partial amnesia was evident in 90 percent of the procedures. It was concluded that safe administration of midazolam required constant observation, use of pulse oximetry, and availability of supplemental oxygen/resuscitation equipment in the event of hypoxemia. A sixty-minute recovery period was judged adequate. Conversely, Knudsen *et al* found no relationship between the dose of midazolam and cerebral blood flow or oxygen consumption.<sup>14</sup>

Systemic adverse side effects with parenteral use of midazolam have been reported infrequently. Hiccoughs, coughing, nausea, vomiting, oversedation, headache, drowsiness, decreased tidal volume and respiratory rate, apnea, blood pressure and pulse rate changes, respiratory and cardiac arrest, and death have

all been reported, however, by the manufacturer.<sup>15</sup> Midazolam is contraindicated in patients with a known hypersensitivity to the drug, or acute, narrow angle glaucoma.

Malamed *et al* evaluated IM and IV midazolam for management of children with severe behavior problems associated with dental treatment.<sup>16</sup> Midazolam was administered intramuscularly at 0.15 mg/kg preoperatively, and IV doses of 0.5 - 1.0 mg were given as needed intraoperatively. Nitrous oxide was utilized, and IV meperidine was administered intraoperatively as well, if necessary. The majority of patients were successfully managed in this manner and their recovery was prompt in all but one case. Oxyhemoglobin saturation levels  $\leq 90$  percent were seen in 12.9 percent of the cases, but in all instances this occurred during treatment of the mandibular arch and management consisted in simply supporting the mandible. Another study using IM midazolam also demonstrated its safety and effectiveness when compared to morphine.<sup>17</sup> These results showed a direct relationship between chronologic age and the effectiveness of sedation.

Rectal administration of midazolam has also been shown to be safe and effective. Holm-Knudsen *et al* reported that rectally administered 0.4 mg/kg midazolam vs. 0.75 mg/kg diazepam for preanesthetic sedation in children had comparable effectiveness and that neither drug created any adverse side effects.<sup>18</sup> No statistically significant differences were seen with respect to systolic or diastolic blood pressures, respiration, pulse rates, or arterial oxygen saturation in healthy two to seven year olds receiving rectally administered doses of 0.25-0.45 mg/kg midazolam compared to a placebo for oral surgery procedures.<sup>19</sup> In a similar study, a higher incidence (23 percent) of disinhibition reactions was seen, however, in the 0.45 mg/kg midazolam group. The authors concluded that 0.25 - 0.35 mg/kg was the dosage of choice, since it provided similar anxiolytic, and sedative responses, and cooperation within thirty minutes of administration, without a high incidence of disinhibition.<sup>20</sup> Although rectal midazolam caused a low incidence of adverse effects, the authors believed that the true incidence of adverse effects was under-reported, due to some unobserved reactions of low intensity.<sup>21</sup> Spear *et al* found rectal midazolam administered at a higher dosage (1 mg/kg) produced clinically insignificant changes in arterial blood pressure, heart rate, oxyhemoglobin saturation, and end-tidal carbon dioxide concentration for preinduction of anesthesia ten minutes after administration.<sup>22</sup>

Orally administered midazolam has also been re-

ported to be safe and effective in children. Saarnivaara *et al* compared the effects of oral chloral hydrate to midazolam as premedicants in children undergoing otolaryngological surgery.<sup>23</sup> This study showed that oral chloral hydrate at 75 mg/kg was a good anxiolytic in children less than five years of age, but only fairly so at 25 or 50 mg/kg. In contrast, only fair anxiolysis was seen in children less than five years old, using midazolam at 0.4-0.6 mg/kg, but good effect was obtained at these doses in children greater than five years old. The authors concluded that oral midazolam at 0.5 mg/kg was recommended for children greater than five years of age and was preferable to chloral hydrate because it was more palatable. Silver compared oral midazolam at 0.3 mg/kg versus 0.5 mg/kg for conscious sedation of physically and neurologically handicapped dental patients, ages thirteen to eighteen years.<sup>24</sup> Both dosages proved successful, without intraoperative or postoperative complications. Hennes *et al* compared oral midazolam (0.2 mg/kg) to placebo in preschool children less than six years of age for laceration repair in an emergency room setting.<sup>25</sup> Significant anxiety reduction was seen in 70 percent of the midazolam group, as opposed to 12 percent in the placebo group, with no respiratory depression or other complications observed. In studies to determine the optimal oral dose of midazolam as preanesthetic medication, Feld *et al* evaluated 124 children, ages one to ten years.<sup>26,27</sup> They concluded that oral midazolam (0.5-0.75 mg/kg) in combination with atropine (0.03 mg/kg) increased sedation, decreased separation anxiety, and improved the quality of induction of anesthesia, while not prolonging recovery in the majority of children; but 9-17 percent of the children were still afraid, combative, or crying.

Intranasal midazolam has recently been demonstrated as a safe, alternate route of administration. Wilton *et al* evaluated preanesthetic sedation of children, eighteen months to five years of age, using intranasal midazolam at doses of 0.2 and 0.3 mg/kg.<sup>28</sup> Forty percent became calm and readily accepted induction of anesthesia, while 60 percent were calm, but became agitated upon induction. No change in respiratory rate or arterial oxygen saturation was seen, nor was there evidence of delayed recovery. It was concluded that 0.2 mg/kg intranasal midazolam produced adequate anxiolysis and sedation in preschool children. No additional sedative effect was seen with the 0.3 mg/kg dosage when compared with 0.2 mg/kg. Karl *et al* found intranasal midazolam at a dose of 0.2 mg/kg to be less pleasant initially, but provided a more reliable sedation, a lower incidence of oxygen desaturation, more

chest wall compliance, and was preferable to sufentanil in most five to ten-year-old children for preinduction anesthesia.<sup>29</sup> Latson *et al* evaluated intranasal midazolam sedation in infants four to thirty-six months old for echocardiography.<sup>30</sup> If a significant level of sedation was not seen in five to ten minutes, using the initial dose of 0.2 mg/kg, a second intranasal dose was administered. The use of 0.2 mg/kg was found to be more effective than 0.1 mg/kg used as a supplemental dose. All patients became passive and slightly to moderately sleepy, but none was completely asleep. Average time to attain maximal sedative effects was ten minutes, with an average recovery time of thirty-two minutes. No clinical respiratory depression, emesis, or oversedation was seen. Intranasal midazolam was found to be safe, with a rapid onset, and short duration of action, without fasting or parenteral administration.

In another recent study of pediatric patients, Twerzky *et al* found that intranasally administered midazolam, using a dosage of 0.2 mg/kg, provided significant anterograde amnesia when compared with placebo in four to ten-year-old patients.<sup>31</sup> Retrograde amnesia, however, was not affected. This finding was similar to that of adult studies, comparing the amnestic qualities of intravenously administered diazepam and midazolam, where both drugs were found to produce significant anterograde amnesia.<sup>32-33</sup>

In summary midazolam possesses many properties that are advantageous for use in pediatric dental sedations. Its effectiveness and safety are well-documented in children for medical and surgical procedures. Reports on its use in pediatric dental patients, however, is lacking. The purpose of this report was to evaluate the effectiveness of oral and nasal midazolam as a sedative agent in recalcitrant pediatric dental patients for short dental procedures.

## METHODS AND MATERIALS

This study was conducted at the University of Florida Pediatric Dentistry Clinic. Patients selected for the study were between the ages of 1.5 to six years, healthy (ASA I), and judged before the sedation as preoperative or definitely negative according to the Frankl behavior rating scale.<sup>34</sup> All parents received written pre- and postoperative sedation instructions. Informed consent was obtained for the delivery of the anticipated dental procedures, the sedative agent(s) and route selected, and, if required, the use of a mouth prop and body restraint (Papoos Board®, Olympic Medical Group, Seattle, WA.). The study population was randomly di-

vided into two groups: Group N received midazolam (0.2mg/kg) intranasally, and Group O received midazolam (0.5mg/kg) orally in hydroxyzine pamoate (25 mg) suspension (Vistaril®, Pfizer Labs, New York, NY). Following administration, a waiting period of either ten minutes or thirty minutes was allowed for sedative effects to occur with the nasal and oral routes, respectively. All patients were continuously monitored with a pulse oximeter and a pretracheal stethoscope. All procedures followed established sedation guidelines.<sup>35</sup> Nitrous oxide USP (40 percent) with oxygen (60 percent) was administered via nasal hood to all subjects. Local anesthesia (2 percent lidocaine with 1:100,000 epinephrine) was administered, not exceeding the maximum recommended dosage (4.4 mg/kg). The necessary dental procedures were then completed under rubber dam isolation. The specifications evaluated included the presence or absence of sedative effect, and whether or not the planned treatment was successfully completed. The sedative effect was subjectively assessed by a global rating as either "satisfactory" or "unsatisfactory" by the operator at the termination of the procedure. Satisfactory sedation was defined as behavior displayed by the child that was indicative of cooperation, such as accepting instructions without resistance and a calm and drowsy state. An unsatisfactory sedation was defined as behavior displaying uncooperativeness, resistance, crying, and struggling.

## RESULTS

Distribution of subjects by group is found in Table 1. There was no significant difference between the two groups for sex, age, or weight. Weight ranged from 9-21 kg, with a mean weight of 14.3 kg. The mean dose of midazolam administered was 2.8 mg for Group N and 6.8 mg for Group O. Although the number of dental procedures varied according to type, there was no significant difference between the two groups in the mean number of procedures completed (Table 2).

Table 3 illustrates the distribution of cases based upon the matching of the two variables used in the definition of a successful sedation. Approximately two-thirds of the cases (64 percent) resulted in a satisfactory level of sedation, which permitted completion of all planned dental procedures. There were no significant differences between the two groups. Complications arising from administration of midazolam appeared rarely and without distinction by group (Table 4).

Table 1 □ Distribution of subjects by group.

Group of subjects	Number	Sex		Mean age (months)	Age range (months)	Mean weight (kg)
		M	F			
N	50	26	24	37.6	18-69	14.3
O	50	24	26	39.1	18-71	14.2

Table 2 □ Distribution of dental procedure type and number by group.

Group	Number of procedures			Mean Total/Subject
	Extractions	Restorations	Pulpotomies	
N	104	46	9	3.2
O	65	92	5	3.2

Table 3 □ Distribution of cases based upon success level by group.

Planned procedures completed	Group	Sedative effects	
		Satisfactory	Unsatisfactory
Yes	N	31	16
	O	33	12
No	N	2	1
	O	2	3

Table 4 □ Distribution of complications by group.

Group	Disinhibition/Excitation	Hemoglobin-Oxygen desaturation (<90%)	Hiccoughs
N	3	1	0
O	1	2	1

## DISCUSSION

There is a great need in pediatric dentistry for sedative drugs that have a high degree of versatility, reliability and safety. Oral diazepam has been used for many years in pediatric dental patients with some degree of success.<sup>1-2</sup> Due to its long half life, the presence of active metabolites, and low potency level, however, diazepam is not the drug of choice in many circumstances. Midazolam, a new short-acting benzodiazepine, has been used safely and effectively for preanesthetic sedation and a variety of medical procedures via IV, IM, rectal, oral, and nasal routes. For selected circumstances, midazolam may be an ideal agent to provide a safe and effective sedation in pediatric dental patients.

The technique for oral administration of midazolam reported in this paper included a dosage of 0.5 mg/kg mixed with 25 mg hydroxyzine pamoate suspension as a vehicle and waiting for a period of thirty minutes.

Since midazolam is marketed only for parenteral use, it was necessary to utilize an oral vehicle such as the flavored hydroxyzine suspension, which would mask its bitter taste. Apple juice or a flavored syrup has also been used successfully to encourage patient acceptance.<sup>27</sup> Hydroxyzine pamoate suspension was utilized in the present study because of its availability and acceptable flavor. Hydroxyzine is also a minor tranquilizer, with antihistaminic, antispasmodic, antiemetic, and somewhat anticholinergic properties. Hydroxyzine has been utilized for many years in pediatric dental sedations, either as a sole agent or in combination with other oral agents.<sup>36-37</sup> The substitution of atropine for hydroxyzine in the oral regimen should be further investigated.<sup>26-27</sup> This antimuscarinic drug inhibits salivation and secretions in the respiratory tract, as well as having bronchodilator activity. These properties would be significantly advantageous during delivery of dental procedures. Nitrous oxide-oxygen inhalation was employed intraoperatively because of the physiologic benefits derived from supplemental oxygen administration in counteracting hypoxemia, as well as the existence of specific receptors capable of potentiating the analgesic effect of nitrous oxide when used in combination with a benzodiazepine.<sup>38</sup>

The technique for the nasal route included a dosage of 0.2 mg/kg utilizing a 1 cc tuberculin needleless syringe, injecting half of the volume slowly in each nostril, and waiting for a period of 10 minutes (Figure). An alternative approach to the nasal route of administration using an atomizer rather than a syringe should be investigated. An atomizer may allow for greater drug absorption through the nasal mucous membranes, less oral intake, more profound effect, and a less noxious mechanism of delivery.

In a previous study, the safety and efficacy of redosing with nasal midazolam was reported.<sup>30</sup> Redosing at a supplemental dose of 0.2 mg/kg, may be considered, if significant anxiety reduction is not evident within 10 minutes from the initial dose. An additional waiting period should be allowed for the sedative effects to occur. If this second dose does not provide sufficient anxiolysis, however, there are no reports at this time indicating safety or efficacy conditions beyond one additional dose, and further administration, therefore, cannot be recommended. If midazolam is administered orally at a dosage of 0.5 mg/kg, a supplemental nasal dose of 0.2 mg/kg may be considered after an adequate waiting period of 30-45 minutes. The total midazolam dose administered would still be within the upper limit (0.75 mg/kg) of the recommended oral dose range. Re-



Figure. Intranasal technique utilizing a 1cc tuberculin needleless syringe.

dosing via the nasal route in cases of inadequate sedation likewise needs to be investigated for pediatric dental sedations.

Midazolam is packaged in both single and multidose vials in the following concentrations: 1 mg/mL in 2, 5, and 10 mL vials and 5 mg/mL in 1, 2, 5, and 10 mL vials. Experience gained from the present report indicated the use of a 10 mL multidose vial at a concentration of 5 mg/mL to be most economical and advantageous, particularly when utilizing the intranasal route, to allow the highest concentration of the drug at the lowest volume. At 5 mg/mL, the entire volume for nasal administration can be contained within a 1cc tuberculin syringe for most patients, which facilitates administration. If redosing is considered, a new syringe should be utilized to maintain sterility.

Flumazenil is packaged in multidose vials of 5 and 10 mL at a concentration of 0.1 mg/mL. The recommended dose for reversal of conscious sedation is 0.2 mg (2 mL) administered IV over a 15-second period.<sup>39</sup> The dose may be repeated every 60 seconds up to four times for a total dose of 1.0 mg. Baktai *et al* found that the sedative effects of IV midazolam for pediatric bronchology procedures were safely and promptly (within one minute) reversed at a 0.1-0.2 mg dose of flumazenil without any complications.<sup>40</sup> Flumazenil should be given in small incremental doses in order to control the reversal of the sedation to the desired endpoint. Patients should be monitored for the potential need for rese-



dation, for a minimum of two hours. If re sedation occurs, repeated doses may be given every twenty minutes as needed, not exceeding 1 mg at any one time and no more than 3 mg in one hour.

The present report has many recognized deficiencies. It was not the intention of this report to quantify objectively the merits of midazolam in a pediatric population, because the literature review as presented confirmed that the dosages and routes studied were safe and efficacious. It was, however, the objective of this report to introduce the clinician to a new sedative agent, administered both via a previously undescribed oral regimen and via an unique nasal route. Better controlled investigations will be necessary to access objectively and accurately, the recommended guidelines for orally and nasally administered midazolam for pediatric dental sedations. This report demonstrated, however, that midazolam could be used effectively under routine clinical situations, in recalcitrant pediatric dental patients. Under those conditions, the outcome of the sedative regimen, whether it was safe and effective, was the determinant in recommending this approach for further clinical investigation. Critics of this report would be correct in citing the need to study the sedative agent in a blind fashion, to eliminate the confounding drug variables, to establish a control group, and to evaluate the sedative effect with a more elaborate behavioral assessment scale. Midazolam should be tested alone, without a hydroxyzine vehicle supplemented with nitrous oxide/oxygen inhalation, to eliminate potential synergistic effects. It is possible that much of the anxiolytic effects observed may have resulted from the use of nitrous oxide analgesia, as patient acceptance of the nasal hood may be one of the chief benefits derived from midazolam administration in patients who would not initially accept its placement. Although there existed several reliable behavioral assessment scales available for use in this study, a simplified global rating was chosen. In a recent study of the sedative effects of meperidine in preschool children, McKee and coworkers compared four behavior assessment scales: categorical, dichotomous, ten-point, and global.<sup>41</sup> They concluded that all four assessment scales resulted in statistically similar results and that a global rating of overall sedation efficacy by the dentist at the termination of the dental procedure as employed in the present study is valid and reliable, when evaluating a single-drug effect at a standardized dosage.

Future studies are indicated to determine the pediatric age ranges which would be most suitable for midazolam sedation. Studies should also evaluate de-

terminants for redosing, including effect upon hemodynamic and respiratory function, as well as determining the optimal dosages for each route. Finally, research should be conducted on children to analyze the effects of the benzodiazepine antagonist, flumazenil, when given via the sublingual and submucosal routes, and to determine the accurate dose for safe and effective reversal through these routes.

## CONCLUSIONS

In summary, midazolam, a new short-acting benzodiazepine, has many desirable properties when considering an agent for pediatric dental sedations. It has a rapid onset, short duration of action, and is safe with minimal side effects. It can be utilized by many routes of administration, and would be particularly useful in pediatric dentistry through the oral and nasal routes. An ideal indication for use would be emergency dental procedures due to trauma or infection, where anxiety is significantly heightened. Midazolam in the dosages and routes administered in this study is not a panacea, however, with its limited (two-thirds) success rate. Its high cost, in comparison to other sedative agents, and the lack of approval for use in children are significant constraints. Even so, midazolam deserves consideration for use in selected cases, where short dental procedures are to be performed for preoperative or highly anxious preschool children.

## REFERENCES

1. Lindsay, S.J.E. and Yates, J.A.: The effectiveness of oral diazepam in anxious child dental patients. *Br Dent J*, 149-153, September 1985.
2. Badalaty, M.M.; Houpt, M.I.; Koenigsberg, S.R. *et al*: A comparison of chloral hydrate and diazepam sedation in young children. *Pediatr Dent*, 12:33-37, February 1990.
3. Vallerand, W.P.; Vallerand, A.H.; Hall, M.B.: Evaluation of the sedative combination of nitrous oxide and orally administered diazepam. *Oral Surg*, 71:660-664, June 1991.
4. Becker, D.E.: Pharmacological considerations for conscious sedation: clinical applications of receptor function. *Anesth Prog*, 38:33-38, January 1991.
5. Reves, I.G.; Fragen, R.J.; Vinik, H.R. *et al*: Midazolam: pharmacology and uses. *Anesthesiology*, 62:310-324, March 1985.
6. Payne, K.; Mattheyse, F.J.; Liebenberg, D. *et al*: The pharmacokinetics of midazolam in paediatric patients. *Eur J Clin Pharmacol*, 37:267-272, September 1989.
7. Alfonzo-Echeverri, E.; Troutman, K.C.; George, W.: Absorption and elimination of midazolam by submucosal and intramuscular routes. *Anesth Prog*, 37:277-281, December 1990.
8. Saint-Maurice, C.; Meistelman, C.; Rey, E. *et al*: The pharmacokinetics of rectal midazolam for premedication in children. *Anesthesiology*, 65:536-538, November 1986.
9. Walbergh, E.I.; Wills, R.I.; Eckhart, J.: Plasma concentrations of midazolam in children following intranasal administration. *Anesthesiology*, 74:233-235, February 1991.

10. Rodrigo, C.R.; Rosenquist, I.B.; Cheng, C.H.: Cardiac dysrhythmias with midazolam sedation. *Anesth Prog* 37:20-23, January 1990.
11. Giovannitti, Jr., J.A.: Midazolam: review of a versatile agent for use in dentistry. *Anesth Prog* 34:164-70, September 1987.
12. Forster, A.; Gardaz, J.P.; Suter, P.M. *et al*: Respiratory depression by midazolam and diazepam. *Anesthesiology* 53:494-497, December 1980.
13. Sievers, T.D.; Yee, I.D.; Foley, M.E. *et al*: Midazolam for conscious sedation during pediatric oncology procedures: safety and recovery parameters. *Pediatrics*, 88:1172-1179, November 1991.
14. Knudsen, L.; Cold, G.E.; Holdgard, H.O. *et al*: The effects of midazolam on cerebral blood flow and oxygen consumption. *Anaesthesia* 45:1016-1019, November 1990.
15. Roche Laboratories: Versed (product information), Nutley, NJ: Hoffman-La Roche, 1991
16. Malamed, S.F.; Quinn, C.L.; Hatch, H.G.: Pediatric sedation with intramuscular and intravenous midazolam. *Anesth Prog*, 36:150-68, September 1989.
17. Rita, L.; Seleny, F.L.; Mazurek, A. *et al*: Intramuscular midazolam for pediatric preanesthetic sedation: a double-blind controlled study with morphine. *Anesthesiology* 63:528-531, November 1985.
18. Holm-Knudsen, R.; Clausen, T.G.; Enø, D.: Rectal administration of midazolam versus diazepam for preanesthetic sedation in children. *Anesth Prog* 37:29-31, January 1990.
19. Roelofse, J.A. and de V Joubert, J.J.: Arterial oxygen saturation in children receiving rectal midazolam as premedication for oral surgical procedures. *Anesth Prog* 37:286-289, December 1990.
20. Roelofse, J.A.; Van Der Bijl, P.; Stegmann, D.H. *et al*: Preanesthetic medication with rectal midazolam in children undergoing dental extractions. *J Oral Maxillofac Surg*, 48:791-796, September 1990.
21. Roelofse, J.A. and Van Der Bijl, P.: Adverse reactions to midazolam and ketamine premedication in children. *Anesth Prog*, 38:73-76, January 1991.
22. Spear, R.M.; Yaster, M.; Berkowitz, I.D. *et al*: Preinduction of anesthesia in children with rectally administered midazolam. *Anesthesiology*, 74:670-674, April 1991.
23. Saarnivaara, L.; Lindgren, L.; Klemola, U.M.: Comparison of chloral hydrate and midazolam by mouth as premedicants in children undergoing otolaryngological surgery. *Br J Anaesth*, 61:390-396, June 1988.
24. Silver, T.C.: Evaluation of oral midazolam sedation for the pediatric dental patient. *Pediatr Dent*, 14:413, November 1992.
25. Hennes, H.M.; Wagner, V.; Bonadio, W.A. *et al*: The effect of oral midazolam on anxiety of preschool children during laceration repair. *Ann Emerg Med*, 19:1006-1009, December 1990.
26. Feld, L.H.; Urquhart, M.L.; Feaster, W.W. *et al*: Premedication in children: Oral versus intramuscular midazolam. *Anesthesiology*, 69:A745, September 1988.
27. Feld, L.H.; Negus, B.; White, P.F.: Oral midazolam preanesthetic medication in pediatric outpatients. *Anesthesiology*, 73:831-834, November 1990.
28. Wilton, N.C.T.; Leigh, I.; Rosen, D.R. *et al*: Preanesthetic sedation of preschool children using intranasal midazolam. *Anesthesiology*, 69:972-975, December 1988.
29. Karl, H.W.; Keifer, A.T.; Rosenberger, J.L. *et al*: Comparison of the safety and efficacy of intranasal midazolam or sufentanil for preinduction of anesthesia in pediatric patients. *Anesthesiology*, 76:209-215, February 1992.
30. Latson, L.A.; Cheatham, J.P.; Gumbiner, C.H. *et al*: Midazolam nose drops for outpatient echocardiography sedation in infants. *Amer Heart J*, 121:209-210, January 1991.
31. Twersky, R.S.; Hartung, J.; Berger, B.J. *et al*: Midazolam enhances anterograde but not retrograde amnesia in pediatric patients. *Anesthesiology*, 78:51-55, January 1993.
32. Ochs, M.W.; Tucker, M.R.; White, R.J.: A comparison of amnesia in outpatients sedated with midazolam or diazepam alone or in combination with fentanyl during oral surgery. *ADA* 113:894-897, December 1986.
33. Luyk, N.H.; Boyle, M.A.; Ward-Booth, R.P.: Evaluation of the anxiolytic and amnesic effects of diazepam and midazolam for minor oral surgery. *Anesthesia Progress*, 33:3742, March 1987.
34. Frankl, S.; Shiere, F.; Fogels, H.: Should the parent remain with the child in the dental operatory? *J Dent Child*, 29:150-163, April 1962.
35. American Academy of Pediatric Dentistry: Guidelines for the elective use of conscious sedation, deep sedation and general anesthesia in pediatric patients. *Pediatr Dent*, 7:334-337, December 1985.
36. Moody, E.H.; Mourino, A.P.; Campbell, R.L.: The therapeutic effectiveness of nitrous oxide and chloral hydrate administered orally, rectally, and combined with hydroxyzine for pediatric dentistry. *J Dent Child*, 53:425-429, November 1986.
37. Shapira, I.; Holan, G.; Guelmann, M. *et al*: Evaluation of the effect of nitrous oxide and hydroxyzine in controlling the behavior of the pediatric dental patient. *Pediatr Dent*, 14:167-70, May 1992.
38. Emmanouil, D.E. and Quock, R.M.: Modification of nitrous oxide analgesia by benzodiazepine receptors. *Anesth Prog*, 36:5-8, January 1989.
39. Roche Laboratories: Mazicon (product information), Nutley, NJ: Hoffman-La Roche, 1992.
40. Baktai, G.Y.; Szekely, E., Marialigeti, T. *et al*: Use of midazolam ('Dormicum') and flumazenil ('Anexate') in paediatric bronchology. *Current Med Res Opin*, 12:552-559, September 1992.
41. McKee, K.C.; Nazif, M.M.; Jackson, D.L. *et al*: Dose response characteristics of meperidine sedation in preschool children. *Pediatr Dent*, 12:222-227, July 1990.

## DETECTING OCCLUSAL CARIES

It has been shown in vitro and in vivo that measuring the electrical conductivity may be the most suitable tool in occlusal caries detection (Flaitz *et al*, 1986; Rock and Kidd, 1988; Verdonschot *et al*, 1992). As the devices tested in the above-mentioned studies are not available on the market, dentists should be taught to combine several techniques. Above all, they should examine bite-wing radiographic films not only for approximal caries, but also for occlusal caries.

Lussi, A.: Comparison of different methods for the diagnosis of fissure caries without cavitation.

*Caries Res*, 27: 409-416, September-October 1993.

# The use of hypnosis for smooth sedation induction and reduction of postoperative violent emergencies from anesthesia in pediatric dental patients

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**H**ysterical crying and continuous screaming among uncooperative pediatric dental patients before, during, and after treatment is not only stressful for the dental staff, but also annoying and unpleasant for other patients and people in the waiting area. Many different modalities have been used to deal with unmanageable pediatric patients, such as hypnosis and pharmacological sedation.

Hypnosis is defined as a trance state characterized by a very relaxed, drowsy and lethargic appearance. It is also characterized by positive attitudes, strong motivation, and enhanced expectations toward the situation, and willingness to follow the suggestions of the hypnotist.<sup>1</sup> Though pharmacological sedation has been used for many years with well established safety and efficacy for dental applications, hypnosis has the advantage of not suppressing the vital signs of the patient. Results are unpredictable, however, and not every patient can be hypnotized.

With pharmacological sedation, auxiliary manpower is needed to monitor vital signs and any untoward reaction from the sedative agent will distract the dentist from the treatment. For the patient who requires sedation through a parenteral route, a needle puncture is unavoidable and, if the patient fears the needle, there can be distinct disadvantages. Research has shown that children ages five to fourteen years fear choking the

most during dental treatment, followed by injections and drilling.<sup>2,3</sup> It is commonly known that if children cry hysterically during induction of sedation or general anesthesia they will also, after treatment is finished, recover from the anesthesia with the same violent emotions. These postoperative emotional episodes are difficult for staff to cope with and can be misinterpreted by parents as an aftermath to inappropriate treatment.

Hypnosis combined with barbiturates induces a state of drug hypnosis known as narcosynthesis.<sup>4,5</sup> Long-acting barbiturates require the time necessary for the patient to sleep off the effect. It has been reported that diazepam (Valium) 2 to 5 mg TID on the day preceding treatment, and one 5 mg tablet one half-hour before dental treatment facilitates induction of hypnosis in agitated and apprehensive dental patients.<sup>6</sup> Although this combination of Valium and hypnosis has good results, the patient has a tendency to recover slowly.

Hypnosis combined with pharmacological sedation is still not very popular because physicians and dentists are rarely trained in both areas. Hypnosis helps prepare the patient for surgery by assuaging fears of anesthesia.<sup>7</sup> This technique of using hypnosis for rapid induction of anesthesia is very practical; pharmacological sedation remains, however, the principal method of stress reduction. Combining some sedative agents, such as Etomidate, with hypnosis have been found to be unsatisfactory because of unwanted patient movement.<sup>8</sup> The benzodiazepines are preferred because of their selective action on the limbic system and their high therapeutic index.<sup>9</sup> Children are more easily hypnotized than adults because they are less critical and

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more amenable to persuasion and suggestions during hypnosis.<sup>10</sup> Ketamine is ideal for uncooperative children because they breathe without airway support and there are few side effects.<sup>10,11</sup> Local anesthetic is not needed with Ketamine because it is also a powerful analgesic.<sup>10,11</sup>

Although it has been reported that hypnosis can minimize or eliminate violent patient reactions, there has not been previously reported a technique for the combination of hypnosis and Ketamine sedation for minimizing the violent emergence of pediatric patients during recovery.<sup>12,13</sup>

## MATERIALS AND METHODS

Thirteen patients ages four to eleven years who needed operative dental work were selected for Ketamine sedation combined with hypnosis. All patients had been successfully sedated with Ketamine previously, and all had a history of violent crying and struggling before sedation and during recovery. They all immediately cried upon entering the dental office. All of the patients were healthy and classified ASA I.

To prepare the patients for the hypnosis we usually ask the parent to tell the children that they will be playing some games with the hygienist or the dental assistant. The next morning when the patients arrive with their parents to the operator, only the hygienist or an assistant is present. Without the dentist present, the child will be more calm. No pre-medication was given before or on the day of operation.

The parent sits next to the patient and the trained assistant begins the hypnosis in a soft monotone voice. The hypnosis proceeds with a series of suggestions. "Let's play a game together. Pretend you are asleep. You are going to watch a movie or circus, or whatever you like. First, close your eyes, take a deep breath and hold it until I count to five and then slowly let it out. Now let's do it again until you become very relaxed and your arms and legs become heavier and heavier."

Children have vivid imaginations and a technique of this kind is quite natural to them. For example, while in the hypnotic state the sound of the drill may be to the child the sound of a gentle whistling breeze. Once the child is under, the dentist can enter the room and administer the Ketamine, one to 2.5 mg/lb, dosage depending on the individual child. While the assistant is still talking to the patient, saying they are watching TV, the dentist injects the Ketamine into the patient's thigh. The patient either will not feel this at all, or only move slightly. For convenience, the assistant can re-

cord the hypnosis induction and, once the patient is in the trance state, continue the hypnosis with ear phones. During hypnosis it is also possible to use the glove anesthesia technique to transfer the suggestion of numbness to the thigh where IM Ketamine is administered or to the mucobuccal fold where local anesthetic is given. For example, the patient is told to touch his icy cold finger to his gum, and the experience of numbness is transferred to the gum.

Once the Ketamine takes effect, the dental work can proceed. If, as the dental work progresses, the patient becomes "light" or begins to move, another half dose of the original dosage of Ketamine can be administered. Because Ketamine is also a powerful analgesic, operative work can be done without local anesthetic. The entire experience can be very pleasant for the patient. When the work is completed, the assistant simply tells the patient to turn the imaginary TV off, stop pretending, and wake up.

Behavior of each patient during recovery was noted. Also, postoperative behaviors were described as totally calm and relaxed, somewhat apprehensive, moderately anxious, or extremely anxious. Patients who could not adequately describe their experiences because of delayed recovery from sedation were called the next day. Patients were asked about pain, redness or stiffness at the injection site. They were asked to describe any pain experienced during dental treatment and how it would be described from any pain, mild pain, moderate pain, severe pain, or pain as bad as it can be. They were also asked whether hypnosis reduced anxiety. The patient's general impression of the entire procedure was also recorded. The operating team determined the manageability of the patient to be excellent, good, fair, or poor.

## RESULTS

The pre-induction status of all patients upon arrival was recorded. All were awake and quiet except one patient who was weeping. The twelve patients who were not crying were comforted by the belief that they were in the office solely to play a game with the nurse or dental assistant, and to have their teeth brushed. As shown in Table 1, only one patient exhibited the extreme agitation that was recorded in the histories of all thirteen.

Of the thirteen patients evaluated, the noted recovery behaviors are listed in Table 2. During the period of Ketamine sedation, all but two patients were calm and quiet. There were two patients who were not successfully hypnotized. Two of the patients sobbed a little

Table 1 □ Pre induction status of patients.

	Number of patients
Totally calm and relaxed	7
Somewhat apprehensive	2
Moderately anxious	3
Extremely anxious	1

Table 2. □ Behaviors during recovery from anesthesia.

	Number of patients
Smooth and uneventful	9
Sobbing and weeping	2
Crying and excited	2

Table 3 □ Operating team evaluation of manageability.

Number of patients	
9	Excellent - no body movements or crying which interrupted the procedure.
3	Good - movement that interrupted the procedure for a short period of time.
1	Fair - crying and body movement that interrupted the procedure from time to time, but procedure was completed.
0	Poor - crying and body movement so severe that the dental procedure cannot be completed.

at the time of injection. One patient did not have a good hypnotic result, because he did not listen attentively and opened his eyes from time to time. He screamed continuously for about two and a half minutes after injection, and wept on and off until Ketamine took effect. The other one without a good result screamed for seven minutes.

At the time of discharge, nine patients were calm and relaxed, three were somewhat apprehensive, and one was moderately anxious. When questioned about the IM injection site, eleven had no pain, one patient had moderate pain, and one slight pain. No patients reported remembering the operative procedure or any intraoperative pain. Ketamine has a good amnesiac effect. Ten patients felt calm and relaxed about the entire procedure. Two were sometimes tense, and one patient felt tense about the entire event. When asked whether hypnosis in combination with sedation helped to reduce anxiety, two patients reported that it helped somewhat, one said it didn't work, and ten patients felt great relief from anxiety. As seen in Table 3, the operating teams evaluation of patient manageability was that nine of the thirteen patients were perceived as

excellent, three as good, and one as fair. The overall results were considered good in all these patients who had histories of preoperative violent reactions. The combination of these techniques seemed to prolong recovery, and the average awakening and recovery time was found to be almost twice as long as when Ketamine is used alone.

## DISCUSSION

There are various tests to determine whether a patient will be able to be hypnotized or not. The tests used in this study were the eye-roll test, the Stanford Scale Tasks test, and the Harvard Scales Tasks test.<sup>14-16</sup> Since all of these patients had a history of violent emotional behavior, the attempt was made to hypnotize all of them. There was, in effect, nothing to lose because, if the hypnosis were successful, the patient had an uneventful and pleasant experience. If the hypnosis did not work, the patient would cry and scream until the Ketamine took effect, which had happened in every case before combining the techniques was attempted.

The results of this study indicate that the combination technique is very beneficial for use with pediatric patients. It solved the problems of violent reactions both pre-induction of anesthesia and during the recovery period. It was also evident that hypnosis augmented the effects of Ketamine, but not in a uniform fashion for all children. Children who test as hypnotizable will benefit the most from this technique, and studies confirm that most children are hypnotizable.<sup>17</sup>

Some previous reports have shown that hypnosis helped to minimize violent reactions during emergence from general anesthesia in postoperative hernia patients.<sup>13</sup> In our study, even those patients who are resistant to hypnosis were calmer during sedation induction and during the procedure. Also the recovery from anesthesia was much less violent than it had been with previous procedures that were performed with sedation alone. Emergence reactions such as vivid dreams, hallucinations, delirium, excitement, irrational behavior, and confusion have been known to occur in patients receiving Ketamine. These reactions leave no residual psychological effects, and the incidence in young patients (age fifteen years or less) is less frequent and can be minimized by IM administration and lower dosages.<sup>18</sup> Our study showed that the combination of low dosage Ketamine IM and hypnosis is very beneficial for young children with a history of violent behavior before and after sedation.

As mentioned previously, hypnosis prolonged the

sedation effect of Ketamine by 40 to 60 percent. This prolonged recovery is the only disadvantage of the combination technique. The benefits of the technique, however, including anxiety relief for the patients and great stress reduction for patients, staff and parents, seem well worth the one disadvantage. We conclude that for patients with a history of violent emotional reactions to dental treatment, this combination technique produces greatly improved results.

#### REFERENCES

- Wallace B.: *Applied Hypnosis: An Overview*. (2nd Edition) Chicago: Nelson-Hall, 1981, p 1, Chapter 1.
- Phobia: conquering fear with trust. *JADA*, 19:593, November 1989.
- Cuthbert M.I. and Melamed, B.G.: A screen device: children at risk of dental fears and management problem. *J Dent Child*, 49:432-435, November-December 1982.
- Zach, G.A.: Hypnosis. Part I, A historical overview. *Compen Contin Educ Dent*, 11:290-297, May 1988.
- Erickson, M.H. and Hershman, S.: *The Practical Application of Medical and Dental Hypnosis*. New York: Julian Press Inc., 1961, p 9.
- Hartland, J.: *Medical and Dental Hypnosis and Its Clinical Application*. Baltimore: Williams and Wilkins, 1975, p 74, Chapter 7.
- Wollman, L.: Hypnosis for the surgical patient. *Amer J Clin Hypnosis*, 7:83-85, July 1964.
- VanEden, A.F. and Leonan, B.C.: Hypnosis with etomidate during total IV anesthesia. *S Afr Med J*, 58:1002-1004, December 1980.
- Donaldson, D.: Anxiety, its management during the treatment of the adolescent dental patient. *Int Dent J*, 32:44-45, March 1982.
- Hirschowitz, A.S. and Kaplan, S.: Minimal dosage Ketamine in pediatric dentistry. *J Dent Assoc S Africa*, 34:321-325, 1979.
- Lu, D.P.: Intramuscular sedation in dentistry. *Compend Cont Ed Dent*, 12:628-637, September 1991.
- Crasilneck, H.B. and Hall, J.A.: *Clinical Hypnosis*. Orlando: Grune & Stratton Inc., 1985, pp 8,9.
- Werbel, E.W.: Use of hypnosis in certain surgical problems. *Am J Clin Hypnosis*, 7:81-83, July 1964.
- Spiegle, H.: An eye-roll sign for hypnotizability. Paper presented at the meeting of the society for clinical and experimental hypnosis. Philadelphia, 1970.
- Wheeler, L.; Reis, H.T.; Wolff, E.: Eye-roll and hypnotic susceptibility. *Int J Clin Exp Hypnosis*, 22:327-334, October 1974.
- Wallace, B.: *Applied Hypnosis*. 2nd Edition. Chicago: Nelson-Hall, 1981, Chapter 2.
- Tinkler, S.: The use of hypnosis in dental surgery. In Hartland J (ed). *Medical and Dental Hypnosis and its Clinical Applications*. 2nd Edition. Baltimore: Williams & Wilkins Co., 1975, p 371.
- Ketamine Hydrochloride, *Physicians' Desk Reference*, Des Moines, Iowa, 1992, p 1726.

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#### AESTHETIC CONCERNS ABOUT FLUOROSIS

Increasing prevalence of dental fluorosis for children both from fluoridated and non-fluoridated communities is now well documented. Along with recent studies purporting possible adverse health effects from fluorides, this proven public health intervention is again being challenged. This study was undertaken to determine the prevalence of dental fluorosis for children from fluoridated and non-fluoridated areas in British Columbia. In addition, children and parents were provided with an opportunity to express concerns about the aesthetics of the child's anterior teeth. Children from representative schools in two communities were surveyed using the Tooth Surface Index of Fluorosis (TSIF). Questionnaires were sent home to parents to detail their child's use of various fluoride preventive practices and residence histories. Completed questionnaires were returned and exams were performed on 1131 children. Of those examined, 60 percent had dental fluorosis on at least two tooth surfaces, only 8 percent had scores ranging from "2" to "6", and 52 percent were classified with a score of "1". Parental and child ratings on the aesthetics or color of the child's teeth suggests that there are few children with aesthetic problems in the TSIF category of "1". While concerns of parents were more common, the actual source of those concerns was not assessed in the questionnaire. Not unexpectedly, children with fluorosis on anterior teeth ranging between TSIF scores of "2" to "6" appear to have increased concerns about tooth color. Data from children with confirmed residence histories from fluoridated communities suggest that the occurrence of aesthetic problems in these children is rare.

Clark, D.C. *et al.*: Aesthetic concerns of children and parents in relation to different classifications of the Tooth Surface Index of Fluorosis. *Community Dent Oral Epidemiol*, 21: 360-364. December 1993.

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## PRACTICE

# Practice characteristics of dual trained pediatric dentistry and orthodontic specialists

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In 1947 Lamons observed that pediatric dentistry and orthodontics in a combination practice may provide services that are equal in quality to that expected when these specialties are practiced separately.<sup>1</sup> He stated further that the combination of the two specialties may offer services with certain advantages to the patient as well as to the practitioner. Dr. Lamons was not the first or last to propose this combination of specialties. Dr. G. Millberry, Dean of the University of California School of Dentistry had proposed this combination of specialties in 1930, and Ackerman proposed this concept again in 1975.<sup>2</sup>

No published studies could be found describing dual specialists, but studies have examined orthodontic services provided by pediatric dentists as well as general practitioners.<sup>3-5</sup> A survey by the American Association of Orthodontists stated 14 percent of the reported reduction in size of orthodontic practices was due to

general practitioners who had increased their orthodontic services.<sup>6</sup>

Kohn observed that pediatric dentistry and orthodontics are recognized as separate specialties; there is a closer didactic and clinical relationship in these two areas, however, than between any other specialty areas in dentistry and training in more than one specialty occurs frequently.<sup>7</sup> Pediatric dentists and orthodontists have varied scopes of interests within their respective specialties. Little is known about their practices and the integration of these two specialties. There have been no reports of dual specialists' practice activities.

The purpose of this study was to survey specialists with dual training in pediatric dentistry and orthodontics and report demographics, amount of time spent in different areas of clinical practice, and the amount of time dual trained specialists wish to spend in different areas.

### METHODS AND MATERIALS

A survey was mailed to 146 dentists who were trained in both orthodontics and pediatric dentistry. The dual trained specialists were identified by the American Academy of Pediatric Dentistry (AAPD) as having completed American Dental Association accredited programs in both orthodontics and pediatric dentistry or a combined orthodontic/pediatric dentistry program with board eligibility in each specialty. Alumni lists from the UCLA combined specialty program were utilized to supplement the AAPD list.

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The thirty question survey asked information about demographics, integration of services in practice, practice characteristics, treatment time in various practice activities, teaching, membership in professional societies, board certification, meeting attendance and reasons for seeking dual specialty status.

**RESULTS**

Questionnaires were sent to 146 dentists. The first mailing yielded ninety-nine completed surveys [67 percent response]. A second mailing was sent three weeks later to nonrespondents, which yielded a total of 115 for a response rate of 79 percent.

**DEMOGRAPHICS**

Seventy-five percent of the respondents graduated from dental school before 1979. The earliest dental school graduation date was 1939 and the most recent was 1987. Seventy-five percent of the dentists completed post-doctoral programs before 1981 in Pediatric Dentistry, and 1987 in orthodontics. Most respondents (82 percent) completed orthodontic programs after their pediatric dental training. Only three completed pediatric dentistry programs after their orthodontic programs. Eighteen respondents attended combined specialty programs and all others attended separate programs.

Practice locations are shown in Table 1. Only two respondents practice in communities with populations of less than 10,000.

**PRACTICE CHARACTERISTICS**

Seventy-nine percent of the respondents practice or teach full time and 21 percent practice or teach part time. Seventy-two percent of the respondents are in small practices of one or two dentists.

Survey participants were asked about the nature of their practices, i.e., the service base or the primary service delivered by the practice. Most responded with multiple answers, as many respondents were involved in more than one activity or practice. Most were involved in pediatric dentistry or orthodontic based practices. Forty-four percent were involved in teaching. Fifteen percent of respondents classified their practice in the "other" category and further explained: adult general dentistry, dean of a dental school, public relations executive, pediatric dentistry/orthodontic combined office, hospital-based dental office and children's hospital. Reported practice characteristics are displayed in Table 2.

Table 1 □ Demographic distribution of survey participants.

Practice Location	Percent
city > 1 million	16
suburban > 1 million	19
250,000 - < 1 million	19
50,000 - < 250,000	25
10,000 - < 50,000	18
city/suburb < 10,000	2

Table 2 □ Nature of practice.

Part-time dental school faculty	28%
Full time faculty with private practice	9
Full time dental faculty, no private practice	3
Military/public health service/indian health service	1
Clinic supported by a government agency	1
Health maintenance organization	0
Multi-specialty group	14
Family practice (generalist based)	5
Pediatric dentistry based practice	46
Orthodontics based practice	53
Other	15

Table 3 □ Percent time spent providing various procedures per week. All respondents vs practitioners who spend 50 percent or more of their time providing orthodontic procedures and those who spend 50 percent or more time providing pediatric dental procedures.

Percent patient care time	All	Orthodontics ≥50%	Pediatric dentistry ≥50%
Recall exam (Ped Dent)	12%	10%	21%
Preventive dental services	12	8	17
Restorative dental services	15	9	20
Pediatric dentistry tx plan discussion	3	3	6
Recall exam (Ortho)	6	8	10
Ortho tx plan/discussion/case present	9	12	4
Intercept/preventive/phase 1 ortho tx	15	18	7
Phase 2 ortho tx	29	31	14
Ped dent total:	41%	30%	64%
Ortho Total:	59%	69%	35%

One survey question asked about the integration of pediatric dentistry services and orthodontic services in the practices. Forty-eight percent of the respondents said that both specialties are fully integrated without separate times or days. Twenty-one percent of respondents treat pediatric and orthodontic patients in separate practices, 10.5 percent treat pediatric dental and orthodontic patients on separate days, and 4.2 percent utilize separate treatment times for pediatric patients.

Respondents were grouped by the percent of time spent in providing pediatric dentistry treatment versus orthodontic treatment (Table 3). This table lists the reported time spent providing various procedures per week. The orthodontic services that were questioned were orthodontic recalls, orthodontic treatment plan/discussion/case presentation, interceptive/preventive/



phase 1 orthodontic treatment, and phase 2 orthodontic treatment. The other four categories were pediatric dental procedures using general anesthesia; nitrous oxide and sedation were included under the "restorative procedures" category.

All respondents were compared to those who spend 50 percent or more of their time providing orthodontic procedures and those who spend 50 percent or more of their time providing pediatric dental procedures.

There were sixty-eight dentists who provide 50 percent or more time in providing orthodontic treatment. Of those predominantly in orthodontics, thirty practice 100 percent time in orthodontics. The average year of graduation from dental school for those predominantly in orthodontics group was 1973, with a range of 1945-87.

There were twenty-three who provide 50 percent or more time in pediatric dental treatment. Of those who practice predominantly in pediatric dentistry, three practice 100 percent pediatric dentistry. The average year of graduation of the 50 percent or more pediatric dentistry group was 1976, with a range of 1956-87.

Participants were also asked how they would like to adjust their treatment time, ten years from now. The respondents replied that they would like to adjust their patient treatment time to 20 percent pediatric dentistry, 73 percent orthodontics, 5 percent in other dental activities and 5 percent in practice related activities.

## TEACHING

Forty-four percent of the 115 respondents were members of a dental school faculty or taught in continuing education courses. Thirty-seven percent are faculty members, 11 percent full time and 26 percent part time. One of the full time and five of the part time faculty members had completed a combined pediatric dentistry/orthodontic program.

Of all respondents who teach as faculty members or in continuing education courses, 18 percent teach pediatric dentistry, 25 percent teach orthodontics, 53 percent teach both, and 4 percent of respondents taught subjects other than pediatric dentistry or orthodontics, i.e., operative dentistry, oral diagnosis or CE courses in unspecified areas.

Twenty-four percent of the respondents belong to a craniofacial team .

## PROFESSIONAL INVOLVEMENT

Forty-three percent of the respondents reported board certification in pediatric dentistry and 19 percent in

orthodontics. Six percent were certified in other groups such as Oral Medicine and Fellowship in the Royal College of Dentists of Canada.

Eighty-one percent of respondents are members of the American Academy of Pediatric Dentistry (AAPD), 50 percent are members of the American Society of Dentistry for Children (ASDC), 90 percent are members of the American Association of Orthodontists (AAO), and 27 percent belong to other professional dental organizations. The "other" professional organizations included the Academy of Dentistry for the Handicapped, International Association for Dental Research, Academy of General Dentistry, Angle Society, American Cleft Palate Association, American Association of Orthodontic Study Groups, Academy of Oral Medicine, British Society for the Study of Orthodontics, and various Canadian associations.

When questioned about regular attendance at professional meetings, most respondents (67 percent) attend AAO meetings regularly; 35 percent attend AAPD; 6 percent attend ASDC; and 15 percent regularly attend meetings of other professional dental organizations.

## INTENTIONS

The respondents were asked their reasons for seeking dual specialty status with choices provided that could be checked from a list. A space also was included for written answers. The choices and response rate are listed in Table 4. Most respondents checked more than one answer. When asked whether they would do it again, 89 percent of the respondents would seek dual training again.

Other reasons cited for seeking dual specialty status included:

- Need to bring specialty to a rural environment not able to support single specialty.
- Pediatric training was changing in a direction I didn't like or was trained to do.
- Opportunity for practice association in my competitive area would be better.
- You cannot be a top notched pediatric dentist without knowing orthodontics.
- Felt early treatment was more the trend.
- Tired of behavior management, like the mental challenge of orthodontics.
- Felt there was a greater likelihood of longevity practicing orthodontics than practicing pediatric dentistry.
- Specialize in "pediatric" orthodontics.
- Pediatric dentistry is too difficult to do every sin-

Table 4  What were intentions in seeking dual specialty status before training?

Meet demand for both ped dent and ortho	52%
Desire to provide more comprehensive services	71%
Faculty position enhancement	26%
Feel the trend in ped dent care requires dual specialty	42%
Increase patient population	23%
Financial considerations	32%
Other	27%

Table 5  Did dual specialty status fulfill intentions?

Patient demand for both ped dent and ortho	54%
Desire to provide more comprehensive services	77%
Faculty position enhancement	34%
Feel the trend in ped dent care requires dual specialty	38%
Increased patient population	32%
Financial considerations	43%

gle day for an entire career, orthodontics is much less stressful.

- Orthodontics is like "not working" when compared to pediatric dentistry.

Responses about whether or not these intentions were fulfilled after training was completed are shown in Table 5. Most of these answers were checked on a list with space for written responses.

Eighty-nine percent of respondents said they would complete training in both specialties, if they could do it again. Responses received for completing dual training included:

- My knowledge of orthodontics was greatly enhanced by my pediatric dental experience prior to orthodontic training.
- Better understanding of dental development and of consequences of orthodontic treatment. Patients were treated better.
- I feel I provide better care than the traditionally trained orthodontist.
- It's the only way to practice pediatric dentistry today.
- Makes me a better orthodontist.
- Flexibility in treating orthodontic cases at most appropriate time for patient. Good continual follow-up for pre-treatment as well as post-treatment cases.
- I love what I am doing and think dual training provides a vital link between the two specialties.
- It is challenging and varied. It is also a very stable practice in a competitive environment.
- Greater variety and ability to teach in both areas.
- I could offer better comprehensive orthodontic treatment than a pediatric dentist. I have better child psychology training than an orthodontist.

Some reasons respondents gave for not seeking dual specialization included:

- Dual specialization does not have enough time for both specialties.
- No, not worth it.

- No, I would only have sought orthodontic training.

Sixty-four percent of respondents felt there was a need for combined programs. When asked if they would have preferred attending a combined program, their responses were mixed. Reasons for preferring combined programs included:

- Because it would eliminate substantial repetition in the curriculum.
- More comprehensive understanding of relationships.
- Less time in training.
- Because I feel the two go hand in hand and it would have allowed for more natural understanding of the development of malocclusion.
- The individual programs I attended did nothing to integrate their training. Each dutifully gnawed or berated the other.
- It would have been more efficient and less costly.
- Ability to undertake more involved research project, as well as start and finish more orthodontic cases.

Reasons for not preferring to have attended a combined program included

- I need to really concentrate on each discipline; it is required to have separate programs.
- I think you learn more orthodontics when you concentrate on just orthodontics for two to three years, instead of having a little of both. There is too much to learn doing both at once.
- Dual programs produce a good orthodontist, not a good pediatric dentist.
- Pediatric component would be subordinated.
- Lack of cooperation between departments providing teaching, staff, and patients.
- One specialty would have suffered, better staff in each individual specialty.
- Too much inbreeding in training, not enough diverse exposure to multiple approaches.

The respondents were asked how they viewed the fu-

ture for dual specialization. The responses were divided and positive comments included:

- A must for teaching and an asset for those desiring to work with handicapped individuals.
- Future is bright.
- Favorable because of multi-specialty trend.
- Politics in school will not make it easy, but almost all practices now have both specialties, so it has happened anyway. Natural way to go/makes total sense/can't be stopped.
- From the pediatric perspective it is essential; but there are only a few pediatric dental programs that have enough political (academic) clout to coordinate a program with the orthodontic program or who have enough faculty with dual training.
- It is the future.

Negative comments on the future of dual specialists included:

- Politically it is difficult, I have found prejudice toward me by members of both specialties.
- Fewer trained due to increased training in residency.
- Very limited.
- It has generally failed; the outcome is that most practice orthodontics.
- Politically, it is impossible to attract outside referrals. The referring dentist does not want to lose patients.

## DISCUSSION

A response rate of 79 percent is considered a high response rate for a mail-in survey. Babbie suggested that often nonresponders are not interested in the subject matter or the survey appears too complex or long.<sup>8</sup> The questionnaire was five pages long with thirty questions that required brief write-in responses. This length could have been a possible reason for failure to respond.

## PRACTICE CHARACTERISTICS

The percentage of time spent in providing pediatric dental services is not surprising, when considering the intentions of respondents when asked why they sought dual training. This study found 32 percent of respondents sought dual training for financial considerations, while Gorczyca found 28.6 percent of surveyed pediatric dentists and general practitioners reported an increase in income as a reason for expanding orthodontic services.<sup>3</sup> Gorczyca's survey also found that 21.4 per-

cent of respondents reported orthodontic treatment was satisfying to perform, while only 16.7 percent felt that there was not enough traditional pediatric dental procedures as the reason for orthodontic expansion. General practitioners devoted 1.6 percent of their time to orthodontics, while pediatric dentists devoted 19.7 percent. Orthodontic services provided 1.1 percent of the income for general practitioners, and 21.4 percent of income in the pediatric dental practices.

In a similar study by Koroluk 74.2 percent of pediatric dentists and 29.9 percent of general practitioners felt there was an increase in demand for orthodontic services, while 52 percent of respondents in this study reported they sought dual specialty training to meet the demand for both pediatric dental and orthodontic services.<sup>4</sup>

When asked how they would like to practice ten years from the time the survey was answered, respondents reported they would decrease their pediatric dental treatment time from an average of 41 percent to 20 percent, with a corresponding increase in orthodontic activities.

When considering less altruistic reasons for pursuing dual specialty status, one could speculate that generally time spent in providing pediatric dental services is less remunerative than providing orthodontic services. Lamons alluded to these differences in remuneration when delivering orthodontic versus pediatric dentistry services.<sup>1</sup> Providing primary care can be viewed as more difficult and stressful than providing less-threatening orthodontic treatment to an older and more cooperative group of patients. Behavior methods used for treating pediatric patients (and parents) has changed and is continuing to change. These behavior techniques may change faster than practitioners may be able to change or wish to change. A few of the written responses from this survey support this by stating the stress and behavior was the major reason for providing fewer pediatric dental services. Dual specialty status can offer practitioners an opportunity to change the nature of their practices without abandoning the aspects of pediatric dentistry which they enjoy. Since most of the respondents completed their orthodontic training six years after their pediatric dental training, one might also speculate that the influence of middle-age conflicts or passages, commonly known as midlife crisis, entered the equation at some point during the decision process. Perhaps some of the respondents just wanted a change to encourage their interest in dentistry.

## TEACHING

Little described the primary reason for the combined program's inception at the University of Washington, Seattle, as a training program for educators. One of the goals of combined pediatric dentistry/orthodontic programs is to train future educators. While students may start a combined program with intentions of teaching, some apparently decide later to pursue other avenues. Only one graduate of the eighteen respondents in this survey who completed a combined program is a full time faculty member; 44 percent of all respondents, however, are full or part time faculty. While little is known of other specialties and combinations of specialties in dentistry and medicine, 44 percent is a representation in dental education that may be unmatched by any other group.

## PROFESSIONAL INVOLVEMENT

More respondents (43 percent) were Diplomates of the American Board of Pediatric Dentistry versus 19 percent with board certification in orthodontics. While 90 percent of respondents in this study belong to the American Association of Orthodontists (AAO), many are denied full membership status. If they practice pediatric dentistry at all, they must join as an "Associate" and are unable to hold office or vote. This is not true for the American Academy of Pediatric Dentistry, which accords full membership rights to dual specialists. While more dual trained specialists may attend AAO meetings for continuing education, they will be unlikely to participate in any leadership capacity in orthodontics. This may be unfortunate due to the need for better communication between pediatric dentistry and orthodontics and the potential dual trained specialists have to provide this communication.

The data from this survey showed the average dual specialist devotes about 41 percent of treatment time to pediatric dentistry and 59 percent to orthodontics. In the study by Gorczyca, general practitioners spend 1.6 percent of their practice time with orthodontics and pediatric dentists spend 19.7 percent.<sup>3</sup>

Koroluk's study reported sixty four percent of pediatric dentists spent 25 percent or less time providing orthodontic services, and 60 percent of general practitioners spend 10 percent or less.

A study of pediatric dentists in North Carolina reported only 7.8 percent of treatment time devoted to orthodontic diagnosis/treatment.<sup>5</sup>

The last question regarding treatment time asked how they would like to adjust patient treatment time in ten years: the response was 20 percent pediatric dentistry and 73 percent orthodontics. Five percent would be used for other dental activities and 5 percent for other practice related activities. This desire to increase the orthodontic component of their practice may again reflect the more stressful activities involved in providing pediatric dental versus orthodontic services and the remunerative considerations mentioned previously.

## SUMMARY

Most respondents to this survey are providing both pediatric dental and orthodontic services to their patients. Almost half of the respondents reported that both specialties are fully integrated without separate times or days. Patient treatment time was reported as 41 percent pediatric dental services and 59 percent orthodontic services; when asked how they would like to adjust patient treatment time in ten years, however, the response was 20 percent pediatric dentistry and 73 percent orthodontics.

A high percentage of respondents (44 percent) were involved in teaching full or part time or in continuing education courses.

## REFERENCES

1. Lamons, F.F.: Pedodontics and orthodontics: a combination practice. *JADA*, 36:56-63, January 1948.
2. Ackerman, J.L.: The future of orthodontics in the specialty education and practice of dentistry for children. *J Dent Child*, 18:266-274, July-August 1975.
3. Gorczyca, A.M.; Jones, J.; Douglass, C.: Orthodontic treatment provided by general practitioners and pedodontists in Massachusetts. *J Clin Orthod*, 5:346-352, May 1989.
4. Koroluk, L.; Jones, J.; Avery, D.: Analysis of orthodontic treatment by pediatric dentists and general practitioners in Indiana. *J Dent Child*, 55:97-101, March-April 1988.
5. Dilley, G.J.; Rozier, R.G.; Machen, J.B.: Pedodontic manpower and productivity in North Carolina—a pilot project. *Pediatr Dent*, 4:115-118, June 1982.
6. American Association of Orthodontists: American Association of Orthodontists announces results of manpower survey. *Am J Orthod*, 63:67-71, January 1973.
7. Kohn, S.L.: Can pedodontics and orthodontics be combined in practice? *J Dent Child*, 35:241-251, May-June 1968.
8. Babbie, E.: *Survey Research Methods*. Belmont, California: Wadsworth Publishing Company, Inc., 1973.
9. Little, R.M.; Williams, B.J.; Fey, M.R.: An interdisciplinary teacher education program. *J Dent Educ*, 44:257-260, May 1980.

## CLINIC

# Radiographic assessments of class II resin composite inlays

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**T**he findings of radiographic assessments of directly applied Class II resin composite restorations were reported in a previous paper.<sup>1</sup> That evaluation was concerned with the cervical adaptation, radiolucent areas adjacent to the restoration, and the homogeneity of the restorative material. In terms of these characteristics, the restorations radiographically showed a less than 100 percent result. It is expected that some of the characteristics studied will show a different result in the case of indirectly applied resin composite inlays. With an indirect inlay it may be easier to achieve a good adaptation of the cervical margin of the restoration than it is in the clinical situation, since the inlay is produced on a cast. It may also be easier to fill the preparation on a cast than directly in the mouth, and this can improve the homogeneity of the material. A disadvantage of the indirect technique is the fact that the luting cement can easily run out during application of the inlay. Hence it may flow to places that are difficult to reach, such as cervically underneath the proximal section of

the restoration. If the cement is regarded as a part of the restoration, an excess of cement will influence the results of an evaluation of the cervical marginal adaptation. The radiopacity of this cement will be a factor affecting the evaluation of the radiographs.<sup>2</sup> If the cement is not radiopaque, or is only slightly radiopaque, this may be interpreted as a crevice between the restoration and the tooth.

This paper examines the influence of a number of factors on the radiographic appearance of indirect Class II resin composite inlays. Class II amalgam restorations are used as a reference for this purpose. The factors studied are:

- The type of restorative material.
- The type of restoration.
- The type of tooth.
- The dentist.

The results are compared with those for direct resin composite restorations.

## MATERIALS AND METHOD

Two hundred and forty Class II restorations were applied to fifty-eight patients (age 23 years (s.d. 5)) in this study. For each patient, one dentist out of a group of three made a series of three indirect resin composite

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inlays→ and one amalgam● restoration; two patients received a total of eight restorations. Each dentist thus produced twenty series, with the materials being allocated at random to the four teeth per patient that needed to be restored. The restorations were applied in accordance with a detailed protocol, which has been described previously.<sup>3</sup> The nonbevelled inlays and amalgam restorations were of a 'standard' conservative size, with the cervical outline of the box of the restorations located occlusally from the cementoenamel junction. A radiopaque glass ionomer lining cement★ was used as dentin replacement. The inlays were luted with dual cure cements†, while during placement the use of a matrix was omitted. The inlays were produced by one dental technician.

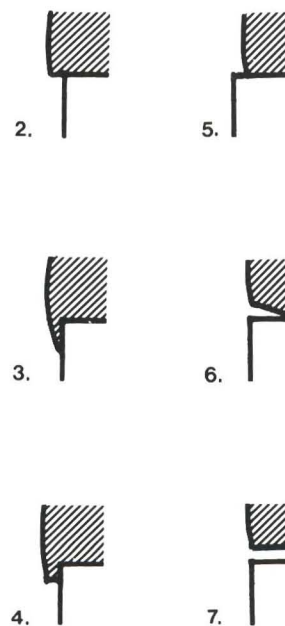
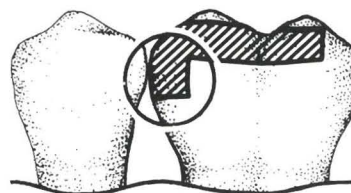
Between two weeks and twelve months (7 months (s.d. 3.5)) after the restorations were applied, two bite-wing radiographs- (one left and one right) were taken, using a standardized beam-aiming method (70 kV, 15 mA, exposure time 0.36 sec.).<sup>4</sup> The method of evaluation was identical to that used in the study mentioned earlier.<sup>1</sup> In summary, this involved the assessment of the cervical marginal adaptation in accordance with a classification of the marginal morphology (Figure 1). A 3-point scale was used to assess the presence of voids and air bubbles ('voids' for short), as an indication of the homogeneity of the material (Figure 1). The presence of radiolucent areas adjacent to the restorations was also assessed using a 3-point scale; and the adaptation to the vertical wall of the step in a two-surface restoration was assessed as being satisfactory or unsatisfactory. In the evaluations, a distinction was made between the mesial and the distal box, and the step of the restoration. A score of 8 was given where a characteristic could not be evaluated in the radiograph.

The bitewings were evaluated independently by two experienced dentists. Where there were differences between their evaluations, joint decision-making was used. In cases where agreement could not be reached, the most negative assessment was used. Calibration was carried out before the assessments were performed, and the degree of observer agreement was de-

Figure 1. Evaluation of radiographs: items and criteria.

1) Cervical marginal adaptation:

- 1 = The cervical marginal adaptation is good.
- 2 - 7 = The cervical marginal adaptation shows defects, as shown in the diagrams below, divided into resin composite and amalgam restorations.
- 8 = The cervical marginal adaptation cannot be evaluated.



2) Voids (as an indication of the homogeneity of the restorative material):

- 1 = No detectable voids.
- 2 = Uncertain whether voids are present.
- 3 = Detectable voids.
- 8 = Evaluation not possible.

3) Adaptation to the vertical wall of the step:

- 1 = The adaptation is good.
- 2 = The adaptation is poor.
- 8 = Evaluation not possible.

4) Radiolucencies adjacent to the restoration:

- 1 = No detectable radiolucencies.
- 2 = Uncertain whether radiolucencies are present.
- 3 = Detectable radiolucencies.
- 8 = Evaluation not possible.

→Herculite XR (Kerr)

Clearfil CR Inlay (Cavex Holland/Kuraray)

Visiomolar (ESPE)

●Tytin (Kerr)

★Fuji lining cement (GC)

†Porcelite Dual Cure (Herculite XR, Kerr)

CR Inlay Cement (Clearfil CR Inlay, Cavex Holland/Kuraray)

Tulux-Cem (Visiomolar, ESPE)

-Kodak Ektaspeed E, size 2 (Kodak-Pathé)

terminated in the previous paper (interobservers agreement, Kappa = 0.87 (range 0.77-1.0); intraobservers agreement, Kappa = 0.79 (range 0.31-1.0)).<sup>1</sup>

Frequency analyses were conducted on the data. Considering slightly skewed distributions of the independent variables 'type of tooth' and 'type of restoration', the influence of the variables on the results was determined, using logistic regression analyses (SPSS/PC). For convenience, collapsible tables are presented. A comparison between the characteristics observed for indirectly applied inlays in this study (Study 2) and those for the directly applied restorations in the previous study (Study 1) will be made, using logistic regression analyses. For this purpose the results for the two dentists who participated in both studies are used.

## RESULTS

### Frequency of deficiencies

Figure 2 gives the frequency distributions of the cervical marginal adaptation observed for resin composite inlays, and that found for amalgam restorations. For the inlays, the percentage of good adaptations ranges from 30.8 percent (mesial) to 22.1 percent (distal), while this percentage ranges between 67.4 percent and 54.5 percent for amalgam. Two sorts of defects in the cervical margin are relatively frequently found for composite resin, whereas they are virtually nonexistent for

amalgam: a crevice between the restoration and the tooth (score 7: 17.3 percent mesial and 20.1 percent distal), and an underextended margin (score 5: 10.6 percent mesial and 14.8 percent distal). Voids were occasionally found in the boxes of resin composite inlays (2.9-6.0 percent). Much more frequently, however, the evaluators were uncertain whether or not this deficiency was present: score 2, to 20.1 percent in the distal box (Figure 3).

Radiolucent areas adjacent to the restorations were definitely established in a few cases (Figure 4, score 3). Conversely, there were numerous cases of uncertainty when assessing the radiolucent areas, especially for the mesial (15.4 percent) and distal (13.4 percent) boxes of the inlays (score 2). Deficiencies in the adaptation to the vertical wall of the step in two-surface restorations were only found regularly for the inlays (20.6 percent).

As with the data reduction involved in the previous radiographic study (Study 1), a distinction is henceforth only made between the presence and absence of deficiencies (score 2 and score 1, respectively). The division of a restoration into a step and box(es) is discontinued; a characteristic showing a deficiency in at least one of these sections is regarded as being deficient for the whole restoration. Table 1 shows the result of reclassifying the data in this way. Significantly fewer defects in the cervical margin were found for amalgam restorations than for resin composite inlays

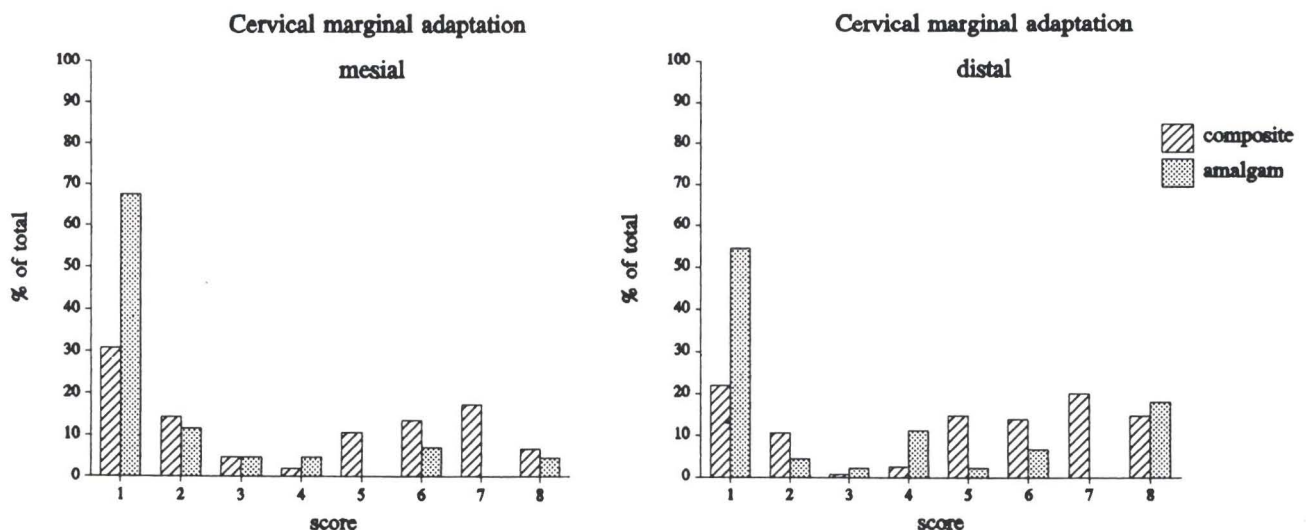


Figure 2. Frequency distributions of the mesial (left) and distal cervical marginal adaptation, in percentages: mesial: composite N = 104, amalgam N = 43; distal: composite N = 149, amalgam N = 44

(32 percent and 73.7 percent, respectively). The percentage of restorations with voids in the inlays was 30 percent. Radiolucent areas appear to be found more frequently with the resin composite restorations, although the difference between the inlays and the amalgam restorations is not significant.

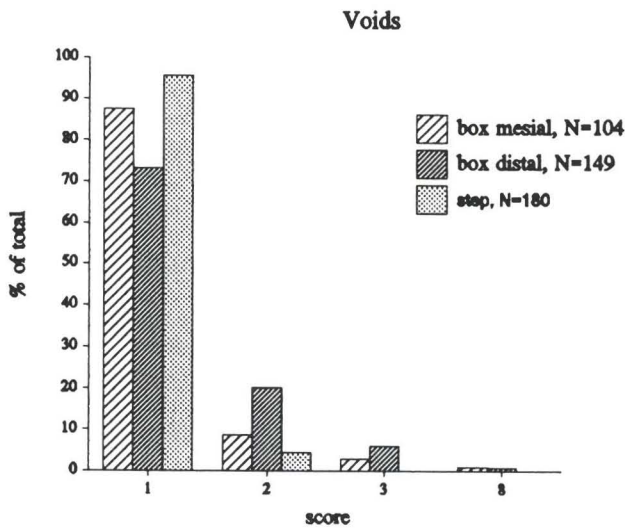


Figure 3. Frequency distribution of the voids observed, in percentages.

### Influence of the factors examined

The influence of different factors on the deficiencies found are shown in Table 2A for the resin composite inlays, and in Table 2B for the amalgam restorations. For the inlays, it appears that the dentist does not influence all of the characteristics examined. With amalgam, the restorations applied by Dentist 2 apparently show fewer deficiencies in the cervical marginal adaptation (11.8 percent) than those applied by Dentist

Table 1 □ Frequency distribution in which no distinction is made between box(es) and step of the restorations, in percentages.

	Restorative material	N	Score <sup>1)</sup>		p-value
			1	2	
Cervical marginal adaptation	Composite	152	26.3%	73.7%	<0.001
	Amalgam	50	68.0%	32.0%	
Voids	Composite	178	70.2%	29.8%	n.s. <sup>2)</sup>
	Amalgam	60	88.3%	11.7%	
Adaptation vertical wall step	Composite	100	78%	22%	
	Amalgam	32	100%	0%	

1) score 1 = no deficiency  
 score 2 = one or more deficiencies  
 2) n.s. = not significant

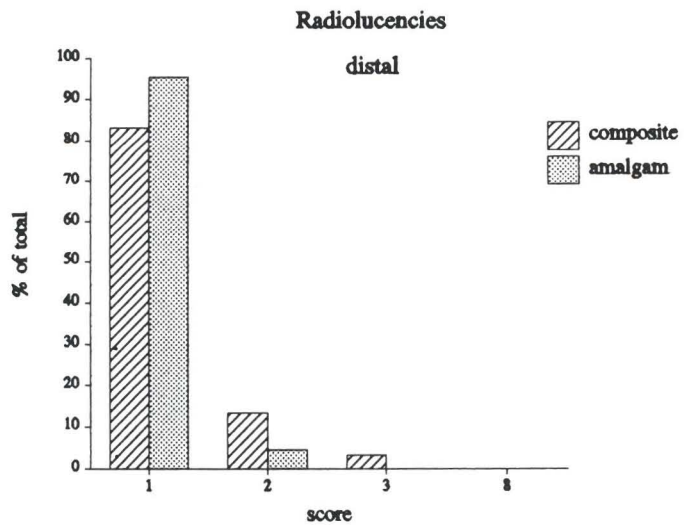
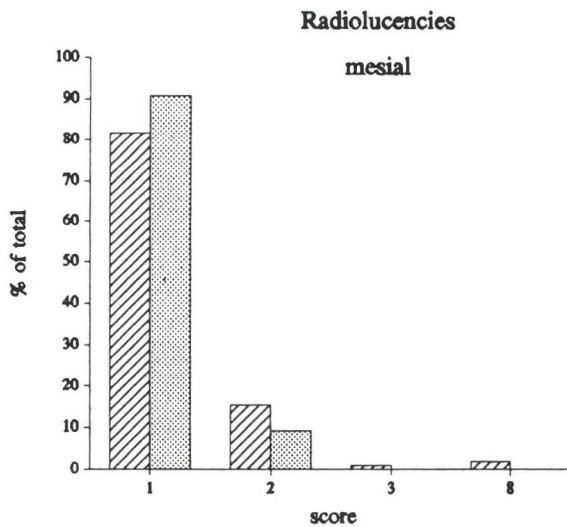


Figure 4. Frequency distributions of the radiolucencies observed adjacent to the mesial boxes (left) and distal boxes, in percentages:

mesial: composite N = 104, amalgam N = 43  
 distal: composite N = 149, amalgam N = 44.



3 (52.9 percent). Due to a skewed distribution of the variable type of restoration this difference is not significant. Three-surface restorations show significantly more defects in the cervical margin than two-surface restorations, both for resin composite and for amalgam. The type of resin composite material appears to have a significant influence on both the cervical marginal adaptation and on the adaptation to the vertical wall of the step. In both cases, Clearfil CR Inlay produces the largest number of deficiencies. In the case of adaptation to the vertical wall of the step in particular, this characteristic is virtually always satisfactory where Herculite XR and Visiomolar are used, whereas the restorations of Clearfil CR Inlay yield a 59 percent deficiency rate. Finally for both composite and amalgam, the type of tooth (premolar or molar) does not influence the results for any of the characteristics studied.

### Comparison between direct and indirect resin composite restorations

Table 3 shows the results produced by Dentists 1 and 3 in the study of the radiographic characteristics of directly applied resin composite restorations (Study 1). These findings are compared with the present results of the resin composite inlays (Study 2). There is a significant difference for the cervical marginal adaptation and for the adaptation to the vertical wall of the step. For both criteria, the inlay shows the largest number of deficiencies (72.7 percent and 21.2 percent, respectively, score 2).

### DISCUSSION

The amount of elapsed time between placing the res-

Table 2A □ Influence of the factors examined on the deficiencies found, resin composite restorations (\* n.s. = not significant).

		Dentist			Type of restoration		Type of composite resin			Type of tooth		
		N	1	2	3	Two-surface	Three-surface	Herculite XR	Clearfil CR	Visiomolar	Pre-molar	Molar
Cervical marginal adaptation	N	46	53	53	89	63	47	54	51	116	36	
	score 1	28.3%	24.5%	26.4%	37.1%	11.1%	42.6%	13%	25.5%	26.7%	25%	
	score 2	71.7%	75.5%	73.6%	62.9%	88.9%	57.4%	87%	74.5%	73.3%	75%	
	p-value	n.s.*			<0.001		<0.01			n.s.		
Voids	N	59	59	60	105	73	60	60	58	134	44	
	score 1	61%	79.7%	70%	67.6%	74%	71.7%	65%	74.1%	68.7%	75%	
	score 2	39%	20.3%	30%	32.4%	26%	28.3%	35%	25.9%	31.3%	25%	
	p-value	n.s.			n.s.		n.s.			n.s.		
Radiolucencies	N	58	60	60	106	72	60	59	59	134	44	
	score 1	72.4%	86.7%	73.3%	82.1%	70.8%	68.3%	86.4%	78%	76.1%	81.8%	
	score 2	27.6%	13.3%	26.7%	17.9%	29.2%	31.7%	13.6%	22%	23.9%	18.2%	
	p-value	n.s.			n.s.		n.s.			n.s.		
Adaptation vertical wall step	N	35	34	31	100		36	34	30	77	23	
	score 1	85.7%	76.5%	71%	78%		94.4%	41.2%	100%	76.6%	82.6%	
	score 2	14.3%	23.5%	29%	22%		5.6%	58.8%	0%	23.5%	17.4%	
	p-value	n.s.					<0.001			n.s.		

Table 2B □ Influence of the factors examined on the deficiencies found, amalgam restorations (\* n.s. = not significant).

		Dentist			Type of restoration		Type of tooth		
		N	1	2	3	Two-surface	Three-surface	Pre-molar	Molar
Cervical marginal adaptation	N	16	17	17	28	22	30	20	
	score 1	68.8%	88.2%	47.1%	82.1%	50%	60%	80%	
	score 2	31.2%	11.8%	52.9%	17.9%	50%	40%	20%	
	p-value	n.s.*			<0.05		n.s.		
Radiolucencies	N	20	20	20	33	27	34	26	
	score 1	90%	90%	85%	90.9%	85.2%	94.1%	80.8%	
	score 2	10%	10%	15%	9.1%	14.8%	5.9%	19.2%	
	p-value	n.s.			n.s.		n.s.		
Adaptation vertical wall step	N	7	17	8	32		17	15	
	score 1	100%	100%	100%	100%		100%	100%	
	score 2	0%	0%	0%	0%		0%	0%	
	p-value								

Table 3 □ Frequency distribution in which no distinction is made between box(es) and step of the restorations of the dentists selected: direct resin composite restorations and indirect inlays, in percentages.

	Restorative technique	N	Score <sup>1)</sup>		p-value
			1	2	
Cervical marginal adaptation	Direct (1)	105	82.9%	17.1%	<0.001
	Indirect (2)	99	27.3%	72.7%	
Voids	Direct (1)	114	52.6%	47.4%	<0.05
	Indirect (2)	119	65.5%	34.5%	
Radio-lucencies	Direct (1)	115	77.4%	22.6%	n.s. <sup>2)</sup>
	Indirect (2)	118	72.9%	27.1%	
Adaptation vertical wall step	Direct (1)	80	93.8%	6.2%	<0.05
	Indirect (2)	66	78.8%	21.2%	

1) score 1 = no deficiency  
 score 2 = one or more deficiencies  
 2) n.s. = not significant

torations and taking the radiographs varied quite widely. The independent variables investigated were distributed, however, more or less proportionally for both 'young' and 'old' restorations. The influence of these factors on the characteristics could, therefore, be determined. It was also expected that the length of the elapsed time should have almost no influence upon the frequencies of the deficiencies. Voids in the material will not change, and the cervical margins of the restorations are not directly exposed to forces and will thus hardly be affected. Because the fluoride releasing glass ionomer cement is used as a replacement for dentin, any carious tissue not completely removed is not

expected to spread during this period.<sup>5</sup> Since amalgam restorations were used as a reference in both Studies 1 and 2, it was possible to obtain an impression of the comparability of the studies by comparing these amalgam restorations radiographically.

From Study 1 it appeared that the results are affected by the dentist involved. Since the composition of the group of dentists was changed (Dentist 2 was replaced after the previous study was completed) it was decided to use only the restorations applied by Dentists 1 and 3 in comparing the two studies. Logistic regression analyses revealed no significant differences in the amalgam restorations applied by the two selected dentists between the two studies (data not shown). It may be assumed, therefore, that the results of the evaluation of direct and indirect resin composite restorations applied by these two dentists can be compared with each other.

The cervical marginal adaptation of resin composite inlays was assessed as significantly less favorable than that of the amalgam restorations (Table 1); but it was also less favorable than that of the direct resin composite restorations (Table 3). The influence of the type of resin composite (Table 2A) on the assessment is clear: the luting cement of Clearfil CR Inlay has a low degree of radiopacity and will thus cause what appears to be a crevice in radiographs (Figure 5).<sup>2</sup> If this composite material is excluded, however, the cervical marginal adaptation of the inlays is still rated less favorably than that of the direct restorations (logistic regression, data not shown). Apparently the approach of producing and polymerizing the restoration outside the patient's mouth,

The cervical marginal adaptation of resin composite inlays was assessed as significantly less favorable than that of the amalgam restorations and of the direct resin composite restorations.

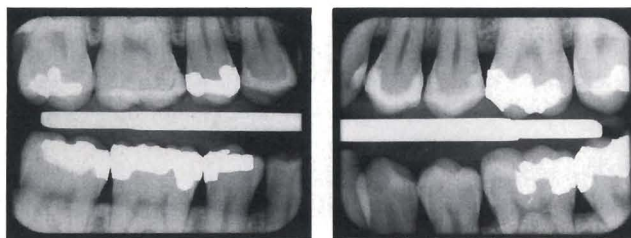


Figure 5. Two bitewings showing resin composite inlays (in teeth 16, 24, and 25). Notice the 'crevice' appearing between the restoration and the tooth, due to the radiolucency of the luting cement (tooth 16, Clearfil CR Inlay).

as well as omitting the preparation of bevels, does not contribute to the ease with which a good level of cervical adaptation can be achieved. This observation is also supported by the fact that no dentist-effect was observed for the cervical marginal adaptation. In addition, it was expected that the luting cement would be difficult to remove after polymerization. This could result in a cervical overhang that would most probably correspond with score 3 for deficiencies of the cervical margin. This did not appear clearly to be the case.

The limited radiopacity of Clearfil CR Inlay cement is certainly a factor that influences the evaluation of the adaptation to the vertical wall of the step. If the inlays made of this material are taken out of consideration for this characteristic, it is not likely that the difference between the inlays and amalgam, or direct resin composite restorations, remains.

The difference that was observed in the presence of radiolucent areas adjacent to direct resin composite restorations and adjacent to amalgam restorations was not found in the present study. Furthermore, there did not appear to be any difference between resin composite inlays in premolars and in molars when evaluating this characteristic. It is not clear why no correlation was shown with the previous study. Nor can an explanation be given for the difference in cervical marginal adaptation found between two- and three-surface amalgam restorations. Here, the interaction with the variable 'dentist' does not permit the detection of a cause-and-effect relation.

It was expected that there would be a smaller number of voids in the inlays than in the direct resin composite restorations. The processing by the dental technician was presumed to be favorable: the restorative material was applied to the cavity as a bulk, with the box and step being filled separately; obtaining voids, therefore, is not as likely as in the case of 'incremental' filling in the clinical situation. In this respect, the inlays showed a difference compared with the directly applied restorations, but it was not as marked as expected (Table 3). The method of production thus does not prevent the development of voids within the restoration. This finding is in accordance with the findings of Wilson et al, who suggest that air bubbles are already present in the resin composite material directly after production of the material.<sup>6</sup>

## CONCLUSIONS

- Radiographic deficiencies of the cervical margins of indirect Class II resin composite inlays frequently occur, more frequently than in comparable amalgam restorations.
- These deficiencies of the cervical margin of the inlays appear to be found more frequently in three-surface than in two-surface restorations.
- Voids in the restorative material do occur in indirect Class II resin composite restorations.

## REFERENCES

1. Kreulen, C.M.; Van Amerongen, W.E.; Akerboom, H.B.M. *et al*: Radiographic assessments of Class II resin composite restorations in a clinical study: Baseline results. *J Dent Child*, 59:97-107, March-April 1992.
2. Akerboom, H.B.M.; Kreulen, C.M.; Van Amerongen, W.E. *et al*: Radiopacity of posterior composite resins, composite resin luting cements and glassionomer lining cements. *J Prosthet Dent*, 70:351-355, October 1993.
3. Kreulen, C.M.; Van Amerongen, W.E.; Akerboom, H.B.M. *et al*: A clinical study on direct and indirect Class II posterior composite resin restorations: Design of the investigation. *J Dent Child*, 58:281-288, July-August 1991.
4. Van der Linden, L.W.J.: Periodontal bone lesions. Amsterdam: Vrije Universiteit, thesis, 1985.
5. Van de Voorde, A.; Gerdts, G.J.; Murchison, D.F.: Clinical uses of glass ionomer cement: a literature review. *Quint Int*, 19:53-61, January 1988.
6. Wilson, M.A. and Norman, R.D.: An investigation into the incidence of voids in indirect composite inlays formed using different packing techniques. *J Dent*, 19:296-300, October 1991.

# The dilemma of treating severely decayed first permanent molars in children: To restore or to extract

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**D**eeply decayed first permanent molars in a child present a major dilemma to the pediatric dentist and to the orthodontist.

If the selected treatment could result in restored teeth of good prognosis, it becomes the treatment of choice. On the other hand, when an irreversible pathologic condition makes the molars unrestorable, their extraction is necessitated.<sup>1-5</sup> These choices are clear and automatic.

The dilemma occurs when the teeth are restorable, but the achievable result will leave the teeth with a questionable prognosis. Lateral root canals may be inaccessible to root canal therapy, perhaps caries elimination has raised the specter of furca involvement, caries or cuspal fracture may have produced an infrabony defect, perhaps extensive loss of coronal tissue will leave little to support a preformed crown.

The extraction of a first permanent molar will often lead to uncontrolled tipping and rotation of the second molar in a mesial and lingual direction, a distal drifting

of the premolars with opening of the interproximal contacts and over-eruption of a surviving antagonist first molar.<sup>4,6-8</sup>

After the second World War, extraction of first molars had become a standard procedure in parts of Britain, offering a way of solving a widespread caries problem through "extraction for prevention".<sup>9,10</sup> Foster pointed out that "...the first permanent molar has been the subject of considerable debate and difference of opinion as to its value in the dental arch...it has been said that it is the keystone of the arch, and should never be removed. Alternatively, it has been advocated that the first permanent molars can be removed as a routine measure".<sup>11</sup> This statement does not appear to take into consideration, however, that by the high standards we see in orthodontics today, the results achieved in wartime Britain of 1944 would not be considered acceptable as a routine measure.<sup>3</sup>

In recent years the high rate of carious first molars markedly declined in many western countries, including Britain, although as late as in 1979 a British survey found that by age nine-and-a-half, these teeth were carious and by eleven years, 20 percent had decayed to the point of extraction. These are the most caries-prone teeth in the mouth, probably due to their exposure to the oral environment from an early age.<sup>4,7,12</sup>

The decline in caries that has occurred during the recent past, is attributed to the wide use of fluoride modalities and fissure sealants.<sup>13-16</sup> Despite this en-

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couraging trend, there are many countries where decayed first permanent molars are still prevalent, including immigrant communities in the U.S.<sup>17-20</sup>

A review of the pediatric dental literature that deals with decayed first permanent molars revealed little that relates to the extraction of severely decayed permanent molars and the orthodontic problems it generates.<sup>21, 22</sup>

In the form of a practical guide, Crabb and Rock offered a number of orthodontic considerations to be applied once the decision to extract was made.<sup>24</sup> The dentist requires, however, some guidelines in deciding the best treatment for the severely decayed molar, with extraction being just one possibility.

In order to consider the problem properly, the following information is necessary:

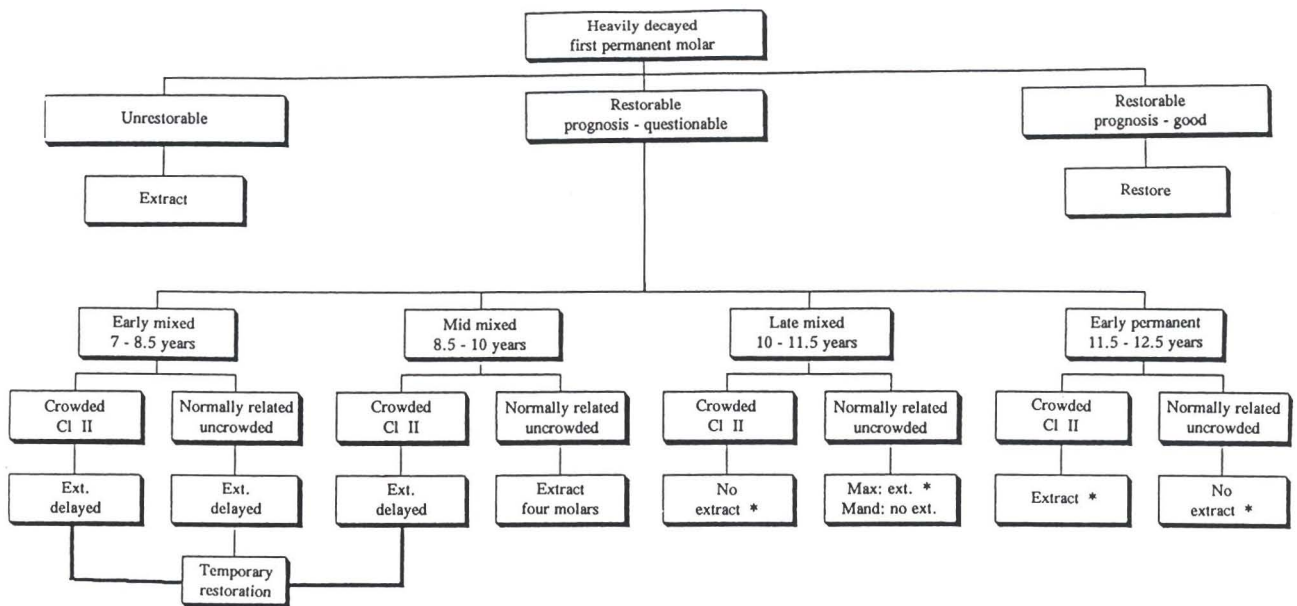
- The long-term prognosis of the restored tooth.
- The dental age of the patient.
- The type of malocclusion (Angle class 1,2 or 3).
- The degree of crowding present.

The purpose of the present article is to provide the practitioner with an overview of the problem, placing emphasis on the various factors that must influence the decision-making process whether to restore or to extract the severely decayed molar. A decision tree is offered to simplify the process.

### ASSESSING THE LONG-TERM PROGNOSIS OF A DECAYED MOLAR TOOTH

The level of execution of a simple restoration varies among practitioners; but, even assuming a mediocre standard of uncomplicated restorative work and given the relative facility with which a faulty restoration may be replaced, the risk factor is very low. Once pulp treatment, in any of its various forms and types (including indirect pulp capping, apexification pulpotomy, pulpectomy and root-canal treatment) is performed, however, the risk factor increases drastically.<sup>25,26</sup> For many of these procedures the success rate has never been determined in posttreatment surveys. Anyone working in the field will know, however, that the failure rate, although low, is significant. Even when figures are available, as in pulpotomy using Formocresol, studies have shown success rates that varied from 71 percent for primary teeth to 89 percent to 97 percent, presumably depending on the criteria for success.<sup>27-30</sup>

These procedures almost invariably require to be followed up with other procedures. Thus apexification is followed by root canal therapy, followed by the adaptation of a preformed crown and, some years later, by



\* Orthodontic cooperation essential

Figure. Heavily decayed first permanent molar. Decision tree for treatment planning.

post and crown construction. Each of these procedures is merely a link in a chain essential to the full restoration of the tooth, but inevitably each of which has its own additional risk factor.

An assessment of the outcome of each procedure performed on a molar, using informed guesswork only, would give apexification about an 80 percent chance of success. Root canal on a two- or three-rooted molar would have approximately a 90 percent success rate, 95 percent for the preformed crown, and 95 percent for the final post and crown restoration.<sup>31</sup> In order to demonstrate the total risk factor involved for a tooth requiring each of these treatments being fully and successfully executed, a mathematical exercise is needed. The total risk factor is calculated by multiplying each of the above percentage figures. In the example used above, this produces a figure of 65 percent for the single decayed tooth.

If the same treatment is required for two of the first permanent molars, by the same method of computation, the chance for full restoration drops to 42 percent, to 27.5 percent for three, while the prognosis for fully and adequately restoring all four molars in exactly the same manner, is only 18 percent.

Naturally, the above estimates are hypothetical and based on a fairly pessimistic prognostication of treatment outcome, but the logical extension of the reasoning to four identically-affected molars must surely encourage the practitioner facing this highly unlikely scenario to reconsider his treatment alternatives.

## ORTHODONTIC CONSIDERATIONS

The orthodontic aspect will now be considered in relation to three main variables, namely the patient's age, the classification of the malocclusion according to Angle, and the presence or absence of significant crowding.

In the ensuing discussion, the age of the patients refers to dental age, rather than chronological age. The use of the term class 2 relation, refers strictly to a dental relation and not a skeletal discrepancy.

Cases in which a skeletal discrepancy in the anteroposterior, vertical or lateral planes is present are excluded from the present debate, since simple answers are not usually available. These cases must be fully evaluated and studied on an individual basis by a competent orthodontist, who would subsequently take charge of the case.

## The early mixed dentition

Between the ages of seven to 8.5 years it is now very rare to see first molars that are in such a serious state that their immediate extraction is mandatory; but, when seen, it is frequently associated with enamel hypoplasia.<sup>32</sup>

At this stage of dental development, a radiograph of the neighboring area will show the presence of the second premolars relatively apical to the fully-formed apices of the primary second molars. These second premolars would normally be in the early stages of root development, but this is a very variable tooth and late development is common.<sup>33</sup>

## NORMALLY-RELATED UNCROWDED ARCHES

In the mandibular arch, extraction made at this time will be followed by early eruption of the second permanent molar, which will have moved superiorly, mesially and relatively bodily through the bone and into the dental arch, close to the second primary molar.

Over-eruption of the maxillary first molar is very likely to occur in the interval until the lower second molar reaches the occlusal level, which could take three or more years. It is also likely that interproximal spacing will appear between the primary molars and, later, the premolars.<sup>4,6</sup>

The greatest problem that may occur is, if the unerupted second premolar is apical to the roots of the second primary molar and unrestrained by them, this tooth may migrate distally and erupt early, distal to the second primary molar and into an upright position.<sup>34,35</sup>

This will then impede the mesial migration of the second molar and provide the operator with a serious dilemma as to what to do with the second primary molar. A variation of this scenario sees the second premolar with a strong distal tip blocked by the second molar.<sup>2,4,6,8</sup> The second premolar crown is in contact with the mesial aspect of the root of the second molar and the roots of the second primary molar are intact, without any signs of resorption.

This type of problem does not seem to occur in the maxillary arch, where an early eruption of the second permanent molar into the place vacated by the extracted first permanent molar seems to be the rule. Thus, extraction is to be recommended, provided the maxillary arch is uncrowded and there is a normal incisor overjet.<sup>6</sup> Third molars that might have otherwise

been impacted are usually freed to erupt into the gained space.<sup>5,7,10,36-38</sup>

In order to improve the chances of a good result in the mandibular arch, the decayed first permanent molar should be treated conservatively, with suitable pulpal procedures (including root canal therapy if needed) and crowning. This will allow the tooth to be retained into the time period when its extraction may offer a more hopeful outcome.

#### **CROWDED DENTITION OR CLASS 2 RELATION**

Extractions made at this time will lead, at best, to total loss of all available space. Thus, in order for preexisting crowding of the dental arches or a class 2 relationship to be treated, additional teeth would later require to be sacrificed to provide extra space. Accordingly, in these circumstances, extraction should be delayed and good provisional restoration be made so that the extraction of the first molars may be performed at a subsequent and more advantageous time (See mid-mixed and late mixed dentitions). At that time, orthodontic treatment will be required to align the teeth and to reduce an overjet, but good extraction timing will simplify this treatment.

#### **The mid-mixed dentition**

This refers to the stage at which the primary first molars are in their latter stages before shedding, between a third and a half of the second premolar root has developed, and these teeth are sited between the roots of the second primary molars. The unerupted second molars will have migrated in an occlusal direction. The patient's dental age is 8.5 to 9.5 years.

#### **NORMALLY-RELATED UNCROWDED ARCHES**

In a good class 1 situation, with a normal incisor relation and little or no crowding, this is a good time to extract all four first permanent molars, if their prognosis is poor, as Wilkinson recommended.<sup>9</sup> It is, however, important to confirm that the second premolars are not resorbing the distal root of the second primary molars only, since this, with or without the fairly commonly-found distal tip of the unerupted tooth, may still lead to the eruption of the tooth into the place of the first molar, without causing the shedding of its primary predecessor.<sup>9</sup> The extraction of a single molar is not advised, due to its adverse effect on the midline in either dental arch. Compensating extraction of the same

tooth is strongly advised on the opposite site of the same dental arch. If this has been performed in the maxillary arch, no balancing extractions need be made in the mandibular arch, given the speed with which the upper second molar will erupt.

Performed in the mandibular arch, balancing extraction of the opposing first molars has generally to be made in order to eliminate the potentially serious and debilitating effects on the maxillary arch.<sup>2,3,12,38,39</sup>

#### **CROWDED DENTITION OR CLASS 2 RELATION**

An increased overjet or crowding of the dentition in the maxilla will provide a class 2 molar relation, if the opposing dental arch alignment is good. Severely carious mandibular first molars should be extracted in consultation with the orthodontist, with the aim of achieving spontaneous mandibular improvement. The carious maxillary first molars should be temporarily restored, and the decision on extraction should be delayed until the late mixed or early permanent dentition, holding space in the maxillary arch with the restored tooth until the maxillary second molars have erupted. The residual space may then be utilized to disperse the crowding distally, as part of a comprehensive orthodontic treatment program.<sup>6</sup> At that time, an orthodontic appliance (a removable appliance may be very suitable) should be fitted, with the aim of holding back the second molars, while the first molars are extracted, and then retracting the premolars into the extraction space. Orthodontic treatment would then follow, to reduce overjet or eliminate crowding into the space vacated by the retracted premolars.

#### **The late mixed dentition**

This refers to the time between the dental ages of ten to 11.5 years, corresponding roughly with the stage when only primary second molars of both arches and the maxillary canines remain, but before the eruption of the second permanent molars.

#### **NORMALLY RELATED UNCROWDED ARCHES**

Extraction of maxillary first molars at this time will bring about rapid eruption of the second molars, which will move forward after their eruption to within close proximity of the second primary molars, although they may exhibit some tilting and rotation about their palatal roots. Nevertheless, their position will generally be fairly acceptable. Accordingly this is again to be advised when

there is little or no maxillary crowding and a good incisal relation. In this situation, no balancing extractions of teeth in the mandibular dentition are required.

In the mandibular arch, the extraction of mandibular first molars will bring about marked mesial tipping and some lingual rotation of the second molars, as they erupt.<sup>40</sup> In the majority of cases, only partial closure of the natural space will occur, leaving some residual space. As a result distal drifting of the premolars will be a more serious feature than before.

If no active orthodontic treatment is needed in the upper arch, at least a maxillary holding appliance will be necessary to prevent the over-eruption of the maxillary first molars that may occur during the elapsed time between the extraction of the mandibular first molar and the eruption and biomechanical alignment of the second molar.

#### CROWDED DENTITION AND CLASS 2 RELATION

When space is needed in the upper arch, restorative procedures are advised, in order to maintain space until the eruption of the second molars. The reasons for this have been described above.

#### The early permanent dentition

The final stage to be discussed is the permanent dentition, which becomes established with the recent eruption of the second molars and second premolars. The patient's dental age is 11.5 to 12.5 years.

#### NORMALLY-RELATED, UNCROWDED ARCHES

In the event that there is little or no crowding and the anteroposterior interarch relations are normal (Angle class 1), a single first permanent molar lost should not be followed by compensatory extraction and must be replaced prosthetically. Orthodontic treatment should be avoided. To bring a single mandibular second molar forward, bodily, will produce a severe dental midline discrepancy, with consequent difficulty in achieving good intercuspals relations.

Even with bilateral closure of mandibular molar space, if all the anterior teeth of the same jaw are used as a composite anchor unit, an increase in the overbite and overjet will occur, due to lingual movement of these anchor teeth (loss of anchorage). The inclusion of all the teeth of the maxillary arch as additional anchorage units, will often lead to a degree of flattening or dishing of the lips at the conclusion of treatment, since the intended bodily movement of second molars through

the dense cortical bone of the mandible is very demanding of anchorage.<sup>4,5,37,41</sup> Given the same normally-related and uncrowded dentition that we have described above, bilateral first molar loss in the maxilla only is more promising, since movement of maxillary second molars through the spongy bone of the maxilla is less demanding of anchorage. Single arch anchorage will usually suffice, with minimal or no adverse profile changes. The loss of all four molars represents a considerable orthodontic challenge, since the amount of closure of space exceeds the combined anchorage values of all the anterior teeth, which will be displaced lingually to the detriment of the facial profile.<sup>37</sup>

Thus, for this to be of value as a treatment option, only a prominent profile patient can be considered and he needs to be highly motivated both with oral hygiene and with the demands of the orthodontic treatment.

#### CROWDED DENTITION OR CLASS 2 RELATION

In this case extraction of a severely decayed first molar is preferred to restoring the tooth if subsequent orthodontic treatment will be provided. Maintaining the upright position of the second molar during the mechanotherapy entails long treatment, requiring considerable expertise.

In class 2 cases, extraction of severely decayed first molars may be considered. It may assist in closing the overjet and achieving adequate occlusal relations, especially during the controlled orthodontic closure of bilateral mandibular spaces. If the mandibular crowding is mild, the remaining mandibular teeth and the entire maxillary arch (when maxillary first permanent molars are not extracted) will be needed as anchorage units, against which the mandibular second molars will be brought forward and the class 2 relation and overjet reduced, if profile changes are to be avoided.

It may be that profile changes are desirable, however, and this may be effected as the mandibular second molars are being drawn mesially, to close the first molar spaces. Thus, for a greater class 2 reduction or where there is a bimaxillary protrusion tendency, the extraction of maxillary teeth will be of assistance in lessening the resistance of the upper dentition and, thereby effecting a desired reduction in facial profile procumbency.

#### DISCUSSION

Performed after all the permanent teeth have erupted, the loss of all four first molars will produce marked and usually adverse profile changes in all except the bi-



maxillary protrusion patients, the strong skeletal class 2 cases, and the severest of crowding cases. A first molar extraction, late in the child's dental development, gives the operator very little room for maneuver in offering orthodontic treatment as an alternative to prosthetic replacement.

It is evident, therefore, that in the early permanent dentition, every effort must be made to restore the first molar, accepting its poor prognosis. The patient must be informed of the risk attached to this line of treatment and he must be prepared for the subsequent prosthetic replacement that will later be necessary.

In the younger groups of children described earlier, those patients who attended for treatment of grossly carious first molar teeth and for whom extraction was planned at a later date, were discussed. In the meantime, the teeth will have been restored and the patient advised to return at the estimated appropriate time to extract these teeth. A proportion of these patients may not return until much later, when the teeth have actually become painful or some other precipitating factor has brought them to the office. At this time, usually in the fully-established permanent dentition, extraction has to be made.

With all the drawbacks and limitations described above, the treatment options are now heavily biased in favor of prosthetic replacement. Any heroic attempt at orthodontic space closure of a full permanent molar width (around 12 mm) on each side of the two dental arches will be exceptionally difficult to achieve from a technical point of view, requiring expertise of a high caliber and an extended time period. While this treatment may offer the opportunity for otherwise impacted third-molars to erupt into the arches, the patient's profile changes will be generally detrimental and the final health of his teeth may be compromised. Enamel decalcification, gingival inflammation and recession, root resorption and loss of vitality are the price that may be paid in the quest to avoid prosthetics.

At the time that Wilkinson put forward his guidelines for the extraction of carious first molar teeth, the orthodontics that was then being practiced in Britain was of a primitive nature.<sup>9</sup> Fixed appliances were largely unknown and simple tipping movements were achieved using Hawley-type removable appliances. Much depended on good extraction timing in the mixed dentition to allow unerupted teeth to drift into more acceptable positions. The final results of such treatment would not stand up to scrutiny today, neither in Britain nor elsewhere.

Nevertheless, the attitude and advice given to us by Wilkinson and the many others workers referred to in this paper who have followed his path over the past fifty years, are as relevant now as they were then and clearly indicate that careful thought given to timely extraction may often simplify and expedite eventual mechanotherapy.

## DECISION TREE

The decision tree is an example of the decision making process and the factors taken into account. One must remember that it is not a strict set of rules but rather a guideline flow chart and that the relative importance of many other factors may alter during the treatment.

## REFERENCES

1. White, T.C.: *Orthodontics for dental students*. London: Staples Press Ltd., 1954, pp 324-331.
2. Walther, D.P.: *Orthodontic notes*. 2nd ed., Bristol: John Wright and Sons Ltd., 1967, pp 80-89.
3. Moyers, R.E.: *Handbook of orthodontics*. 3rd Ed. Chicago: Yearbook Medical Publishers Inc., 1973, pp 353-354, 482-514.
4. Muir, J.D. and Reed, R.T.: *Tooth movements with removable appliances*. St. Louis: C.V. Mosby Co., 1979, pp 94-101.
5. Mills, J.R.E.: *Principles and practice of orthodontics*. Edinburgh: Churchill Livingstone, 1982, pp 91-97.
6. Beresford, J.S.: *Orthodontic diagnosis*. Bristol: John Wright and Sons Ltd. 1965, pp 66-73.
7. Tulley, W.J. and Campbell, A.C.: *A manual of practical orthodontics*. Bristol: John Wright and Sons Ltd., 1960, pp 64-77.
8. Spyropoulos, M.N.: Orientation and eruptive patterns of the mandibular second premolars. *Oral Surg*, 69: 642-646, May 1990.
9. Wilkinson, A.A.: The early extraction of the first permanent molar as the best method of preventing the dentition as a whole. *Dent Rec*, 64: 2-8, January 1944.
10. Finn, S.B.: *Clinical pedodontics*. 4th ed. Philadelphia: W.B. Saunders Co., 1973, pp 392-393.
11. Foster T.D.: *A Textbook of orthodontics*. 3rd ed. Oxford: Blackwell Scientific Publications, 1975, pp 217-221, 332.
12. McDonald, R.E. and Avery, D.R.: *Dentistry for the child and adolescent*. 5th ed. St. Louis: C.V. Mosby Co., 1988, pp 225-226, 753.
13. Brunn, C.; Lambrov D.; Larsen M.J. *et al*: Fluoride in mixed human saliva after different treatments and possible relation to topical fluoride caries inhibition. *Community Dent Oral Epidemiol*, 10:124-129, June 1982.
14. Hargreaves, J.A.; Thompson, G.W.; Wagg, B.J.: Changes in caries prevalence of Isle of Lewis children between 1971 and 1981. *Caries Res*, 17: 554-559, 1983.
15. Newbrun, E.: Effectiveness of water fluoridation. *J Pub Health Dent (Special Issue)*, 49: 279-289, 1989.
16. Weintraub, J.A.: The effectiveness of pit and fissure sealants. *J Pub Health Dent (Special Issue)*, 49: 317-330, 1989.
17. Laine, T. and Havsen, H.: Cross-sectional study of orthodontic treatment and missing permanent teeth in two birth cohorts of Finnish students according to sex. *Community Dent Oral Epidemiol*, 10: 209-213, August 1982.
18. Melsen, B. and Terp, S.: The influence of extractions caries cause on the development of malocclusion and need for orthodontic treatment. *Swed Dent J (Suppl)*, 15:163-169, 1982.

19. Gjeramo, P.; Beldi, M.I.; Bellini, H.T. *et al*: Study of tooth loss in an adolescent Brazilian population. *Community Dent Oral Epidemiol*, 11: 371-374, December 1983.
20. Renson, E.: Changing patterns of oral health and implications for oral health manpower. Report of FDI/WHO Joint Working Party, Group 5, *Int Dent J*, 35: 234-251, March 1985.
21. Wei, H.Y.: *Pediatric dentistry. Total patient care*. Philadelphia: Lea and Febiger, 1988.
22. Braham, R.L. and Morris, M.E.: *Textbook of pediatric dentistry*. Baltimore: Williams and Wilkins, 1980.
23. Pinkham, J.R.: *Pediatric dentistry. Infancy through adolescence*. Philadelphia: W.B. Saunders Co, 1988.
24. Crabb, J.J. and Rock, W.P.: Treatment planning in relation to the first permanent molar. *Br Dent J*, 131:396-401, November 1971.
25. Heithersay G.S.: Stimulation of root incompletely developed pulpless teeth. *Oral Surg*, 29:620-622.
26. Klein, S.H. and Levy, B.A.: Histologic evaluation of induced apical closure of human pulpless tooth. *Oral Surg*, 38:954-956, December 1974.
27. Trask, P.A.: Formocresol pulpotomy on (young) permanent teeth. *J Am Dent Assoc*, 85: 1316-1323, December 1972.
28. Doyle, W.A.: *A comparison of the formocresol pulpotomy technique with the calcium hydroxide technique*. MS Thesis, Indiana University School of Dentistry, Indianapolis, 1961.
29. Schroder, U.: Evaluation of healing following experimental pulpotomy of intact human teeth and capping with calcium hydroxide. *Odontol Revy*, 23: 329, 1972.
30. Emmerson, C.C.: Pulpal changes following formocresol applications on rat molars and human primary teeth. *J Calif Dent Assoc*, 27: 309, September 1959.
31. Weine F.S.: *Endodontic therapy*. 4th Ed., St. Louis: C.V. Mosby Co., 1989, p 8.
32. Shafer, W.G.; Hine, M.K. & Levy, B.M.: *A textbook of oral pathology*. 4th ed. Philadelphia: W.B. Saunders Co., 1983, p 51.
33. Garn, S.M. and Lewis, A.B.: Effect of agenesis on the crown size profile pattern. *J Dent Res*, 48: 1314, November-December 1969.
34. Harary, D. and Zilberman, Y.: Eruption of mandibular second premolar. Case Report. *J Pedod*, 7: 337-342, Summer 1983.
35. Sandler, P.J. and Springate, S.D.: Unerupted premolars—an alternative approach. *Brit J Orthod*, 18:315-321, November 1991.
36. Thilander, B. and Skagius, S.: Orthodontic sequelae of extraction of permanent first molars. A longitudinal study. *Trans Eur Orthod Soc*, 429-442, May 1970.
37. Williams, R. and Hosila, F.J.: The effect of different extraction sites upon incisor retraction. *Am J Orthod*, 68: 388-410, April 1967.
38. Zilberman, Y. and Becker, A.: Non-routine extractions in orthodontic treatment. *Israel J Dent Med*, 27:21-24, October 1978.
39. Holm, U.: Problems of compensative extractions in case with loss of first permanent molars. *Trans Eur Orthod Society*, May 1970, pp 409-428.
40. Stern N.; Revah, A. and Becker, A.: The tilted posterior tooth. Part I, Etiology, syndrome and prevention. *J Prosth Dent*, 46:404-407, October 1981.
41. Brandt, S. and Safirstein, G.R.: Different extractions for different malocclusions. *Am J Ortho*, 68: 15-41, July 1975.

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## DIAGNOSIS OF SMALL APPROXIMAL CARIES LESIONS

This study measured validity and reproducibility of unaided clinical diagnosis, fibre-optic transillumination (FOTI), and bite-wing radiology in the diagnosis of approximal caries. Sixty models were made using extracted premolars and molars, each containing four teeth with six contacting approximal surfaces. The teeth were examined first using unaided clinical examination and then using FOTI. Bite-wing radiographs were then taken of the teeth set in the models and examined. The three examinations were repeated after 1 week. Histological sections of the undecalcified teeth were prepared following their removal from the models, and those showing signs of caries were examined to give the valid state of disease in each surface. The diagnostic threshold was caries penetrating into dentine. The reproducibility of all three methods was acceptable with kappa values exceeding 0.6. All specificity values exceeded 0.95. Statistically significant differences were seen between sensitivities for clinical (0.38) and bite-wing (0.59) diagnosis and between clinical and FOTI (0.67) examination, but not between bite-wing and FOTI. It is concluded that the validity of FOTI is at least as high as that of bite-wing radiology, and both are superior to unaided clinical diagnosis.

Peers, A. *et al*: Validity and reproducibility of clinical examination, fibre-optic transillumination, and bite-wing radiology for the diagnosis of small approximal carious lesions: An in vitro study.

*Caries Res*, 27:307-311, July-August 1993.

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# Mechanical assessment of interocclusal clearance

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Many considerations are necessary to assure the clinical success of a removable appliance. One of them is the assessment of interocclusal clearance, when preparing teeth for either removable partial dental prostheses or removable pediatric/orthodontic appliances. Of special interest is the attention given to the occlusal embrasures as they interface with the traversing metal of a direct retainer, e.g. a cast circumferential or wire clasp arm (Figure 1).

The success of a removable orthodontic appliance is determined by its retention. Clasps are an important component for the retention and anchorage of any removable appliance.<sup>1,2</sup> One of the most difficult steps in fabricating a clasp is contouring the wire over the occlusal of the interproximal contacts. It is critically important, therefore, to adjust the wire as close to the occlusal surface of the teeth as possible, in order to maintain an occlusion free of interferences.<sup>2</sup> The wire should fit into the interproximal space to avoid occlusal trauma from the opposing tooth.<sup>3</sup> In primary and mixed dentition, the interproximal contouring of a wire for a clasp is not as difficult a task to achieve as in the permanent dentition.

Children in the mixed dentition stage of occlusal development generally have interproximal spaces in the posterior segments of the arches that easily accommodate wire clasps. When the permanent dentition is completed, however, it is more difficult to adjust a clasp interproximally.

Common areas of clasp breakage result from metal fatigue and/or wear at specific areas of excessive occlusal contact.<sup>4</sup> One of these areas is the buccal portion of the occlusal embrasure of mandibular posterior teeth. Another area is the lingual portion of the occlusal embrasure of the maxillary posterior teeth. These areas, when traversed by the metal of a removable partial denture prostheses retainer, or an orthodontic appliance, have a high incidence of occlusal stress. In an effort to reduce the incidence of fractured clasp arms at these areas, pass-throughs may be prepared either in enamel or in restorations.

Before the grinding of the enamel in the interproximal area, a clinical estimate of the amount of ameloplastia should be done.

When restorations serve as abutments for removable appliances, it is important that occlusal accommodation is provided for any cast or wrought wire elements that traverse the occlusal surfaces of the restorations. An accommodating pathway (pass-through) can be adequately measured by using an occlusal gauge. This concept receives attention in Removable Partial Prosthodontic Ped-Ortho teaching (Figure 2a).<sup>5</sup> Provisions for rest seats in enamel or amalgam restorations likewise are essential for avoiding occlusal interfer-

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ences.<sup>6</sup> The strength and contour of the restoration will be preserved, if the tooth preparation accommodates the pass-through (Figure 2b).

However well intended, unverified clinic judgment of adequate space is often less than justified by the

excessive occlusal contacts on a finished metal framework and on clasps for retainers. The assurance of adequate space as measured by an instrument is advantageous, therefore, for providing a successful pass-through in enamel or in a wax pattern.

The adequacy of intraocclusal space frequently is assessed only after a patient uses an appliance. Observation of a removable partial denture or a removable pediatric/orthodontic appliance that has been worn for some time may reveal the appearance of shiny facets on any metal within the functional occlusal contacting surface. These facets may appear inside the framework.<sup>7</sup> They indicate inadequate clearance for parts of the framework or wire elements pointing to the need for gauging the interocclusal clearance accurately, and can be seen on orthodontic appliance wires as well as cast clasps.

### MEASUREMENT OF OCCLUSAL CLEARANCE

The authors developed a convenient method that can be advantageously used intraorally or in the laboratory in a variety of applications. A wire gauge is made following the pattern shown in Figure 3. A two-inch piece of 18 gauge (.040") wire is used to verify adequate occlusal space for a direct retainer arm for a partial denture framework or a retainer clasp. Other wire gauges are used for other purposes. Freedom from premature contact is essential.<sup>8,9</sup> Any resistance to withdrawing the wire gauge indicates a lack of adequate occlusal clearance. This will predispose the framework or other appliance to failure by fracture.

Using this gauge technique in the laboratory allows for proper waxing of the pass-through on the articulated die. Several gauges with angles bent to conform to various cuspal forms can be easily made and con-

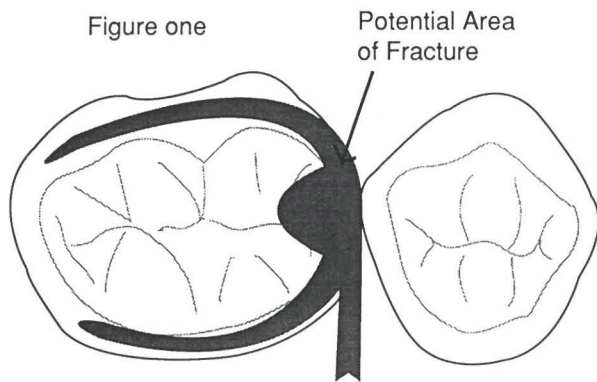


Figure 1.

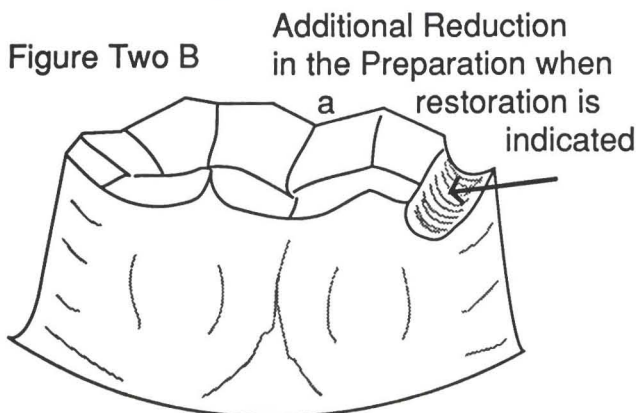
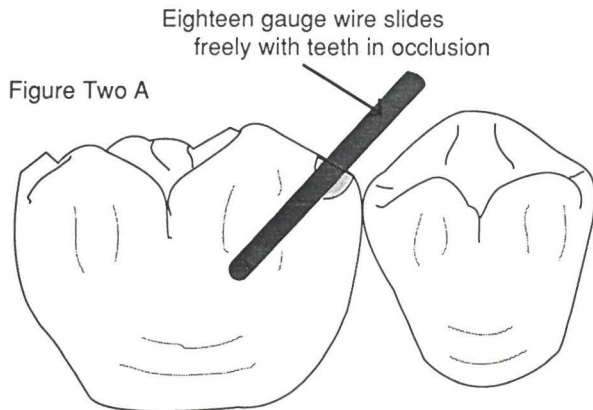


Figure 2a,b.

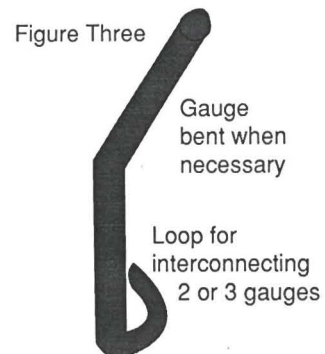


Figure 3.

nected together for convenient reference by bending loops on one end of each wire gauge. The loop ends can be utilized for attaching a length of dental floss for safety purposes. Regarding the safety of altering the occlusal enamel so as to provide adequate rest seats or pass-through for occlusal clearance, the necessary recontouring has been noted as safe providing the surface is smooth and treated with fluoride.<sup>10</sup> The loops should be inter-connected to avoid loss (Figure 3). Achieving some degree of standardization of clinical care in establishing occlusion is made easier by this method. Fracturing of direct retainer components is reduced by providing an adequate pass-through with these gauges.

Multiple uses of the gauges in a variety of other clinical instances is allowed by simple modifications of this technique. Occlusal clearance of full cast crown restorations, and clasp retainers for orthodontic and pedodontic appliances can be determined through the use of gauges made from different diameters of wire. Predictable occlusion after placement of dental appliances is available through the utilization of these easily made wire occlusion clearance gauges. For these cases, a careful, slight reduction of the embrasures may be indicated.

## SUMMARY

Appropriate design considerations for pediatric or adult appliances are a part of diagnosis as well as therapy.<sup>11</sup>

These include occlusal factors. The occlusal considerations warrant accurately accommodating the cast metal framework or wire elements of a removable appliance. A gauge measurement can be accomplished utilizing the device we describe.

## REFERENCES

1. Muir, J.D. and Reed, R.T.: *Tooth movement with removable appliances*: 1st Edition, St. Louis: The C. V. Mosby Co., 1979; pp. 52-53.
2. Greiger, A. and Hirschfeld, L.: *Minor tooth movement in general practice: 3rd Edition*, St. Louis: The C. V. Mosby Co., 1974, pp. 196-199.
3. Poffit, W.K.: *Contemporary Orthodontics: 2nd Edition*, St. Louis: The C. V. Mosby Co., 1993, pp. 336-338.
4. Henderson, D. and Steffel, V.: *McCraken's removable partial prosthodontics: 6th Edition*, St. Louis: The C.V. Mosby Co., 1981, pp 55, 413.
5. Tischler, P.: *Removable partial denture syllabus, tooth preparations*, April 1993; S.I.U.E. School of Dental Medicine.
6. Barco, M. P., Jr. and Flinton, R. J.: An overview of four removable partial denture clasps, *Intern J Prosthodont*, 1:159-163, 1988.
7. Frank, R. P.: Direct retainers for distal-extension removable partial dentures. *J Prost Dent*, 56:562-567, 1986.
8. Johnston, P.: Preparation of mouths for fixed and removable partial dentures. *J Prost Dent*, 11:456-462, 1961.
9. Kobayashi, Y. and Shiga, H.: The path of chewing movement before and after experimental occlusal interference. *Frontiers Med Biolog Engineer*, 3:193-198, 1991.
10. Chrystie, J.A.: Principles of clasps retention: a review. *Australian Dent J*, 33:96-100, 1988.
11. Berg, T., Jr.: I-Bar: myth and counter myth. *Dental Clinics North America*, 28:371-381, April 1984.

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## CONTROL OF CALCULUS FORMATION

The aim of this study was to re-investigate the anticalculus effects of calcium lactate. To this end calcium lactate was incorporated into experimental toothpastes. Three groups of 20 human volunteers brushed their teeth at least twice daily with three different toothpastes: (1) one containing calcium lactate, (2) one containing calcium lactate plus sodium lauryl sulphate, and (3) a control toothpaste. Plaque accumulation, gingival bleeding and calculus formation were scored at the beginning and at the end of the 3-month experimental period. After the first clinical examination the dentition was professionally cleaned to remove all dental deposits. The use of the calcium lactate containing toothpastes had no significant effects on plaque accumulation and gingival bleeding. However, calculus scores were significantly reduced in the calcium lactate groups at the end of the experiment. The results confirm and extend previous findings that the topical use of calcium lactate reduces calculus formation by, as yet, unexplained mechanisms.

Schaeken, M.J.M. and van der Hoeven, J.S.: Control of calculus formation by a dentifrice containing calcium lactate. *Caries Res*, 27:277-279, July-August 1993.

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# Peripheral odontoma: Report of case and review of literature

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**O**dontomas are by definition mixed tissue tumors of odontogenic origin. These common odontogenic lesions, which are considered to be hamartomas rather than neoplasms, result from growth of epithelial and mesenchymal cells, exhibiting complete histogenic differentiation into functional ameloblasts and odontoblasts. These cells produce enamel and dentin in an abnormal pattern, because the organization of the odontogenic cells fails to reach a normal state of morphodifferentiation.<sup>1</sup>

The World Health Organization distinguishes between two types of odontomas. The complex odontoma is defined as "a malformation in which all the dental tissues are represented, individual tissues being mainly well-formed but occurring in a more or less disorderly pattern." The compound odontoma is defined as "A malformation in which all the dental tissues are represented in a more orderly pattern than in the complex odontoma, so that the lesion consists of many tooth-like structures. Most of these structures do not resemble morphologically the teeth of normal dentition, but in each one enamel, dentine, cementum, and pulp are

arranged as in the normal tooth."<sup>2</sup> The distinction between the two types, however, is arbitrary. Generally when the specimen has the gross anatomical similarity to a normal tooth, it is considered to be a compound odontoma.

The etiology of odontomas is unknown, although local trauma, infection, and genetic factors have been suggested.<sup>2,3</sup> A review of several surveys regarding this lesion indicates that they may be discovered at any age, but are most commonly diagnosed during the second decade of life.<sup>4-8</sup> They occur with equal frequency in males and females. One survey reports an increased occurrence in blacks nearly double that of whites.<sup>6</sup> The most common location is the anterior maxilla, although there is no predilection for either the maxilla or the mandible. When the designation of compound versus complex odontoma is made, the former tend to occur in the anterior jaws and the latter in the posterior jaws.

Odontomas occur central in bone between the roots of teeth and the majority are asymptomatic. The most common clinical presentation is the association with impacted teeth or retained primary teeth (nearly 50 percent of reported cases).<sup>4-8</sup> Other less frequent signs and symptoms are pain, suppuration, expansion and displacement of teeth. They are most often diagnosed as a result of a radiographic survey, during which they appear as an irregular mass of calcified material surrounded by a narrow radiolucent band with a smooth outer periphery. Intraosseous odontomas may lie superficially in bone, facilitating their eruption into the

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The opinions expressed in this article, unless otherwise specifically indicated, are those of the authors. They do not purport to express the views of the Department of the Air Force or any other Department or Agency of the United States Government.

oral cavity.<sup>10,11</sup> There are reports of rare occurrences in the maxillary sinus, midpalate, and the middle ear.<sup>12-14</sup> Also reported in the literature are associations with impacted primary teeth, idiopathic formation following avulsion of immature permanent incisors, cysts, ameloblastic fibro-odontomas and a central calcifying and keratinizing cyst.<sup>15-17</sup>

The treatment for odontomas is surgical excision with osseous recontouring when required. Recurrences are highly unlikely. Submission for microscopic examination is recommended because radiographically, they bear resemblance to the ameloblastic odontoma and ameloblastic fibro-odontoma.

Extrasosseous, or peripheral odontomas are rare occurrences, especially when unerupted. This article reports on an unerupted, peripheral odontoma and its clinical presentation, radiographic appearance, histologic evaluation and treatment. Only two such cases, both by the same author, have been reported in the literature.<sup>19</sup> These cases are compared to the case in this report, which discusses common features and possible etiology.

#### CASE REPORT

A six-year-old black male reported to the Dental Service for routine dental examination and prophylaxis. At that time, a dome-shaped, gingival mass on the lingual aspect of the mandibular left second primary molar was noted (Figure 1). The swelling was pink, firm, nontender to palpation and approximately 2.5 cm x 1.5 cm in dimension. Surface ulceration was also present. Periodontal probing depths were within normal limits. The onset and duration of the swelling were unknown, no recent trauma to the area could be recalled and the family history was unremarkable. A periapical radiograph revealed no apparent pathology (Figure 2) and



*Figure 1. Preoperative clinical photograph of gingival mass on lingual aspect of mandibular left second primary molar.*



*Figure 2. Preoperative periapical radiograph of mandibular left second primary molar.*

**The treatment for odontomas is surgical excision with osseous recontouring when required.**

the patient was given an appointment for follow-up.

At the follow-up appointment, the gingival mass appeared unchanged and remained asymptomatic. Probing depths were also similar to the previous appointment. An occlusal and panoral radiograph were taken. No abnormalities were noted except for a congenitally missing mandibular left second permanent premolar (Figures 3 and 4).

The parents of the patient consented to an excisional biopsy of the lesion. The preoperative diagnosis was fibrous hyperplasia versus peripheral ossifying fibroma.

Nitrous oxide sedation was administered with 50 percent nitrous oxide and 50 percent oxygen. After an appropriate level of conscious sedation was achieved, an inferior alveolar block injection was made with 1.8 cc 2 percent lidocaine with 1:100,000 epinephrine. The gingival mass was excised with a number 15 blade, and upon further probing with a number 4 molt curette, a hard ovoid mass measuring 1.0 cm x 1.0 cm x 0.25 cm

was discovered and removed (Figure 5). Both specimens were placed in 10 percent neutral buffered formalin and submitted for microscopic evaluation with a postoperative diagnosis of peripheral ossifying fibroma. One week postoperatively, the area of recent surgery was healing well, and at six weeks healing appeared complete (Figure 6).

### Microscopic Examination

Microscopic sections at multiple levels stained with hematoxylin and eosin revealed a decalcified specimen composed of enamel matrix, dentin, pulpal tissue and cementum (Figure 7). These structures are surrounded by a fibrous connective tissue capsule similar to the dental follicle that surrounds a normally developing tooth. Closer examination revealed an admixture of dental tissues to include enamel matrix, dentin exhibiting dentinal tubule formation, pulpal tissue bordered



Figure 3. Preoperative mandibular occlusal radiograph.

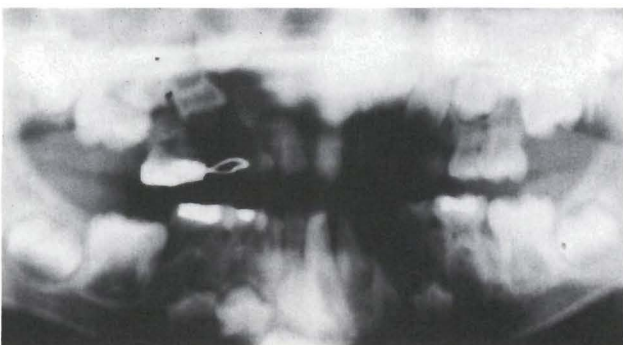


Figure 4. Preoperative panoral radiograph.

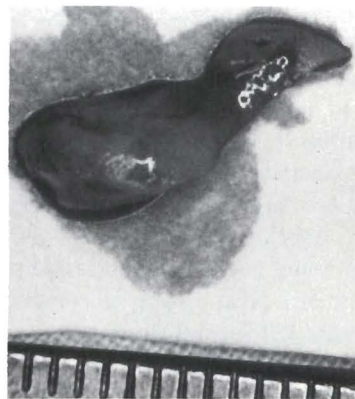


Figure 5. Gross specimen following surgical excision.

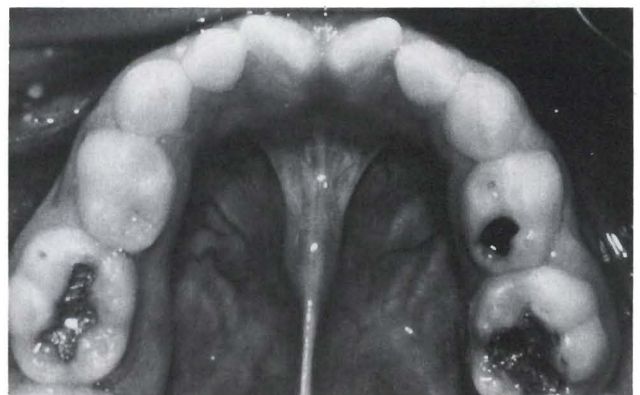


Figure 6. Six-week postoperative clinical photograph.



by odontoblasts, and cementum (Figures 8-10). The microscopic diagnosis was odontoma (compound), peripheral.

## DISCUSSION

Odontomas are most commonly located intraosseously and are generally asymptomatic. Their discovery is usually the result of a radiographic survey where their appearance is dependent upon the degree of calcification. In general the early stages of odontomas are radiolucent, intermediate stages are mixed radiolucent-radiopaque and mature odontomas are radiopaque, with similarities to teeth (compound odontomas) or vague, irregular opacities (complex odontomas)<sup>1,2,21</sup>

Peripheral odontogenic tumors possess the histological features of their intraosseous counterparts, but are located entirely in the soft tissue in the tooth-bearing areas of the jaws. These extraosseous tumors are quite rare and the reports in the literature of peripheral odontomas are limited to only a few cases.<sup>18,19</sup> The clinical presentation, intraoperative findings, and histological characteristics of this case support the diagnosis of peripheral odontoma of the compound type.

A developing odontoma may present difficulty in diagnosis on routine radiographic evaluation because of the lack of calcification. This was certainly the case here as well as in Case 1 of the two case reports by Giunta and Kaplan.<sup>19</sup> Another radiographic similarity was a congenitally missing succedaneous toothbud: a maxillary left second premolar in the aforementioned case and a mandibular left second premolar in this case. In

addition, both cases occurred during the first decade of life (age five vs age six). One significant difference, however, was the dramatic increase in size of the lesion reported by Giunta and Kaplan. The literature indicates that the majority of these tumors tend to be slow growing and this case was representative of that process.<sup>20</sup>

Another feature noted was the displacement of the mandibular left second primary molar toward the buccal aspect of the alveolar ridge. This can be appreciated from the occlusal radiograph (Figure 3) and from the clinical occlusal view (Figure 6). This suggests that a slow relentless force, such as that from a developing tumor, was able to displace a primary tooth in a lateral direction and that this force originated lingually to the tooth. Thus, the clinical presentation lends support to the peripheral origin of this compound odontoma and dismisses the possibility that the tumor was the succedaneous toothbud, since the permanent successor arises centrally in bone.

The etiology of the odontoma is not known. Several proposed hypotheses consider that they are either in-



Figure 7. Photomicrograph of excised specimen. This low-power view demonstrates a compound odontoma composed of dental tissues (Hematoxylin and eosin stain. Original magnification x20).

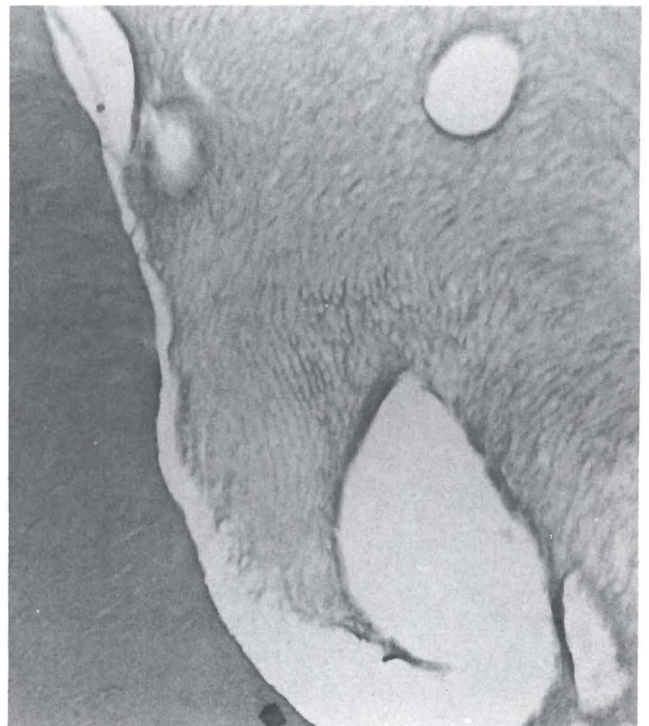


Figure 8. Higher magnification of Figure 7 demonstrates areas of enamel matrix and dentin exhibiting dentinal tubule formation (Hematoxylin and eosin stain. Original magnification x200).

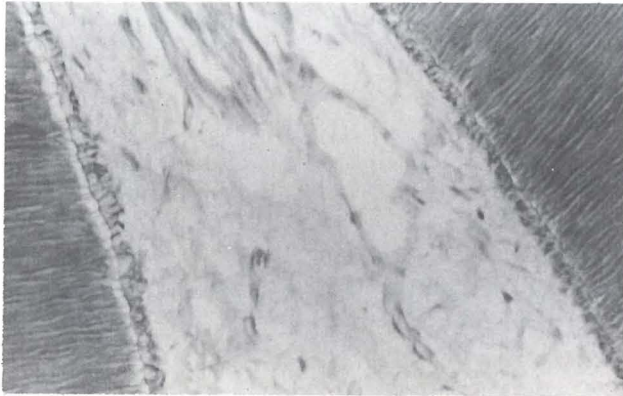


Figure 9. Higher magnification of Figure 7 exhibits dental pulp tissues with peripheral area composed of odontoblasts (Hematoxylin and eosin stain. Original magnification x200).



Figure 10. Additional areas demonstrating the formation of cementum (Hematoxylin and eosin stain. Original magnification x200).

herited, due to a mutation or that there is postnatal interference with the genetic control of tooth development.<sup>3</sup> Local trauma or infection have also been implicated, but there is insufficient evidence to support these hypotheses.<sup>16</sup> The fact that tooth formation occurs early in life and that odontomas have been discovered in bizarre, extraoral locations, indicates that the etiology is somehow related to an embryologic disturbance. Hitchin suggested that a mutation in the epithelial cells of the tooth germ may change the inherent capacity of odontogenic epithelium to go through the cap and bell stages necessary for tooth formation, and yet retain its ability to stimulate mesenchymal differentiation necessary to form functional ameloblasts and odontoblasts, leading to the formation of an odontoma.<sup>3</sup>

#### REFERENCES

1. Shafer, W.G.; Hine, M.K.; Levy, B.M.: A Textbook of Oral Pathology, ed 4. Philadelphia: W. B. Saunders Co., 1983, pp 309-310.
2. Pindborg, J.J.; Kramer, I.R.H.; Torloni, H.: *Histological Typing of Odontogenic Tumours, Jaw Cysts, and Allied Lesions*. ed 1. Geneva: World Health Organization, 1971, p 30.
3. Hitchin, A.D.: The aetiology of the calcified composite odontoma. *Br Dent J*, 130:475-482, December 1971.
4. Katz, R.W.: An analysis of compound and complex odontomas. *J Dent Child*, 56:445-449, November-December 1989.
5. Toretti, E.F., Miller, A.S.; Peezick, B.: Odontomas: an analysis of 167 cases. *J Pedod*, 8:282-284, Spring 1984.
6. Kaugars, G.E., Miller, M.E.; Abbey, L.M.: Odontomas. *Oral Surg Oral Med Oral Pathol*, 67:172-176, February 1989.
7. Brudnick, M.D.: Compound and complex odontomas. *Oral Surg Oral Med Oral Pathol*, 42:501-503, October 1976.
8. Slootweg, P.J.: An analysis of the interrelationship of the mixed odontogenic tumors - ameloblastic fibroma, ameloblastic fibro-odontoma, and the odontomas. *Oral Surg Oral Med Oral Pathol*, 51:266-276, March 1981.
9. Birnbaum, M.; Tyrangel, A.; Steinerman, S.M.: *Oral Surg Oral Med Oral Pathol*, 49:96, January 1980.
10. Serio, F.G. and Levy, B.A.: Erupted compound odontoma. Review and report of case. *Ann Dent*, 46:41-45, April 1987.
11. Swan, R.H.: Odontomas: A review, case presentation and periodontal considerations in treatment. *J Periodontol*, 58:856-860, December 1987.
12. Clayman, G.L. and Marentette, L.J.: Complex odontoma of the maxillary sinus with a complete dentition. *Otolaryngol Head Neck Surg*, 101:581-583, November 1989.
13. Hunsuck, E.E.: A midpalatal odontoma in an infant. *Oral Surg Oral Med Oral Pathol*, 29:353-355, March 1970.
14. Bellicci, R.J.; Zizmor, J.; Goodwin, R.E.: Odontoma of the middle ear. *Arch Otolaryngol*, 101:571-573, September 1975.
15. Brunetto, A.R. *et al.* Impaction of a primary maxillary canine by an odontoma: surgical and orthodontic management. *Pediatr Dent*, 13:301-302, September-October 1991.
16. Motokawa, W., Braham, R.L. Taniguchi, K.: Idiopathic odontoma formation following avulsion of immature permanent incisors: Two case reports. *J Dent Child*, 57:303-308, July-August, 1990.
17. Vuletin, M.D.; Solomon, M.P.; Pertschuk, D.O.: Peripheral odontogenic tumor with ghost cell keratinization. A histological, fluorescent microscopic, and ultrastructural study. *Oral Surg Oral Med Oral Pathol*, 45:406-415, March 1978.
18. Buchner, A. and Scuibba, J.J.: Peripheral epithelial odontogenic tumors: A review. *Oral Surg Oral Med Oral Pathol*, 63:688-697, June 1987.
19. Giunta, J.L. and Kaplan, M.A.: Peripheral, soft tissue odontomas. *Oral Surg Oral Med Oral Pathol*, 69:406-411, March 1990.
20. Acton, C.H.C. and Savage, N.W.: Odontomes and their behaviour: a review. *Aust Dent J*, 32:430-435, December 1987.
21. Wood, N.K. and Goaz, P.W.: *Differential Diagnosis of Oral Lesions*, ed 2. St Louis: The C. V. Mosby Co., 1980, pp 504-505.

# DEMOGRAPHICS

## And the children get poorer

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

I was not planning on writing another article on the number of children living in conditions of poverty in the United States. A previous report in the *Journal of Dentistry for Children* had summed up the reality that through the mid-1980s there “really are a lot of poor children in the United States.”<sup>1</sup> But as I was leafing through a 1993 publication by the Social Security Administration on the improving economics of the elderly during the past quarter of a century, I could not help but notice the occasional item that indicated that during the same period, the number and percent of children living below the poverty level was increasing (and this report did not include the years of the recessionary period during the early 1990s).<sup>2</sup>

Note: the federal poverty line provides a standard financial figure for the minimal subsistence of a family (the figure varies for families of different sizes) in a particular year and residential locale (i.e. urban vs rural). For example, in 1992, the poverty level for a family of two in the contiguous forty-eight states and the District of Columbia was \$9,190, \$14,343 for a family of four, \$23,470 for a family of eight.<sup>3</sup> In addition, families living just above this minimum standard are considered “near poor” (e.g. families living below 125 percent of the poverty level).

In the mid-1980s, in the *Journal of Dentistry for Children* I considered the question, “Are the unmet needs of children overshadowed by our concern for the

aged?”<sup>4</sup> It would seem to be appropriate as we enter the mid-1990s to once again consider this question, specifically in terms of the reality that “children are getting poorer.”

### MORE POOR CHILDREN AND FEWER POOR ELDERLY

Between 1967 and 1990, in all age-groups less than forty years, there was an increase in the percent of persons who were living below the poverty level. In all groups age fifty-five and over, there were decreases in the percent of persons who were living in poverty. While the percent of children living in poverty increased by 25 percent to 44 percent (for youngsters less than fifteen years of age), the percent of elderly living in poverty decreased between 47 percent to 61 percent (for the elderly in the various age-groups over 65 years) (Table 1).

During the past thirty years, except for the period between 1966 and 1973, a greater percent of children lived below the poverty level than did the sixty-five and over population. In addition, in every year since 1960, a greater percent of children lived in poverty than did the population between eighteen and sixty-four years (Table 2).

### POVERTY, RACE AND ETHNIC ORIGIN

While there have been small variations during the past twenty years in the percent of the population living below the poverty level, the total number of people

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living in poverty increased from 25.4 to 33.6 million (and from 35.6 to 44.8 million living below or near the poverty level).

During the same period, while the percent of the white population living in poverty remained at approximately 10 percent, the percent of blacks living in pov-

erty remained at approximately 31 percent. Between 25 percent and 29 percent of the Hispanic population lived in conditions of poverty (Table 3).

Between 1981 and 1990, there were decreases in percent of the black, white and Hispanic elderly populations living in poverty. There was an increase in the percent of poor white and poor Hispanic children, but essentially no change in the percent of black children living in poverty.

While the overall number of poor elderly remained almost constant, the number of white poor elderly decreased. During the same period, there were increases in numbers of white, black, and Hispanic children. Overall the number of poor children (< 16 years) increased by one million. In 1990,

- The number of white poor children (< 16 years) was 2.8 times the number of their elderly counterpart.
- The number of black poor children (< 16 years) was 4.6 times the number of their elderly counterpart.
- The number of Hispanic poor children (< 16 years) was thirteen times the number of their elderly counterpart.
- 16 percent of white, 45 percent of black, and 39 percent of Hispanic children lived in poverty, compared to 10 percent 34 percent and 22 percent, respectively, for their elderly counterparts (Table 4).

In summary, in the two decades before 1990, with very minor exceptions, there was a progressive increase in the number and percent of white, black and Hispanic children living in poverty (Table 5).

Table 1 □ Percent of persons in poverty by age: 1967, 1990.<sup>2</sup>

Age in years	1967	1990	Percent change 1967-1990
All ages	13.3	13.5	0.2
Under 65	11.8	13.7	16.1
65 +	27.9	12.2	-56.3
Under 5	16.6	24.0	44.5
5-9	15.5	21.3	37.4
10-14	15.0	18.7	24.7
15-19	13.8	16.4	18.8
20-24	10.5	15.8	50.5
25-29	8.0	12.8	60.5
30-34	8.9	11.4	28.1
35-39	8.2	9.1	10.9
40-44	8.0	7.7	-0.4
45-49	7.0	7.3	4.3
50-54	7.6	8.4	10.5
55-59	11.1	9.0	-18.9
60-64	15.4	10.3	-33.1
65-69	21.8	8.4	-61.5
70-74	25.8	11.3	-56.2
75-79	33.3	13.3	-60.1
80-84	37.7	17.5	-53.6
85+	38.0	20.2	-46.8

Table 2 □ Percent of persons below poverty level by age: 1960-1990.<sup>5</sup>

Year	Under 18	18-64	65+
1960	26.9	22.2	17.8
1961	25.6	21.9	17.4
1962	25.0	21.0	16.4
1963	23.1	19.5	15.3
1964	23.0	19.0	14.9
1965	21.0	17.3	13.3
1966	17.6	10.5	28.5
1967	16.6	10.0	29.5
1968	15.6	9.0	25.0
1969	14.0	8.7	25.3
1970	15.1	9.0	24.6
1971	15.3	9.3	21.6
1972	15.1	8.8	18.6
1973	14.4	8.3	16.3
1974	15.4	8.3	14.6
1975	17.1	9.2	15.3
1976	16.0	9.0	15.0
1977	16.2	8.8	14.1
1978	15.9	8.7	14.0
1979	16.4	8.9	15.2
1980	18.3	10.1	15.7
1981	20.0	11.1	15.3
1982	21.9	12.0	14.6
1983	22.3	12.4	13.8
1984	21.5	11.7	12.4
1985	20.7	11.3	12.6
1986	20.5	10.8	12.4
1987	20.3	10.6	12.5
1988	19.5	10.5	12.0
1989	19.6	10.2	11.4
1990	20.6	10.7	12.2

Table 3 □ Persons below the poverty level and below 125 percent of poverty level by race and Hispanic origin: selected years 1970-1990.<sup>5</sup>

Year	All races*	White	Black	Hispanic**	Below 125% of poverty level
Number (in millions)					
1970	25.4	17.5	7.5	na	35.6
1975	25.9	17.8	7.5	3.0	37.2
1980	29.3	19.7	8.6	3.5	40.7
1985	33.1	22.9	8.9	5.2	44.2
1990	33.6	22.3	9.8	6.0	44.8
Percent					
1970	12.6	9.9	33.5	na	17.6
1975	12.3	9.7	31.5	26.9	17.6
1980	13.0	10.2	32.5	25.7	18.1
1985	14.0	11.4	31.3	29.0	18.7
1990	13.5	10.7	31.9	28.1	18.0

\* Includes other races not shown separately

\*\* May be of any race

Table 4 □ Children and elderly below poverty level by race and Hispanic origin: 1981, 1990.<sup>6</sup>

Age in years	Year	Number below poverty level (in millions)				Percent below poverty level			
		All races*	White	Black	Hispanic	All races*	White	Black	Hispanic
Under 16	1981	11.2	7.0	3.8	1.7	20.5	15.7	45.8	36.3
	1990	12.3	7.6	4.2	2.6	21.1	16.3	45.6	39.2
65+	1981	3.8	3.0	.8	.1	15.3	13.1	39.0	25.7
	1990	3.7	2.7	.9	.2	12.2	10.1	33.8	22.5

\* Includes other races not shown separately

Table 5 □ Children below poverty level by race and Hispanic origin: selected years 1970-1990.<sup>6</sup>

Year	Number below poverty level (in millions)				Percent below poverty level			
	All races*	White	Black	Hispanic	All races*	White	Black	Hispanic
1970	10.2	6.1	3.9	na	14.9	10.5	41.5	na
1975	10.8	6.7	3.9	1.6	16.8	12.5	41.4	33.1
1980	11.1	6.8	3.9	1.7	17.9	13.4	42.1	33.0
1985	12.5	7.8	4.1	2.5	20.1	15.6	43.1	39.6
1990	12.7	7.7	4.4	2.8	19.9	15.1	44.2	39.7

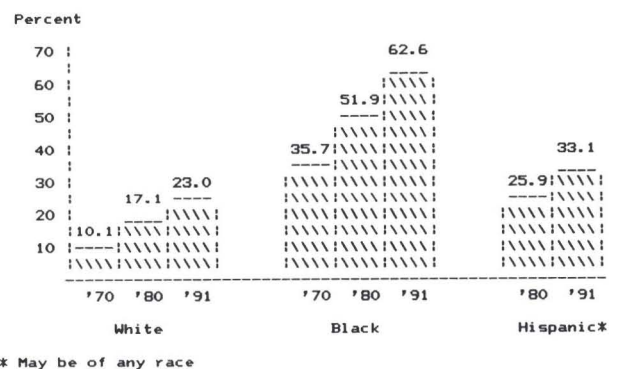
\* Includes other races not shown separately

## POVERTY AND THE FAMILY STRUCTURE

During the past twenty years, there have been dramatic increases in the number of single-parent families. Between 1970 and 1991, the percent of white single-parent families increased from 10 percent to 23 percent of all white families. Black single-parent families increased from almost 36 percent to almost 63 percent of all black families. Between 1980 and 1991, single-parent Hispanic families increased from 26 percent to 33 percent of all Hispanic families (Figure 1).

Note: the most dramatic increases have been in the percent of single-parent families maintained by mothers that were never married. Between 1970 and 1991, the percent of white families with children maintained by never-married women increased from less than 3 percent to almost 20 percent. During the same period, black families maintained by never-married mothers increased from 15 percent to 54 percent. Comparable increases in Hispanic families were from 21 percent to 29 percent.<sup>7\*</sup>

These marked increases in single-parent families must be considered in terms of the high rate of poverty in female led households. Between 1979 and 1990, there was an increase from 5.6 to 7.4 million children living in poverty in single female led families. In 1990, more than half (53 percent) of all the children living in single female led families were living in poverty (Table 6).



\* May be of any race

Figure. One parent families with children as a percent of all families by race and Hispanic origin: 1970, 1980, 1991.

## TRYING TO KEEP PACE WITH INFLATION

There were economic difficulties faced by families raising children during the 1980s. Median family incomes did not keep pace with the rates of inflation. Although current dollar family incomes increased between 1979 and 1990, in terms of constant dollars (i.e. removing the effects of inflation) with few exceptions, median incomes did not maintain parity with the rates of inflation. This decrease in purchasing power would be felt most profoundly in the already low income female

Table 6 □ Children in families below the poverty level by race of head of household and family status: selected years 1979-1990.<sup>6</sup>

	Number (in millions)		
	1979	1985	1990
Children under 18 in families with			
Male householder*			
White	5.9	7.8	7.7
Black	3.7	4.1	4.4
Female householder	5.6	6.7	7.4
Other families**	4.4	5.8	5.4
	Percent		
Children under 18 in families with			
Male householder			
White	11.4	15.6	15.1
Black	40.8	43.1	44.2
Female householder	48.6	53.6	53.4
Other families**	8.5	11.7	10.7

\* Includes families with both spouses present and families with male householder with no spouse present.

\*\* Includes races and members of unrelated subfamilies not listed separately.

Table 7 □ Median income of families with children by family type, race and Hispanic origin: selected years 1979-1990.<sup>6,9,10</sup>

	Current dollars			Constant dollars		
	(in thousands)			(in thousands)		
	1979	1985	1990	1979	1985	1990
CPI (1982-84 = 100)				72.6	107.6	130.7
All families						
White	\$21.1	\$28.9	\$36.5	\$29.1	\$26.8	\$27.9
Black	10.7	14.9	19.4	14.7	13.8	14.8
Hispanic	14.0	17.0	22.0	19.3	15.7	16.8
Female headed families						
White	\$ 9.1	\$11.3	\$14.9	\$12.4	\$10.5	\$11.4
Black	6.6	7.3	10.3	9.1	6.8	7.9
Hispanic	5.9	7.4	10.1	8.1	6.9	7.7

headed black and Hispanic single-parent families (Table 7).

### WHY WRITE ANOTHER ARTICLE ON PEDIATRIC POVERTY?

As this material is being prepared in the summer of 1993, the various political action committees are reminding the Administration and the Congress, "not to touch Social Security" and "improve health services for the elderly under any new system of health insurance" (particularly long-term care and pharmaceutical coverage). The fact that the older population "flocks to the polls on election day" and the threat that "we will not forget any missteps" are emphasized repeatedly. But, "(u)nfortunately, children can't vote!"<sup>4</sup> Never mind the fact that, "(m)ore than 26.2 percent of children living in cities with populations of 100,000 or more were impoverished in 1989."<sup>1</sup>

Maybe the next best thing is a continuing stream of articles that repeat, repeat and repeat the reality that the elderly are getting increased attention "and the children are getting poorer!"

### REFERENCES

1. Waldman, H.B.: There really are a lot of poor children in the United States. *J Dent Child*, 59:123-125, March-April 1992.

2. U.S. Department of Health and Human Services, Social Security Administration. *Studies in Income Distribution: An Assessment of the Economic Status of the Aged*. SSA Pub No. 13-11776 (16). Washington, D.C.: Government Printing Office, 1993.
3. Fisher, G.M.: Poverty guidelines for 1992. *Soc Sec Bul*, 55:43-50, Spring 1992.
4. Waldman, H.B.: Are the unmet needs of children overshadowed by our concern for the aged? *J Dent Child*, 53:267-270, July-August 1986.
5. U.S. Bureau of the Census, Current Population Reports: *Income, Poverty, and Wealth in the United States: A Chartbook*. Series P-60, No. 179. Washington, D.C.: Government Printing Office, 1992.
6. U.S. Department of Commerce. *Statistical Abstract of the United States, 1982-83; 1990; 1992*. Washington, D.C.: Government Printing Office, 1982; 1990; 1992.
7. U.S. Bureau of the Census, Current Population Reports: *Household and Family Characteristics*. Series P-20, No. 458. Washington, D.C.: Government Printing Office, 1992.
8. Waldman, H.B.: Single parent families. *J Dent Child*, 60:330-336, July-October 1993.
9. Select Committee on Children, Youth and Families. U.S. House of Representatives, One Hundred First Congress: *U.S. Children and Their Families: Current Conditions and Recent Trends, 1989*. Washington, D.C.: Government Printing Office, 1989.
10. Bureau of Economic and Behavior Research: *The Consumer Price Index and Dental Services*. Chicago: American Dental Association, 1992.
11. U.S. children poorer. *Newsday*, August 12, 1992, p 16.
12. Poverty in the U.S. *Newsweek*, October 18, 1993, p. 44.

### Addendum

#### Poverty levels in 1992<sup>12</sup>

Age	Percent in age group that is poor	Number of poor in age group
< 18 yrs	21.9%	14.6 million
18-64 yrs	11.7	18.3 million
65 + yrs	12.9	3.9 million

# Invisible children: The children of migrant farm workers

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

**E**dward R. Murrow's often rebroadcasted 1960 portrayal of migrant farm workers in the television program *Harvest of Shame*—images of hardworking, exploited and desperately needy people—has become the basis of our stereotyped images of the tragic world of the migrant farm worker. But if this "...documentary were to be replicated now, both the interviewers and the interviewed would most likely be speaking Spanish."<sup>1</sup>

During the first half of this century, there were two distinct groups of migrants engaged in farm work. The first was predominantly non-Hispanic white, U.S. citizens traveling with families to follow crops northward, primarily from homes or locations in the southern and western states. The second major group entered the migrant stream during the 1940s through a series of agreements between the governments of the United States and Mexico. These agreements marked the beginning of Mexico becoming the ongoing source of a majority of migrant farm laborers.<sup>1</sup>

While many thought that mechanization would decrease the need for farm workers, in actuality there was an expansion of the workforce needed to produce fruits and vegetables as fewer workers were needed to produce cotton and sugar beets. The most recent estimates are that fewer than 280,000 of the nation's two million crop-farmers actually follow the crops. But 40 percent of this group bring their families to the work-

site. As a result, there are almost six hundred thousand children of migrant workers in the United States at some time during the year. Most travel with their families to do agricultural work, but once here, most do not follow the crops.<sup>1</sup>

Information from the Migrant Clinicians Network Survey indicates that among migrant children, "...otitis media, upper respiratory infections, nutritional diseases, dental diseases, conjunctivitis, parasitic infections, and work-related injuries occur with a frequency much higher than in the U.S. national population.<sup>1</sup>

It is essential in caring for the children of migrant farm workers that health practitioners pay particular attention to the socioeconomic setting within which the youngsters are reared. Yet the reality is that many health providers have limited or virtually no experience (and very probably limited interest?) with the children of migrant laborers.

"...the need will be to transcend the few directions that many dental students learned in dealing with Spanish language patients, *Abre la boca, Cierra la boca, and Escupe.*"<sup>2</sup>

It is in an effort to "introduce" these "invisible" pediatric patients that the following presentation is directed.

## SOURCE OF DATA

The National Agricultural Workers Survey (NAWS) includes information on seasonal farmworkers who currently are employed in crop agriculture and who have travelled at least seventy-five miles in search of work.

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The NAWS does not count individuals employed in agriculture associated industries (e.g. processing and packing) and dairy or poultry farming.<sup>3</sup> Although overall national studies of the oral health of migrants and their children have not been carried out, the consistency of the results from the reports on studies of local conditions, as well as the Migrant Clinicians Network Survey, do provide a general picture of the oral health status of the "invisible children" in many of our rural communities.

In addition, since the vast majority of migrant laborers are of Hispanic origin, (particularly from Mexico) (see below) the general findings for Mexican-American children from the only recent national study that collected data on the oral health status of Hispanic children (the Hispanic Health and Nutrition Examination Survey conducted between 1982 and 1984 by the National Center for Health Statistics) will be used for comparative purposes.<sup>4</sup>

#### AGRICULTURAL MIGRANT WORKER DEMOGRAPHICS AND RELATED DATA

Consider first, the migrant farmworker. Estimates from the National Agriculture Worker Survey (NAWS) indicate that:

- There are three movements or streams of workers. One stream includes Texas and north to the central plains region. A second consists of California to the Northwest and western states. The third stream includes Florida and north along the east coast.

While there are changes in the patterns, there are general trends in these movements. Families from Puerto Rico frequently travel to the Northeast and mid-Atlantic states. Families from Mexico migrate to California and Texas. Families from Canada migrate to Maine.

- Forty-two percent of the approximately two million U.S. crop farm workers are migrants. (Note: not all migrants actually follow the crops. Some remain in particular locations for varying periods of time.) Of those, 60 percent are immigrants and 31 percent are parents accompanied by an average of approximately two children (or about 587,000 children) during 1990.
- Depending on region, between 71 and 82 percent are of Hispanic origin (94 percent of whom were born in Mexico). In the Southeast, Northwest, and Southwest regions of the country, minorities make up 90 percent of the workforce. For example, in 1980, less than 10 percent of the farm

workers in North Carolina were from Mexico. Ten years later, the state's peak workforce was mostly Mexican. This "Mexicanization" came in the wake of U.S. citizens finding better nonfarm jobs and the result of farm labor contractors and Mexican workers forming networks to fill these farm jobs.

- Some states are considered by a large percentage of migrant families to be their "home base" or place from which they start their migration and to which they return after they complete their seasonal work (e.g. California, Texas and Florida). Other states have large numbers of migrant families during the agricultural season (e.g. Minnesota and Wyoming).
- Sixty-five percent of migrants are less than thirty-five years of age.
- More than three-quarters are male.
- Sixty-four percent are married. Seventy percent are married and/or have children. Fifty-seven percent work with their families at the work site.
- Fifty-one percent have been in the U.S. longer than eight years.
- One out of five has no work authorization from the Immigration and Naturalization Service.
- Fifty-three percent have an eighth grade or less education. Most do not read or speak English.
- Most migrants (83 percent) "shuttle" between home bases abroad (usually Mexico or Central America) and U.S. farm sites. Only 33 percent follow the crops within the U.S.
- Fewer than half are covered by unemployment insurance.
- Fewer than a quarter have health insurance.
- They are paid by the hour with a median income of \$4.85 per hour. Fifty percent earn less than \$7,500 per year. The median annual income of authorized workers is between \$5,000 and \$7,500 and between \$2,500 and \$5,000 for nonauthorized workers. Fifty percent of families are below the poverty line. Eighteen percent received some type of government operated social service program assistance in the past two years (e.g. food stamps [16 percent], and Aid to Families with Dependent Children [3 percent]).<sup>1,2</sup>

#### CHILDREN OF MIGRANT LABORERS

"...in the fields it is normal for children to be working at a very young age. Most migrant families are large and cannot survive on a single income ... I was 10 years old when I first started working ... With 14 people in



the same house it is very difficult to make ends meet.”<sup>1</sup>

Consider next, the children of migrant agricultural workers.

- Forty-eight percent moved at least once during the past year.
- Eighty-four to 94 percent qualify for free or reduced cost school lunches.
- More than one-third are one or more grades behind their age-appropriate grade level.
- Lack of fluency in English interferes with the classroom work of approximately 40 percent of the students.
- Over 40 percent are estimated to be achieving below the 35th percentile in reading.
- Some have little to no exposure to formal education.

In all states, to greater or less degree children of migrants laborers are enrolled, however, in educational programs, ranging from fifty-four in New Hampshire and seventy-one in West Virginia to almost 34 thousand in Florida, more than 60 thousand in Texas, and almost 80 thousand in California.

### DENTAL HEALTH AND CARE OF THE CHILDREN OF MIGRANT FARM WORKERS

During the past twenty years a series of studies have documented the oral health of the children of migrant workers in particular communities and sections of states. The reports from these studies (which include references to similar findings from earlier periods) indicate that:

- “...it is evident that the migrant (black) child was almost completely lacking in dental care except for possible treatment of an emergency nature.” (1971)<sup>5</sup>
- “The unmet dental caries need of (the children of Mexican-American migrant workers) ... remained constant at 75 percent for all age groups (3-13 years).” (1981)<sup>6</sup>
- “Given the high percentage of decayed teeth, low level of restorative care, and the indications of oral hygiene neglect, it appears that the dental health needs of this highly mobile population are not being met adequately and should receive greater attention.” (1984)<sup>7</sup>
- “...the prevalence of (dental) disease for this population (children of migrant farm workers) continues to exceed the national and regional average.” (1987)<sup>8</sup>

- “The literature documents a significant decline in the prevalence of dental caries among children. Unfortunately, dental decay rates of children of migrant workers remain high.” (1990)<sup>9</sup>

The results from the national study of Mexican-American and other Hispanic children are comparable to the findings from local studies of the children of migrant laborers.

“Mexican-American children from families with low annual income have about two times more decayed teeth than children from high-income families ... (the) data also show a high percentage of Mexican American children have mild gingivitis.” (1987)<sup>4</sup>

While the DMF rates of Mexican-American and “white” children were comparable, the decay component for Mexican-American children was almost triple the rate for “white” children.<sup>2</sup>

“But limitation in access to health care by Hispanics is not confined to dental services. As with dental services, the ability of Hispanics to obtain general medical care is hampered by relatively low incomes, lack of health insurance coverage and ties to a particular health provider.” (1986)<sup>10</sup>

In addition, the particular difficulties in care for the children of migrants (especially those with disabilities) is related to the general perception of the potential action of government agencies. “There is the aspect of fear that government is going to take away the child.”<sup>1</sup> Thus many disabled children are not identified.

### FROM THE PRACTITIONER'S PERSPECTIVE

“The success of the community (pediatric migrant) projects ... (resulted from) the dedication and enthusiasm of the (dental) students who do not receive credit for their efforts. In the words of one of them, they do it because *it needs to be done*.” (emphasis added)<sup>11</sup>

Outsiders who are unable or unwilling to put down roots in our communities, different cultures and languages, and limited finances—do we need any more reasons not to be concerned with these children? Individual practitioners cannot be expected to shoulder the burden of providing dental (and medical) care to scores, hundreds, or more children that pass through their communities. Nevertheless, these are children in need of health services and as long as we continue to employ migrant farm workers, collectively we inherit an obligation to provide the care for their families. This is the message that must be communicated to our legislators as they consider the national programs for health insurance. Surely with the availability of financial sup-

port, "the outsider with no roots in our communities, and with different cultures and languages" would readily be accepted in an individual dental practice.

#### REFERENCES

1. Invisible Children: A Portrait of Migrant Education in the United States. A final report of the National Commission on Migrant Education. Washington, D.C.: Government Printing Office, 1992. (Note: In addition to the specific survey, the authors quote extensively from scores of additional reports. In an effort to simplify this presentation, only the overall report is referenced. Interested readers are directed to this report for an extensive bibliography.)
2. Waldman, H.B.: Hispanic children: an increasing reality in pediatric dental practice. *J Dent Child*, 59:221-224, May-June 1992.
3. Department of Labor, Office of Program Economics. Mines, R.; Gabbard, S.; Boccalandro, B.: Findings from the National Agricultural Workers Survey (NAWS) 1990: A demographic and employment profile of perishable crop farm workers. Washington, D.C.: Government Printing Office, 1991.
4. Ismail, A.L.; Burt, B.A.; Brunelle, J.A.: Prevalence of dental caries and periodontal disease in Mexican-American children 5 to 17 years: results from Southwestern HHANES, 1982-83. *Amer J Pub Health*, 77:967-970, August 1987.
5. Bachand, R.G.; Gangarosa, L.P.; Bragassa, C.: A study of dental needs, DMF, def, and tooth eruption in migrant Negro children. *J Dent Child*, 38:35-39, November-December 1971.
6. DiAngelis, A.J.; Katz, R.V.; Jensen, M.E. *et al*: Dental needs in children of Mexican-American migrant workers. *J School Health*, 51:395-399, August 1981.
7. Woolfolk, M.; Hamard, M.; Bagramian, R.A. *et al*: Oral health of children of migrant farm workers in Northwest Michigan. *J Pub Health Dent*, 44:101-105, Summer 1984.
8. Call, R.L.; Entwistle, B.; Swanson, T.: Dental care in permanent teeth in children of migrant farm workers. *Amer J Public Health*, 77:1002-1003, August 1987.
9. Koday, M.; Rosenstein, D.I.; Lopez, G.M.N.: Dental decay rates among children of migrant farm workers in Yakima, WA. *Pub Health Rep*, 105:530-533, September-October 1990.
10. Andersen, R.M.; Giachello, A.L.; Aday, L.A.: Access of Hispanics to health care and cuts in services: a state-of-the-art overview. *Pub Health Rep*, 101:238-252, May-June 1986.
11. Sharma, P.S.: "Because it needs to be done." *J Amer Dent Assoc*, 84:506-508, March 1972.

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#### PREVENTING TOBACCO USE AMONG YOUNG PEOPLE

This year's surgeon general's report on smoking and health is the first such report to focus on young people. From extensive data that indicate that tobacco use is a pediatric epidemic, the report reached six major conclusions: (1) Nearly all first use of tobacco occurs by age 18. (2) Most adolescent smokers are addicted to nicotine. (3) Tobacco is often the first drug used by young people who subsequently use illegal drugs. (4) There are identified psychosocial risk factors for the onset of tobacco use. (5) Cigarette advertising also appears to increase young people's risk of smoking. (6) Communitywide efforts have successfully reduced adolescent use of tobacco. This commentary restates each of the six conclusions, summarizes the data that support each, and then considers the implications of the conclusions for public health action.

Elders, M.J. *et al*: The report of the surgeon general: Preventing tobacco use among young people.

*Am J Public Health*, 84:543-547, April 1994.

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## ABSTRACTS

**Hartgraves, Phillip M. and Primosch, Robert E.: An evaluation of oral and nasal midazolam for pediatric dental sedation. *J Dent Child*, 61:175-181, May-June 1994.**

Midazolam is a new short-acting benzodiazepine which is more potent than diazepam. Reports on its use in young pediatric dental patients is lacking in the literature. The purpose of this study was to evaluate the sedative qualities of midazolam via the oral and nasal routes in 100 recalcitrant pediatric dental patients between 1.5 and 6 years of age. One half of the patients received oral midazolam at a dose of 0.5 mg/kg administered with 25 mg hydroxyzine pamoate suspension as a vehicle. The other half received nasal midazolam at a dose of 0.2 mg/kg. Nitrous oxide-oxygen inhalation and local anesthesia were used in all cases. The results indicated that a satisfactory level of sedation was achieved in approximately two thirds of the cases. Complications were rare, and not of clinical significance. There was no significant difference in the frequency of success or complications reported between the oral and nasal routes. The results of the present study support the need for future investigations to determine optimal pediatric dosages and regimens for each route.

**Midazolam; Nasal application; Oral application with hydroxyzine pamoate; Nitrous oxide; Local anesthesia.**

**Lu, Dominic P.: The use of hypnosis for smooth sedation induction and reduction of postoperative violent emergencies from anesthesia in pediatric dental patients. *J Dent Child*, 61:182-185, May-June 1994.**

Hypnosis combined with chemical sedation is uncommonly utilized by physicians, however, the combination of hypnosis and sedation can be an effective modality in the management of un-

cooperative pedodontic patients. In order to examine the efficacy of this combination technique, we selected 13 pedodontic patients for Ketamine sedation combined with hypnosis. The patients ranged from four to 11 years of age, and all had previous histories of violent emotional reactions before and after dental treatment. We found the combination technique to be extremely effective in successfully overcoming the stressful and frightening aspects of dental care for these pedodontic patients.

**Hypnosis for children; Reduction of post-anesthesia emergencies.**

**Hayakawa, Seth and Jedrychowski, Joseph R.: Practice characteristics of dual trained pediatric dentistry and orthodontic specialists. *J Dent Child*, 61:186-191, May-June 1994.**

This study was designed to describe the practice characteristics and professional activities of dentists who have completed approved training programs in both pediatric dentistry and orthodontics. A survey was mailed to 146 dual trained specialists identified by the American Academy of Pediatric Dentistry with 79 percent compliance. The survey asked for demographic data, amount of time providing various procedures, integration of services in the practice; also information regarding intentions in seeking dual specialty status, board certification, and organization membership.

Of those who completed separate specialty programs, 75 percent completed their pediatric dentistry training before 1981 and completed their orthodontic training before 1987. Forty-four percent of respondents were full- or part-time faculty members or taught continuing education courses. The reported percentage of time spent treating orthodontic patients was 59 percent and 41 percent pediatric dental patients. When asked how they would like to

adjust their patient treatment time ten years from now, the median response was 73 percent orthodontics and 20 percent pediatric dentistry.

**Education, dental postdoctoral; Education, dental, graduate; Practice characteristics; Dental specialty training**

**Kreulen, C.M.; van Amerongen, W.E.; Borgmeijer, P.J. et al: Radiographic assessments of class II resin composite inlays. *J Dent Child*, 61:192-198, May-June 1994.**

Radiographic evaluations of indirect Class II resin composite inlays, shortly following their placement are presented. One hundred and eighty restorations of 'standard' conservative size were recorded using a beam-aiming device. Four radiographic characteristics were assessed of which the most important were: cervical marginal adaptation, voids in the material, and radiolucencies adjacent to the restoration. In comparison with amalgam restorations influencing factors are studied, and differences with direct resin composite restorations of a previous study are discussed.

The inlays showed more deficiencies in cervical marginal adaptation than the amalgams (74 percent and 32 percent, respectively). Radiolucencies adjacent to the restorations and voids in the resin material were observed. The marginal adaptation appeared to show less deficiencies with two-surface than with three-surface restorations. Regarding the resin restorative materials, the limited radiolucency of one of the luting cements is discussed with respect to marginal adaptation. Comparison with direct restorations revealed a somewhat greater number of deficiencies in the cervical margins of indirect inlays.

**Radiographic assessment; Class II restorations; Resin composite inlays; Clinical trial**

**Zoeller, Gilbert N. and Martinez, Norman P.: Mechanical assessment of interocclusal clearance. J Dent Child, 61:206-208, May-June 1994.**

The clinical success of any dental removable appliance is mainly determined by its retention. Most of these appliances need clasps for retention. In the fabrication of a clasp, the contouring of the wire or metal over the occlusal area of the inter-proximal contacts is a difficult step to achieve. In order to simplify this procedure, the authors have designed a mechanical device to measure the interocclusal clearance needed.

**Interocclusal clearance; Measurement**

**Waldman, H. Barry: And the children get poorer. J Dent Child, 61:214-217, May-June 1994.**

A historical review is provided of the decreasing economic condition of children as compared to other age populations.

**Poor children**

**Waldman, H. Barry: Invisible children: The children of migrant workers. J Dent Child, 61:218-221, May-June 1994.**

A review is provided of the general demographics of migrant farm workers and their families, as well as the particular dental conditions of their children.

**Children, migrant workers**

**Rowland, D. and Salganicoff, A.: Commentary: Lessons from Medicaid improving access to office-based physician care for the low-income population. Am J Public Health, 84:550-552, April 1994.**

Medicaid offers important lessons about providing access to office-based physician services for the poor. First, differentials in physician fees between Medicaid and other payers compromise access to care and are difficult to

reverse. Second, managed care alone is not enough to attain equity in access, especially if differentials in payment rates between Medicaid and private patients in managed care settings are allowed to grow. Finally, financing strategies alone are not sufficient to resolve the shortage of health care providers in medically underserved areas. In these areas, payment policy must be combined with resource development to ensure that vulnerable populations have access to care.

**Medicaid; Physician fees; Access to health care**

**Brownbill, J.W.; Holmberg, M.; Fleming, P. et al: Ectopic eruption of transposed mandibular permanent lateral incisors beneath primary first molars. Case report. Australian Dent J, 39:11-14, February 1994.**

Mandibular permanent lateral incisors showing bilateral transposition and ectopic eruption were seen beneath primary first molars on bitewing radiographs in a female aged 9 years. This report chronicles management of the case during the mixed dentition period. Appropriate space maintenance after extraction of mandibular primary first molars, cuspids and lateral incisors on both sides facilitated eruption and repositioning of the permanent lateral incisors without the need to sever supracrestal gingival fibres.

**Case report; Ectopic; Incisor; Lateral; Mandibular; Transposition.**

**Inokuchi, T.: Mechanism of calcium deposition on the surface of amputated dental pulp in the deciduous teeth of young dogs. Japanese J Pediatr Dent, 32:40-54, January 1994.**

The deciduous tooth pulp of young dogs, which was amputated and dressed with  $\text{Ca}(\text{OH})_2$ , was investigated histologically in order to clarify the mechanism by which the calcium is deposited in the residual tooth pulp after pulpot-

omy. According to the histological structure, the residual tooth pulp after pulpotomy was classified into three layers such as the necrotic, basophilic, and vital pulp layers. The surface of the residual pulp after amputation in contact with  $\text{Ca}(\text{OH})_2$  necrosed within 1 hour postoperatively. Angioneclerosis accompanying a formation of microthrombi was observed concomitantly. Calcium that was recognized as black-brown colored granule by means of von Kossa staining, appeared in the lumina of the necrotizing capillary.

These calcium granules exuded from the necrotizing blood vessels and widely distributed over the perivascular pulp tissue at 1.5, 3 and 6 hours.

Subsequently, exudated calcium granules were deposited in the pulp tissue which was located under the necrotic layer resulting in a formation of basophilic layer (the von Kossa positive layer) observed 12 hours and 1 day after the operation. Fibroblastic proliferation occurred in the upper layer of vital pulp at 7 days postoperatively. Osteodentin was formed in the fibroblastic layer at 10/14 days as thin layer of hard tissue that was followed by a development to the reparative dentin bridge.

It was assumed therefore that the exudation of calcium ions from the sera in the necrotic blood vessels caused by pulp amputation procedure and/or dressing with  $\text{Ca}(\text{OH})_2$ , was responsible for the calcium deposition in the basophilic layer.

**Calcium deposition; Amputated dental pulp**

**Freed, G.L.; Bordley, W.C.; Clark, S.J. et al: Universal hepatitis B immunization of infants: Reactions of pediatricians and family physicians over time. Pediatrics, 93:747-751, May 1994.**

*Objective.* In November 1991 the Advisory Committee on Immunization Practice (ACIP) recommended universal hepatitis B immunization of infants. In February 1992 the American Acad-

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already large and busy practice continues to grow. Looking for energetic, enthusiastic, quality-oriented dentist(s) who truly love(s) children! Send resume to: Raymond M. Solomon, DDS, 10125 Verree Road, Suite 106, Philadelphia, PA 19116, or call (215) 677-0380.

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emy of Pediatrics (AAP) and in August 1992 the American Academy of Family Physicians (AAFP) issued similar recommendations. The purpose of this study was to assess over time the effectiveness and impact of the dissemination efforts of the ACIP, AAP, and AAFP regarding the new recommendation and to determine the factors affecting its adoption.

*Design.* Cohort survey over time.

*Setting.* North Carolina.

*Participants.* All 778 pediatricians and a random sample of 300 family physicians in North Carolina were surveyed by mail 3 months after publication of the ACIP recommendation (January/February 1992), but before the AAP and AAFP recommendations. Response rate was 78%. Of these, 83% responded to

a follow-up survey 8 months later (October 1992).

*Main outcome measures.* Rates of agreement and adoption of the recommendation for universal infant immunization with hepatitis B vaccine; factors affecting agreement and adoption of the recommendation.

*Results.* In the first survey (3 months after the ACIP recommendation) more pediatricians than family physicians were aware of the new recommendation (82% vs 48%), yet only 37% of pediatricians and 23% of family physicians agreed that immunization of all newborns in their practice was warranted. Eight months later, after the AAP and AAFP recommendation, 66% of pediatricians and 32% of family physicians agreed universal immunization was warranted, but

still only 53% of pediatricians and 23% of family physicians had adopted it into practice. Factors associated with these low rates of adoption include physician and practice characteristics, cost, perceived need for the vaccine, and aversion to multiple injections.

*Conclusions.* Federal, AAP, and AAFP efforts have not been effective thus far in fostering widespread agreement and adoption of this recommendation. If this and future vaccine programs are to succeed, research is needed to determine influences on implementation of new recommendations and to address the economic and noneconomic concerns of physicians and parents.

**Hepatitis B immunization; Infants; Reactions of pediatricians and family physicians**