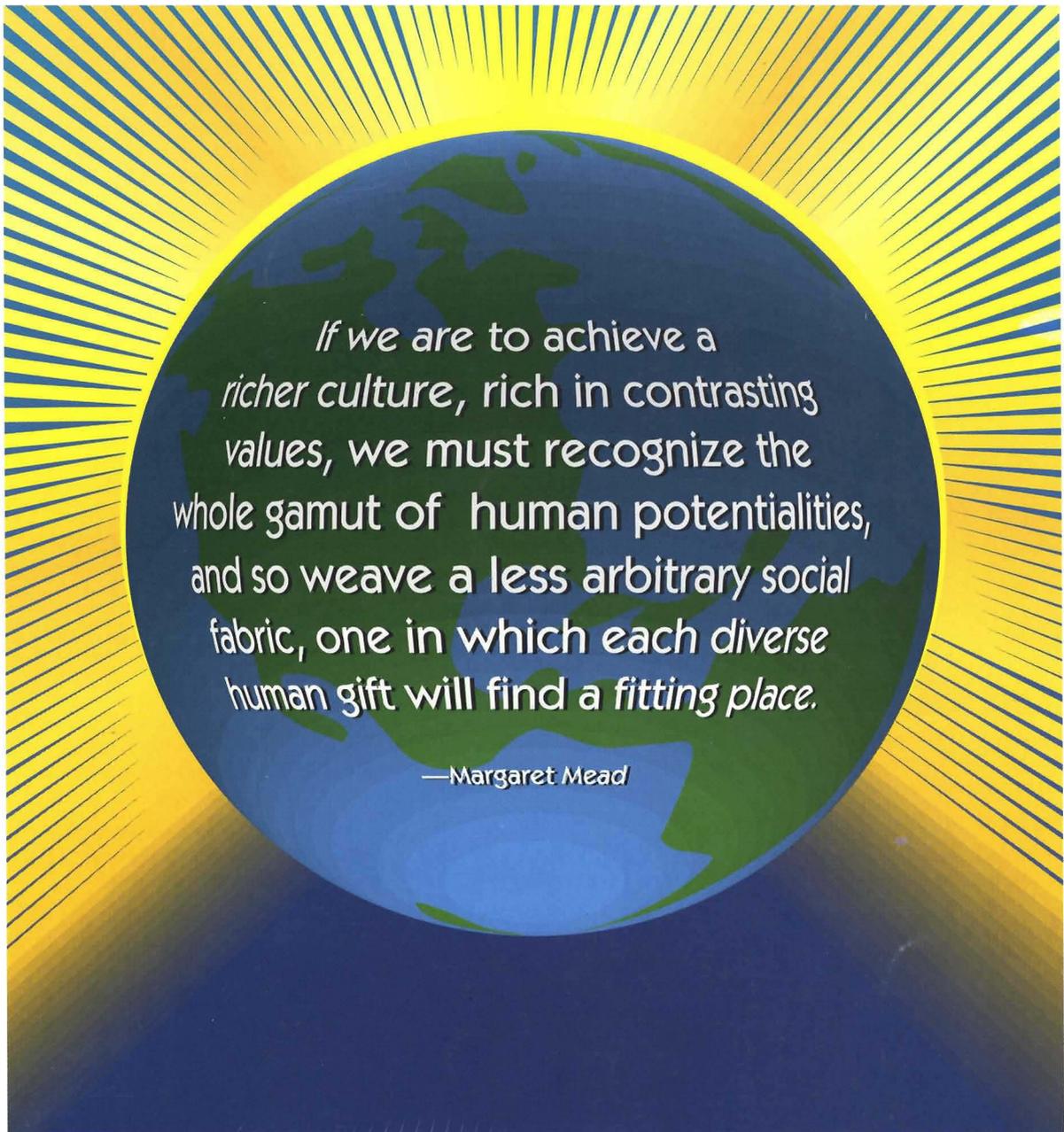


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IN WORLD HISTORY, THOSE WHO HAVE HELPED TO BUILD THE SAME CULTURE ARE NOT NECESSARILY OF ONE RACE, AND THOSE OF THE SAME RACE HAVE NOT ALL PARTICIPATED IN ONE CULTURE. IN SCIENTIFIC LANGUAGE, CULTURE IS NOT A FUNCTION OF RACE.

—Ruth Fulton Benedict



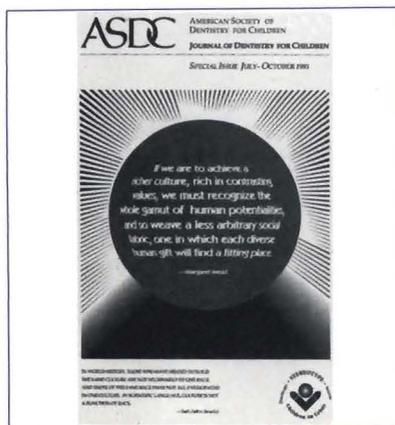
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Many characteristics other than skin color distinguish one culture from another.

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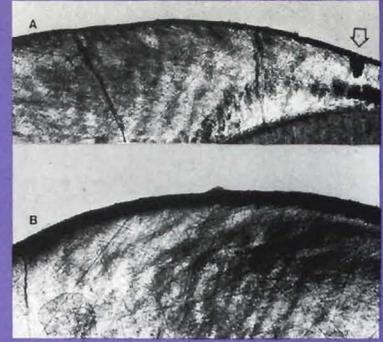
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HISTORY

Alfred Kantorowicz, pediatric dentistry innovator

Hannelore T. Loevy, CD, MS, PhD
Aletha A. Kowitz, MA

Alfred Kantorowicz was born on June 18, 1880 in Posen. Posen was the capital of the Province of Posen, an area that was transferred to Poland in 1918 and became known as Posnan. His father, William, was a business man and in 1884 moved the family to Berlin, where Alfred went to school.

Kantorowicz received his dental degree on December 17, 1900 at the rather young age of 20. During his study in Berlin, he came into contact with several well known authorities in dentistry, Friedrich Busch, Willoughby Dayton Miller, and Ludwig Warnekros among others, who were teaching dentistry there.¹ Apparently Miller had a great influence on the beginning of Kantorowicz' career.

After receiving his license to practice dentistry, Kantorowicz decided to study medicine, registered in Berlin and studied there in 1901, subsequently in Munich and Freiburg, and graduated on July 7, 1906 "cum laude." He presented his thesis, "Critique and new methods of percussion," and formally finished his studies on July 8, 1906. He then started to work as an university assistant at the Virchow hospital in Berlin and also worked at the Robert Koch Institute. Finally, from 1907 until 1909, he worked in surgery with Carl

Garr in Bonn. His writing activities, however, started even before graduation. In 1904 he published a paper on dental enamel.² He also published a paper on bacteriology with his Berlin sponsor, Georg Jochmann; and two papers on fermentation while working in Bonn. By 1909 Kantorowicz went to Munich to work as an assistant with Otto Walkhoff, where he continued to do research on the histology of teeth. This led to his being made a "Privatdozent" on March 21, 1912. At the time Kantorowicz was concerned principally with the development of dental caries, and methods for preventing its occurrence. He was also interested in the organi-



Figure 1. Alfred Kantorowicz

Dr. Loevy is Professor of Clinical Pediatric Dentistry, College of Dentistry, University of Illinois at Chicago and Editor of the Bulletin of the History of Dentistry.

Miss Kowitz is the former director of the Bureau of Library Services of the American Dental Association and the Secretary-Treasurer of the American Academy of the History of Dentistry.

zation of treatment centers in primary schools, where prevention of dental caries in children could be promoted. He started developing his ideas and methods, which later became his major thrust and which became known as the "Bonn system." The precepts of the "Bonn system" stated that in order to combat dental caries, treatment should begin in the primary schools, be obligatory, be paid for by the state, and be organized in such a manner that all children would receive treatment, not only for teeth that were decayed and painful, but for incipient lesions in which pain had not yet occurred. He felt that the development of good habits would carry through life, and children trained to keep dental appointments would regularly return to their dentists as adults.

Kantorowicz also developed a mobile clinic, especially designed for use in the country, which had space for both a dentist and a dental assistant.³ The ergonomics were designed so that the work paths of the dentist and of the assistant would not interfere with each other. Since the number of clinics was usually inadequate to provide treatment for all of the children in a region, Kantorowicz suggested adaptation of moving vans to serve as mobile dental clinics to provide care for the children in underserved areas.⁴

His activities were curtailed, but did not stop during World War I. He volunteered for service in the German army, but while working as a dentist for the 21st Army, he continued his writing. By the time of World War I, he was writing on the genetics of malocclusion. He had presented a paper before the war in 1914 in Berlin at a convention of German dentists; but in the written form of the presentation, he reported inability to verify all the references because of his war time location.⁵ During World War I most of his papers were related to surgery and in them he frequently described case reports and experiences in treatment of service personnel, when using local and extraoral anesthesia. He did, however, pursue his interest in the etiology of malocclusion, and published on the malocclusion caused by breathing defects while still active in the army.⁶

On August 6, 1917, Kantorowicz received the Iron Cross, Class 2, a high honor from the German government, and on May 1, 1918 was invited to the University of Bonn "immediately and when military duty permits."⁷

The school dental clinic in Bonn was a private institution, as were many other institutions of this type in Germany. It had been established by Dr. H. Boennecken around 1890, was maintained by him and financed by him with only a small subsidy from the state.⁷

Boennecken's successor was Dr. Max Eichler who remained in charge until his death in 1917. As a follower of Eichler, Kantorowicz by November 25, 1921 was named director of the dental institute and director of the school dental clinic in Bonn by the Prussian Minister of Science, Arts and National Education. While at the turn of the century the institute had 21 students (three of them women), after World War I the number of students increased dramatically and by 1920/21, 302 students were registered.⁸ The appointment of Kantorowicz was considered an excellent one by other German dentists. In a letter to Dr. Gustav Korkhaus, in 1919, while Korkhaus was still a student looking for a university at which to study, Prof. Hermann Schroder of Berlin stated:

"Wenn Sie nach Bonn gehen werden Sie viel lernen. Bei Kantorowicz weht ein frischer Wind. (If you go to

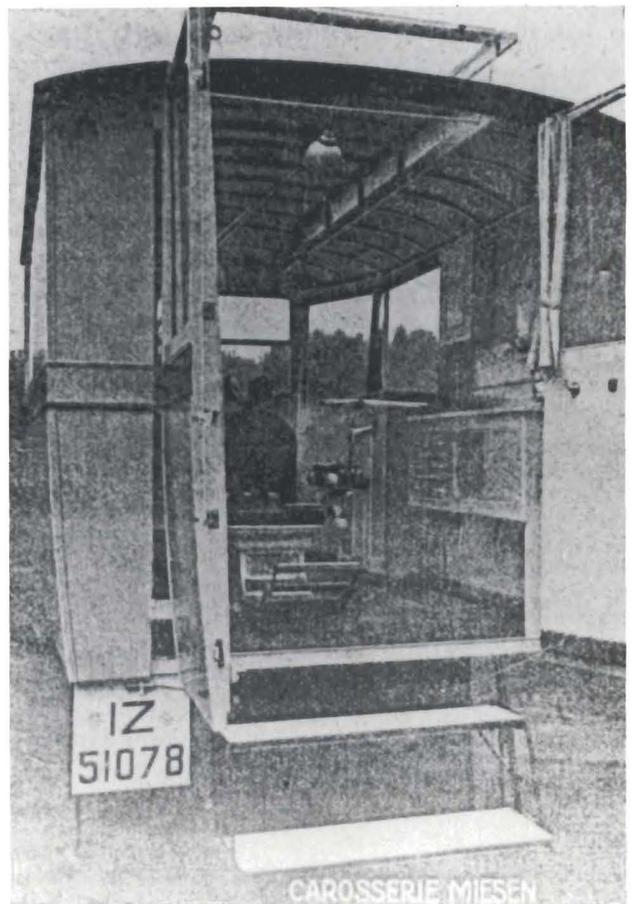


Figure 2. Interior of the moving van adapted for dental treatment by Alfred Kantorowicz.

Bonn, you will be able to learn a lot. With Kantorowicz there is a fresh wind blowing)."⁹

At the time Kantorowicz took over the dental institute at Bonn, it was antiquated and needed modernization of both equipment and academic personnel.^{8,9} Kantorowicz selected and trained outstanding students from his classes. One of the first to be selected was Korkhaus, who became his assistant in 1920, and much later the director of the institute. Kantorowicz found it necessary to teach all clinical and preclinical subjects in the different courses.⁹

From the beginning of his teaching at Bonn he made it clear that he had two major concerns for dentistry. First, research, in which anthropology and pathology were especially important. Second, the social concerns and the concerns of the individuals and their well being. This led to his major thrust of the eradication of dental disease, particularly dental caries in children.

By 1926, Kantorowicz was able to transfer the administration of the dental institute to the state, which also took over the dental clinic, but which retained Kantorowicz as its director. This was very much to Kantorowicz liking since he had always been concerned with prevention of dental caries in children and now was able to proceed to develop activities to stimulate a preventive program in the Bonn area. Having federal funds greatly improved the possibilities for providing appropriate treatment for children in a nation was still suffering the after effects of war and major inflation.

THE "BONN PLAN"

The development of clinics for the treatment of children was started in Germany by Ernst Jessen at the beginning of the 20th century at Strasbour which was at that time part of Germany.¹⁰

Some private clinics for the treatment of children and military personnel associated with the University polyclinic were already in existence in Strasbour, but Jessen developed his clinic for children of school age into one supported by the government. This model inspired many dentists in Germany and in other countries to establish clinics for children. Arthur Merritt, in his autobiography, states that after visiting the Strasbour clinic in 1906, he had the idea of establishing dental clinics in New York schools under the auspices of the Children's Aid Society.¹¹ The Strasbour model was also used and expanded by Kantorowicz in 1914 when he was working in the Munich area, and again after the first World War.³ Kantorowicz acquired experience in this area while still in Munich where he

established a clinic in 1912/13 for the treatment of school-age children in Ruhpolding. It was done with the aid of private donations from rich citizens of Munich. In his opinion these preventive and curative efforts were needed to combat the indifference and lack of care of the dental health of their children by parents. Initially he was interested only in prevention and treatment of dental caries. With time he also felt that the several types of malocclusion were a result of rickets and mald-evelopment of the jaws associated with them and also that eradication of orthodontic malfunction could be achieved by the introduction of orthodontic prophylaxis in school hygiene programs.⁷ He discussed this point with even greater emphasis many years later on his return from exile in Turkey.¹²

Kantorowicz' plan called for complete eradication of dental caries in children. "Jugendzahnpflege" (youth dental care) was an important activity for Kantorowicz and his "Bonn system." Kantorowicz was of the opinion that all children should be seen by dentists regularly and not only on demand; that small problems should be taken care of routinely and not after waiting for the development of large problems caused by delay. The system had its critics, but Kantorowicz believed firmly that by offering a pattern of good dental care to children, a pattern of good dental care would follow these patients through life and would ultimately result in a healthier nation. Further, Kantorowicz was of the opinion that by reducing decay, and interproximal decay in particular, the child would mature with an intact dentition with adequate space for the permanent dentition. This was one of his major goals. These opinions were originally stated in 1915, long before Kantorowicz went to Bonn, and were based on Kantorowicz' activities in Ruhpolding. As director of the institute at Bonn, Kantorowicz was able to put his theories into practice, sometimes accompanied by intense debate.¹⁴ By distributing toothbrushes free of charge to patients in dental schools, and by instituting toothbrushing programs in primary schools further prophylactic efforts were obtained.

OTHER ACTIVITIES IN BONN

In addition to his many teaching duties at the University of Bonn, his activities in dental treatment for children in the Bonn area, and writing his scientific articles, Kantorowicz was involved with the publication of several books in dentistry. In 1920 he published *Zahn-ärztliche Technik (Dental technique)*, a book for preclinical students, in collaboration with Wilhelm Bal-

ters who was a dental student at the time.¹⁵ Kantorowicz was also one of the editors of the *Handbuch für Zahnheilkunde (Handbook of Dentistry)*, a work in four volumes which had been started before World War I.¹⁶ Kantorowicz was involved with the second, third and fourth volumes, in particular, and in writing the long chapters on orthodontics and pediatric dentistry of the second volume. The first volume of the series appeared during the war, while the second volume, the first in which Kantorowicz made major contributions, appeared in 1925. He also published a two volume work, *Klinische Zahnheilkunde (Clinical Dentistry)*, in 1924.¹⁷

Kantorowicz expanded the dental institute by the development of an oral surgery and an orthodontics division. He wrote extensively, presented papers at meetings, and developed an extensive group of co-workers. By the mid-1920s, Kantorowicz started a program to eradicate rickets and introduced a program of dietary supplements (Vigantol) to lessen the severity of the disease. He was of the opinion that this would also decrease dental caries, defective jawbone development, and malocclusion and would result in generally healthier children. In the "Bonn Plan" all children in a school were called from the classroom, given needed dental treatment, and then called at four-month intervals at which times incipient lesions were taken care of immediately. This led to some critical comments and heated debates in which the need for efficiency in dentistry for children was discussed by Kantorowicz. According to him, "dental treatment of children without dental assistants is time wasted".¹⁴

One of Kantorowicz' major areas of research was in the etiology of malocclusion.⁵ He felt that many malocclusions were genetic in origin. Together with Korkhaus he did extensive research in this area, and this later developed into many other research studies by Korkhaus in the area of occlusion and in Korkhaus' studies of the genetics of occlusion in twins. Because of this work Kantorowicz decided in 1927 to establish a separate division of orthodontics positioned with pediatric dentistry. In this manner he hoped to develop a system by which dental caries and malocclusion could be prevented. To achieve this Kantorowicz placed Korkhaus in charge of the new division. Kantorowicz stated that:

"The introduction of orthodontic prophylaxis is of great importance in school hygiene. The school dental surgeons who have performed practically only mechanical work up to now will find in the future a new scope full of problems, and their activities will be raised from monotonous routine into highly intellectual sphere in

which their abilities will be taxed to the utmost."¹⁸

Longitudinal studies of dental development were initiated in Bonn soon after the arrival of Kantorowicz, and an extensive collection of casts was gathered primarily through the efforts of Korkhaus. Kantorowicz concluded that if there was no space loss due to caries, malocclusion could be prevented, and some positional maldevelopment could be self-correcting with age and selective grinding without the need for major orthodontic treatment.¹⁹

Among his many trips related to dentistry, Kantorowicz went to Moscow in 1923, and received another invitation to go there at the time of the translation of the *Handbuch* into Russian. These trips encouraged the myth that Kantorowicz was a Communist, but there seems to be no truth in this since Kantorowicz was a registered member of the SPD (Socialist) party.^{7,20} On January 2, 1926, the medical faculty of Bonn awarded an honorary dental degree (*honoris causa*) to Kantorowicz in recognition of his many activities.²¹

EXILE FROM GERMANY

With the rise of Hitler to power in 1933, major changes in university life took place all over Germany. By a decree of Dr. Stuckart, Prussian Minister of Science, Art and Public Education, Kantorowicz was removed from his position as professor at the University of Bonn.⁷

Notice of the dismissal of Kantorowicz was published in the *Zahnärztliche Rundschau*, in a three line statement.²² The same year a search committee provided the university with a list of names of three people who could replace Kantorowicz. The first name on the list was Hermann Euler, who was in Breslau, and who remained there for the duration of the war, immigrating only to Western Germany when his clinic was bombed. The second name on the list was Erwin Hauberrisser, of Göttingen, who accepted the invitation, but his appointment was short lived.²³ According to Kahle this was strictly a political appointment because Hauberrisser was a member of the SS.²⁰ It became necessary to move him from Bonn because of his inability to administer the well-known and prestigious institute at Bonn. The *Zahnärztliche Rundschau* of 1935 notes that Hauberrisser had accepted a position at the University of Erlangen.²⁴ He was followed by Dr. Friedrich Proell who was active for several years, but by the time the Americans arrived in Bonn on March 8, 1945, Korkhaus was already acting director due to the illness of Dr. Proell.⁸

The order removing Kantorowicz from his position

as professor was issued on September 23, 1933, but was retroactive to April 7, 1933.⁷ It also announced that after December of that year no further salary would be paid to Kantorowicz. This was a moot point, however, since by that time Kantorowicz was a prisoner of the Nazis in a German concentration camp. He was first a prisoner at Borgermoor in the Lüneberger area, and later in the concentration camp for prominent persons and intellectuals in Lichtenstein in Saxony. A short description confirming Kantorowicz's presence in Borgermoor can be found in a book by Wolfgang Langhoff originally written in German but published first in English in 1935.²⁵ Langhoff had also been a prisoner in the Borgermoor concentration camp where he met Kantorowicz during a consultation for dental treatment. Kantorowicz apparently was forced to work in the infirmary while at the camp. Since Langhoff's book was already published in 1935, long before World War II, his description further confirms the statement by Ingeborg Rose that Kantorowicz was not a Communist, but had been placed in the concentration camp because of his religion.⁶ This is further confirmed by Kahle who states that Kantorowicz was a well-known, politically active Socialist and former member of the town council of Bonn.²⁰ Langhoff describes Kantorowicz as a precise, law-abiding individual, very upset with the events, and adjusting with great difficulty to the camp. According to Rose this description was not accurate, and was more "poetic license" than fact.⁶ Many years after the end of his exile Kantorowicz was still very bitter about the "wasted years," and stated that "even with the help of many kind and generous people there is no substitution for the native country from which one was removed for no fault of ones own."²⁶

Kantorowicz was released from the camp just before Christmas 1933 through the intervention of the Crown Prince of Sweden who had found him a job in Istanbul.⁷ The Crown Prince met Kantorowicz while the former was the President of the Red Cross, and when Kantorowicz, on a tour through Sweden, had presented several conferences on school dental clinics. The so-called "Bonn system" had been introduced in some areas of Sweden, allowing dental treatment and preventive programs for children of school age. Immediately after his release, Kantorowicz went to Turkey to start his professional activities. By January 1934 he was active primarily as a teacher and not so much as a researcher.⁷ He remained in that country until 1950.

Kantorowicz was not the only academician "cleaned" from university records. Thomas Mann, the German writer, had been awarded an honorary doctorate in phi-

losophy by the University of Bonn in 1919. On December 2, 1936, however, Mann was deprived of his German citizenship because of anti-Nazi writings. He also received a notice on December 19, 1936 from the dean of the philosophical faculty of the University of Bonn which informed him that "as a consequence of your loss of citizenship the philosophical faculty finds itself obliged to strike your name off its roll of honorary doctors."²⁷

Kantorowicz arrived as a professor, but after one year became clinic director in Istanbul. The time of arrival was a good one. Kamal Atatürk and his Minister for Culture, Resit Galip, were in the process of an educational reform and Galip had in 1931 hired the Swiss educator, Albert Malche, for consultations.²⁸ By 1933 a new University reform law had been approved and was in effect. Kantorowicz was one of several university professors who were forced into exile by the Nazi regime and received university appointments in Istanbul. Based on the plans, Kantorowicz started to reform the dental school curriculum. When he arrived in Turkey, dental education was a three-year program and the clinical areas were divided into prosthodontics and conservative dentistry and were based primarily on the French educational system.⁷ He separated surgery from conservative dentistry, obtained the transfer of esthetic surgery of the face (including cleft lip and palate) into the dental curriculum from the medical department, and introduced orthodontics into the curriculum. The curriculum was also lengthened to four years. Because of his extensive administrative duties few research papers were produced during this period. He published several text books for dentists and auxiliary personnel, however, and developed a group of coworkers.²⁸ He also published several needed text books which had been translated into Turkish by his co-workers. In 1943 he published a text on modern dental surgery (*Distababeti Sir rjisi*), translated by Pertev Ata.²⁸ While living in Istanbul in 1936, he went to Vienna to attend the IX International Dental Congress of the FDI and spoke on pediatric dentistry. As often was the case, his main topics were on the need of dental treatment in children under the age of six as a means of preventing malocclusion in the permanent dentition, the genetic aspects of malocclusion, and the teaching of proper oral hygiene to children. As he had done many times before, he emphasized the point that good oral hygiene habits in children would develop into good habits in adulthood.

By 1950 Kantorowicz was able to return to Germany. During his years in exile he had suffered severe heart

problems, which had made it impossible for him to return to Bonn in 1946, when first asked to do so. By 1947, at the age of 67, Kantorowicz relinquished his post as chair in Bonn because of health problems. His pupil, Korkhaus, was given the position. After his return to Bonn Kantorowicz continued his research activities in Korkhaus' institute. His retirement decree is dated July 1948, and on his return to Bonn he became "Dental Advisor to the Ministry of Work, Social and Reconstruction."⁷

After his return from exile Kantorowicz continued to work on dental research and caries prevention and continued to publish reviews and discussions based on his various activities in Germany before his exile. Kantorowicz was awarded another honorary degree (*honoris causa*), this time in medicine, on June 18, 1955, and was honored on his 70th, 75th and 80th birthdays, as well as, in celebration of the 50th anniversary of his receiving the title of "Privatdozent." His "*Lectio Aurea*" took place on February 17, 1962 in the auditorium of the new dental institute of the University of Bonn. The subject was "Is there an increase in dental caries in Germany?" During this celebration, Kantorowicz started to suffer severe pain, and was hospitalized for an appendectomy. While convalescing from the operation, he died on March 6, 1962, apparently as a result of a heart attack.

PEDIATRIC DENTISTRY

During his professional career, Kantorowicz was interested in several aspects of dentistry. Because of his dual degree he was interested in and published in pathology, physiology, bacteriology, and histology and also in surgery, prosthodontics and orthodontics. His special interest in the dental and preventive treatment of children of school-age stimulated their treatment in dental clinics established for the purpose. In spite of his being a physician by training he did not consider dentistry a specialty of medicine, but continued to consider dentistry as an independent profession. His training and the help of Walkhoff were instrumental in the production of major contributions to histology with profusely illustrated papers on the subject. His paper on the histogenesis of dentin, published in 1910 in the *Deutsche Monatschrift für Zahnheilkunde*, has twelve high quality illustrations and his paper on histology of impacted teeth also published in 1910 has fourteen high quality illustrations.^{29,30} Several of these illustrations were later incorporated into the *Handbuch* published in 1924.¹⁶

Kantorowicz acquired experience in the prevention and treatment of caries in grammar school children while still in Munich when he established a clinic in Ruppolding in 1912/13. These preventive and curative efforts were needed to combat the indifference and lack of care of the dental health of children. With time, he also felt that the several types of malocclusion were due to a maldevelopment of the jaws associated with rickets and that "eradication of orthodontic malfunction" could be achieved by the "introduction of orthodontic prophylaxis into school hygiene." He discussed this point with great emphasis on his return from exile in Turkey.³¹

He was the author of several text books in dentistry and a lexicon of dental terminology. He published extensively on the genetics of malocclusion, prevention of malocclusion, and dental caries. Through his efforts, the Bonn Institute already had a hospital ward in dentistry in 1924, and there was a special examination in orthodontics, which was given only in Berlin, Leipzig and Bonn.²¹

CONCLUSION

At the beginning of this century, Germany produced several outstanding leaders in dentistry. Alfred Kantorowicz stands out among them because of his creativeness and his ability to overcome professional and personal problems within the German academic system. He was an amazing leader with a special interest in the oral health of school-age children.

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A NEW KIND OF INEQUALITY

Societies that cherish the notion of the equal potential of all persons must somehow come to terms with a new kind of inequality—a growing list of specific genetic advantages and disadvantages that can be measured in adults and before birth. Should airlines be allowed to reject pilots with a genetic predisposition to a premature heart attack? If it becomes possible to identify those with a strong predisposition to early-onset alcoholism, a whole new set of legal problems would immediately arise. Should such individuals be allowed to buy alcohol on the same terms as other individuals to whom it would not be so harmful? Can we hold such persons to the same standard of legal responsibility for acts committed while intoxicated?

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BEHAVIOR MANAGEMENT

Pharmacologic patient management in pediatric dentistry: An update

Raymond L. Braham, BDS, LDSRCS, MScD
Martin S. Bogetz, MD
Mitsutaka Kimura, DDS, PhD

In most cases the basic techniques of behavior modification, used with an empathetic approach and appropriate local anesthetic, will enable the dentist to carry out all necessary dental treatment for children. A few patients do not respond to regular techniques, however, and resort must be made to pharmacologic means. In such cases the choice usually lies between general anesthesia and pharmacologic sedation. With general anesthesia, all the impediments to treatment associated with a fearful and highly combative child are removed. The patient is unconscious, immobile, and temporarily free from anxiety.¹ The down side to this approach is the high cost, even in a free-standing outpatient surgery center; the notorious difficulty in persuading insurance carriers to cover the cost of operating room and anesthesia for dental procedures; and the inherent risk associated with administration of a general anesthetic (albeit this is not a major problem if the dentist works in close association with an efficient and competent medical anesthesia team). In addition rela-

tively few dentists are familiar with the procedures for functioning in the hospital environment. The foregoing disadvantages have encouraged the development of various pharmacologic techniques whereby the patient may safely be treated in the dental office environment.

Much has been written on the subject of pharmacologic patient management in pediatric dentistry. Many agents have been recommended, both singly and in combination. Some, such as the *lytic cocktail* containing meperidine, promethazine and chlorpromazine, although usually effective, represent what can only be described as a *shot-gun* approach to the subject. Not surprisingly there have been increasingly frequent reports of problems associated with the various techniques, some resulting in severe morbidity or even mortality.² In recent years the entire subject of pharmacologic patient management has come under increasingly close scrutiny by legal bodies, governmental regulatory agencies, and professional organizations. Rightly so, specific guidelines and requirements have been drafted concerning the safe administration of sedative drugs.³ In the 1993 Accreditation Manual for Hospitals, the Joint Commission on Accreditation of Health Care Organizations has redefined the standards of care for Surgical and Anesthesia Services as follows: *The standards in this chapter apply when any patient, in any setting, receives, for any purpose, by any route: 1) general, spinal or other major regional anesthesia; or 2) sedation (with or without analgesia) for which*

Dr. Braham is Clinical Professor and Director - Predoctoral Pediatric Dentistry, Departments of Growth and Development and Pediatrics, Univ. of California, San Francisco; Dr. Bogetz is Associate Professor of Clinical Anesthesia, Departments of Anesthesia and Medicine, Director - Surgery Center, University of California, San Francisco; and Dr. Kimura is Professor and Chairman, Department of Pediatric Dentistry, Kyushu Dental College, Kitakyushu City, 803, Japan.

Requests for reprints to: Dr. Raymond L. Braham, Box 0436, School of Dentistry, University of California, San Francisco, San Francisco, CA 94143.

there is a reasonable expectation that in the manner used, the sedation/analgesia will result in the loss of protective reflexes for a significant group of patients.⁴

No longer is it acceptable to practice sedative techniques on a "hit or miss" basis. The clinician must be highly knowledgeable as to the agents being used and well-skilled in their administration. The rationale for sedating any given patient must be thoroughly considered and the pros and cons of the chosen method well documented.

It is now accepted standard of care that the minimum number of personnel present when a patient is undergoing sedation shall be two; i.e. the operator and an assistant trained to monitor appropriate physiologic parameters and assist in any support or resuscitation measures required. These individuals, in addition to training in basic life support, must have specific assignments and must have current knowledge of the emergency cart inventory. It is expected that the entire office staff participate in periodic reviews of protocol and emergency procedures.⁵

This presentation will review current recommendations for conscious-sedation procedures in pediatric dentistry and consider which of the many older drugs still utilized are truly appropriate in the light of current pharmacologic research and development. The tendency in clinical dental practice is to rely on tried and trusted pharmacologic agents. It is our contention that newer drugs are constantly being developed, e.g. midazolam, the effects of which are much more predictable than chloral hydrate. In addition, skilled clinicians are investigating and developing more novel and acceptable routes of administration. We will review some of these new pharmacologic agents that appear to show great promise and offer comment on their suitability for general and pediatric dental practice. No attempt will be made to describe detailed techniques and procedural methods. These may be found in numerous excellent texts on the subject.^{6,7}

Conscious sedation may be defined as a controlled state of depressed consciousness that retains the patient's ability to maintain the airway independently and continuously and to respond appropriately to physical stimulation and verbal command, such as "open your eyes."⁵ It may be produced by pharmacologic or non-pharmacologic methods, alone or in combination.

Deep sedation is a state of depressed consciousness, accompanied by partial loss of protective reflexes, including inability to respond purposefully to verbal command.⁵

Deep sedation frequently borders on general anesthesia, which is defined as a controlled state of unconsciousness, accompanied by loss of protective reflexes, including inability to maintain an airway independently and to respond purposefully to verbal command.

No patient should be treated, let alone sedated, without first obtaining a detailed medical and family history. A complete physical examination should have been carried out within the past year and preferably within the past month.⁴ The patient's age in years and months and weight in pounds or kilograms will be clearly noted in the medical record.⁵ In general, only patients of American Society of Anesthesiologists Classifications I and II (Table 1) should be sedated in the dental office. The decision to treat those patients with severe incapacitating or debilitating conditions should be made in consultation with the patient's physician and a medical anesthesiologist.

INFORMED CONSENT

No patient should be sedated without obtaining their own or the parent or guardian's "informed consent." Briefly stated, this means explaining, in detail, the risks and benefits of the procedure and discussing any reasonable alternatives. To be "Informed" the consent process must be intelligible to the person giving it. This means bringing in an interpreter if necessary. A written and signed consent is obviously superior, under law, to any oral agreement or implied consent.

PRE-SEDATION INSTRUCTIONS

Verbal and written instructions regarding eating and drinking, transportation and postoperative care must

Table 1 American Society of Anesthesiologists Classification. Modified from: Malamed, S.F.: Sedation — A Guide to Patient Management (2nd ed.). St. Louis, C.V. Mosby Co., 1989.

A.S.A. Classification	Physical status
ASA I	Normal, healthy patient without systemic disease
ASA II	Patient with mild systemic disease
ASA III	Patient with severe systemic disease that limits activity but is not incapacitating
ASA IV	Patient with incapacitating systemic disease that is a constant threat to life
ASA V	A moribund patient not expected to survive 24 hours with or without operation
ASA E	Emergency operation of any sort. The E precedes the number indicating the patients physical status (e.g. ASA E-II)

be reviewed with the parent before every sedation appointment. The instructions must be explicit and shall include an explanation of potential or anticipated post-operative behavior and limitation of activities together with dietary precautions.⁵

NPO (NOTHING BY MOUTH) GUIDELINES

The generally accepted guidelines are that no solids or dairy foods should be taken after midnight the day before the procedure (sedation appointments are best scheduled early in the day). It is now generally accepted that it is safe for children to drink clear liquids, such as water, up to two hours pre-sedation. Current reasoning has it that this helps to clear any built-up acid from the stomach and also serves to improve the disposition of the child and minimize dehydration.^{8,9} The parent or guardian should be called the day before the sedation appointment to review thoroughly the dietary instructions and NPO guidelines.

POSTSEDATION INSTRUCTIONS

These will include detailed written instructions regarding diet, bathing, limitation of activities and any complications that might be anticipated. A 24-hour emergency telephone number shall be provided and the parent or guardian will be instructed to bring the patient to the dental office for a follow-up appointment within ten to fourteen days of the procedure. The day after the procedure, a designated member of the dental office staff should call the parent or guardian to ascertain and document the patient's status.

ADMINISTRATION OF SEDATIVE AGENTS

Although the literature is replete with administrative routes, these authors consider the following as representing present-day viable avenues of administration:^{1,6,7,10}

- Inhalation sedation
Nitrous oxide/Oxygen
- Enteral sedation
Oral
Rectal
- Parenteral sedation
Intranasal
Sublingual
Intramuscular
Intravenous

The clinician who would utilize pharmacologic sedation as part of his or her day-to-day practice would be well advised not to run the gamut of the many different agents available. Far better to identify a few relatively safe and effective drugs and become thoroughly familiar with their pharmacologic actions, side effects, possible complications and abilities to assist the patient through a safe and pleasant dental experience. It is totally inappropriate for a dentist to indulge in sedation heroics in order to carry out a specific procedure in the dental office.

We will now consider specific routes of administration and those agents which the authors consider to be the most appropriate for pharmacologic patient management in the modern-day pediatric dental office.

Inhalation sedation

Pharmacologic agents may be administered by the inhalation route. Nitrous oxide/oxygen inhalation sedation is the most common technique used in dentistry. Surveys of pediatric dentists indicated, however, that it ranks second in popularity to orally administered pharmacologic agents.^{11,12} Discussion of the pharmacologic properties of nitrous oxide follows in the section on specific agents. At this juncture it may be stated that nitrous oxide/oxygen sedation works very well, if the patient is willing to accept placement of the nasal mask and allow the procedure to take its course. In the case of the defiant, hysterical or otherwise combative patient, however, it is of little or no use.

Enteral sedation

ORAL ADMINISTRATION

The oral route is the most commonly used route of drug administration and has been in use the longest period of time. In general, it is the easiest, safest, most economically expedient and convenient way to administer medication. It obviates the need for syringes and requires no specialized training. The disadvantages of oral administration include its dependence upon patient compliance, the protracted period of time that is necessary between administration of the drug and attainment of full effect, potentially erratic and incomplete absorption from the gastrointestinal tract, inability to titrate a given drug, inability to alter the level of sedation on demand, and prolonged duration of action.

Without a doubt, oral sedation in dental practice should be restricted to those situations in which light levels of sedation will suffice and which are not likely to result in complications.

RECTAL ADMINISTRATION

The rectal route of administration presents several advantages, such as avoidance of the drug being regurgitated, more accurate and controlled absorption, and avoidance of the need for needles. The authors do not recommend it, however, as a technique for use in dentistry. In dealing with the pediatric patient, it is open to misinterpretation by the parent or guardian. In addition, it can create unnecessary problems in the event that the bowel has not been emptied previously. The rectal administration route is extremely valuable when pre-sedating very young children with methohexital sodium or midazolam before general anesthesia, since the parent can support and comfort the child while the anesthesiologist is administering the drug.

Parenteral sedation

INTRANASAL ADMINISTRATION

This route is relatively new but is becoming quite popular with anesthesiologists for the administration of some of the newer pharmacologic agents, such as midazolam (a water soluble benzodiazepine). One great advantage of using this route is that the parent can support and comfort the child while the clinician places the sedative drops into the child's nostril. From this location absorption takes place across the mucous membrane. On the negative side, a young infant will often object, quite strongly, to having the drops placed in its nose.¹³ One way round this would seem to be development of stronger concentrations of the drug.¹⁴

SUBLINGUAL ADMINISTRATION

As previously noted, intranasal administration of midazolam is not universally accepted by young children.¹³ Recent investigations have reported favorably on the administration of midazolam by the sublingual route.¹⁵ The major problem with sublingual administration of sedative agents would seem to be palatability. Investigations are continuing with regard to this issue.¹⁶

INTRAMUSCULAR ADMINISTRATION

This route lends itself to administration of sedative agents when dealing with the highly disruptive pediatric patient who has proven resistant to other techniques. Its advantages include rapid onset of action (15 minutes), maximal clinical effect (30 minutes), more reliable absorption than the enteral routes and the fact that patient cooperation is not essential. The disadvantages include the prolonged duration of effect, necessity for an injection and risk of injection complications.

INTRAVENOUS ADMINISTRATION

While this route provides the most effective, accurate and controllable means of administering drugs, it has the least useful place in pediatric dentistry. To put it succinctly, "if you can set up an I.V. for a child you do not need sedation".

Of the foregoing routes for administering sedative drugs it is the authors opinion that the most practical for use in pediatric dental practice are, in order of preference, inhalation, oral, intranasal and intramuscular. It is, of course, possible to supplement oral, intranasal and intramuscular sedation with nitrous oxide/oxygen. Since nitrous oxide is a CNS depressant, the dosage of the various drugs would have to be reduced appropriately, however, in order to avoid additive effects.

SEDATIVE AGENTS FOR PEDIATRIC DENTISTRY

As previously stated, a myriad of agents have been and still are recommended in the dental literature. Many of them have long surpassed what little use they had.

The ideal sedative agent does not exist. However, were it available it would have certain properties:

- It would totally overcome apprehension, anxiety or fear.
- It would raise the pain threshold.
- It would control gagging and secretion from the mucous and salivary glands.
- It would be easily administered and well-accepted by the patient.
- It would have rapid and predictable onset and controllable duration of action.
- It would produce minimal respiratory depression and have no side-effects.
- Its effect would wear off more or less as soon as the procedure was finished, leaving no active me-

tabolites in the patient's body and leaving no form of "hangover" or residual depression.

- It would produce a selective amnesic effect on episodic memory without significantly impairing long-term memory or attention.
- It would have minimal cost.

As previously stated, no pharmacologic agent presently in use possesses all the above properties.¹⁷ The best we hope to achieve is a calm and fully compliant patient who will accept the administration of such local anesthetic as may be necessary to achieve total pain control and permit all appropriate dental procedures to be completed with maximum expediency and minimal stress to all involved.

Traditional sedative agents

NITROUS OXIDE

Inhalation sedation in dentistry has become synonymous with the use of nitrous oxide.¹⁸ Nitrous oxide is the only inorganic inhalation agent. It is a colorless, sweet-smelling gas that has no explosive nor flammable properties, although it will support combustion as well as oxygen. It is the weakest of all sedative agents, being a good analgesic agent but a poor sedative. Within the bloodstream its effect is purely physical and it does not combine chemically with any of the body tissues. Its insolubility in blood explains its rapid onset of action and equally rapid reversal. When administered with an adequate supply of oxygen, its pharmacological effects are extremely mild.

When administered with oxygen, the primary effects of nitrous oxide are noted on the central nervous system, where a dose-related reversible depression is noted. In the conscious patient, the responses of the cardiovascular system to nitrous oxide/oxygen inhalation have been demonstrated to parallel those of inhaling 100 percent oxygen. A minor elevation of mean arterial pressure results from an increase in total peripheral resistance while cardiac output falls, as does the cardiac workload.

On the respiratory system, the action of nitrous oxide is likewise inconsequential. The respiratory minute volume is increased without depression of the reactivity of the respiratory center to carbon dioxide. Nitrous oxide is exhaled unchanged primarily through the lungs. A phenomenon known as diffusion hypoxia may occur on termination of the procedure, if the patient is allowed to breathe room air directly. The rapid

excretion of nitrous oxide from the blood into the lungs dilutes the available oxygen in the lungs to hypoxic levels. This may result in lethargy, headaches, nausea, and a "hangover" effect. This may be prevented by administration of 100 percent oxygen for a minimum of 3-5 minutes at the end of the procedure.

As previously mentioned, nitrous oxide/oxygen sedation is not possible if the patient cannot or will not accept the mask.

Adverse reactions to nitrous oxide are mostly the result of too great a concentration being administered. Many patients dislike the dissociation that is an effect of nitrous oxide. Dissociation may be defined as inability to perceive one's spatial orientation. It is an early effect of administration of nitrous oxide and reaches its peak level in the analgesia range.

The main complication associated with nitrous oxide is nausea and vomiting. Houck and Ripa evaluated a group of pediatric patients.¹⁹ They concluded that children have a natural tendency to vomit, which is unrelated to eating before treatment, concentration of nitrous oxide, or duration of the sedative procedure. Preoperative evaluation of the patient should seek to determine the tendency of the patient to this behavior. Another cause of nausea and vomiting is the possibility of too high a concentration of nitrous oxide. This can be reduced or avoided by carefully titrating the agent and continual careful monitoring and communication with the patient. Malamed recommends that in the event a patient complains of nausea or "stomach upset," the concentration of nitrous oxide should be decreased by 10 percent every minute until the symptom disappears.¹⁸

CHLORAL HYDRATE

Chloral hydrate is one of the oldest available sedative hypnotic agents. First synthesized in 1832 and introduced as a hypnotic agent in 1869, it continues to be used to induce sedation and sleep in infants, children and adults.²⁰ Chloral hydrate was in widespread use before the FDA began regulating drugs in 1938. Accordingly, it was never comprehensively tested for toxicity or efficacy. In the very young and elderly, it is often held up as the ideal hypnotic agent. There are minimal data, however, in support of this claim; indeed some authors do not believe it to be a safe drug, claiming instead that it is neither safe nor efficacious.²¹ Recently, concerns have been raised regarding the possible carcinogenicity and genotoxicity of chloral hydrate. It has been speculated that chloral hydrate is a toxic me-

tabolite of the rodent carcinogen trichloroethylene (TCE) and a mutagen and chromosome damaging agent.²² In December 1990, the California Department of Health Services (CDHS) sent a letter to the Food and Drug Administration (FDA) highlighting a review of the carcinogenicity and genotoxicity of chloral hydrate. The CDHS requested that the FDA require the manufacturer to amend the drug's labeling when carcinogenicity is confirmed. The CDHS suggested that studies be initiated in neonates and children to assess the safety of chloral hydrate. It also recommended developing alternative agents for use in this group of patients.²³ Chloral hydrate has been used extensively in pediatric patients and it has several advantages and disadvantages.

Perhaps the greatest advantage of chloral hydrate is the route of administration. Chloral hydrate is usually administered orally or rectally. There is little doubt that the avoidance of intramuscular injections or the frustrations of setting up an I.V. is a particular advantage in children. Parenteral formulations are not available. Oral and rectal administrations are non-invasive and relatively painless. On the other hand these routes of administration may result in slow onset of action and unpredictable sedation levels. One of the main disadvantages of chloral hydrate is its irritant properties. These account for its unpleasant taste and may lead to gastrointestinal discomfort, nausea and vomiting in some children.²⁴

Chloral hydrate has long enjoyed great popularity for the pharmacologic management of pediatric dental patients. In such cases it is used either alone or in combination with hydroxyzine or promethazine and/or nitrous oxide. Despite widespread use, frequent unsatisfactory and unpredictable levels of sedation are achieved when using the manufacturer's recommended dose of 50 mg/kg of chloral hydrate. Practitioners will frequently use 80-100 mg/kg to achieve desired sedation.²⁵ Houpt reported that, in 1985, 89 percent of dental practitioners used sedation in less than 10 percent of their pediatric patients. In this survey, chloral hydrate doses ranged from 25-80 mg/kg and the standard dose of 50 mg/kg was used most frequently. When chloral hydrate was used alone, practitioners felt it resulted in good to excellent sedation only 65 percent of the time. On the other hand, practitioners felt that the combination of chloral hydrate and hydroxyzine resulted in good to excellent sedation in 81 percent of patients.²⁶

Several clinical trials have found that low-dose chloral hydrate (30-50 mg/kg) had no benefit over placebo, when

used as sedation for dental procedures.²⁷⁻²⁹ Various studies have reported high failure rates.^{25,30} In one retrospective review, failure rates for chloral hydrate were reported for either chloral hydrate and hydroxyzine or these two agents used in combination with nitrous oxide. The failure rate for the first group was 92 percent, when the chloral hydrate dose was 50 mg/kg and 77 percent; when a dose of 70 mg/kg was administered. For the second group, the failure rate was 75 percent and 45 percent respectively.²⁵ Another trial evaluated chloral hydrate as an oral dose of 50 mg/kg or 75 mg/kg, each given in combination with nitrous oxide. The low dose regimen was rated as bad or very bad in 82 percent of cases compared with the high dose regimen which rated very good or good in 75 percent of cases.³⁰ There is a total lack of prospective, randomized trials with specific patient selection criteria addressing the issues of (1) defining the optimal dose and utility of chloral hydrate and (2) determining the most effective combination of medications.

In summary chloral hydrate has been used for over 150 years as a sedative-hypnotic agent in infants, children, adults, and the elderly. It has been considered a safe drug with minimum respiratory depression when given at therapeutic doses. In light of recent allegations regarding its potential carcinogenicity and genotoxicity, however, its routine use should be re-evaluated. Until further studies define the carcinogenic risks in humans, it would seem to be prudent to use chloral hydrate only when necessary and to limit its use to situations where the potential benefit outweighs the alleged risks. The efficacy of chloral hydrate as a perioperative medication for dental procedures has not been clearly demonstrated. The optimal dose and combination of medications is still unknown.

MEPERIDINE

First synthesized in 1939, meperidine was originally studied as an atropine-like agent. Its analgesic properties were soon recognized, and its atropine-like properties are now classified under the agent's side effects.⁷

In pediatric dental practice, meperidine is usually administered IM or subcutaneously, in which case the onset of action is approximately ten to fifteen minutes, with maximal effectiveness developing between thirty and sixty minutes. Duration of action is approximately two to four hours. Meperidine is, without a doubt, the most commonly used narcotic agonist in dental practice, its clinical onset and duration of action being quite amenable to the average dental appointment.⁷ There

has been a marked increase in its use in pediatric dentistry, however, since alphaprodine was withdrawn from the market. It is the opinion of these authors that this is a somewhat regressive approach to the subject of pediatric sedation. Not the least consideration is that meperidine, being a respiratory depressant, must be accompanied by full monitoring procedures, as will be discussed later. In addition, it should never be administered without a narcotic antagonist (Naloxone) to hand in the event of opioid induced respiratory depression. Administered orally, meperidine is approximately half as effective as parenteral administration.

HYDROXYZINE

Hydroxyzine is derived from a group of drugs called diphenylethanes. Although classified as an antihistaminic, hydroxyzine possesses sedative, antiemetic, antispasmodic and anticholinergic properties.⁷ Two forms are available [hydroxyzine hydrochloride (Atarax) or hydroxyzine pamoate (Vistaril)], either of which can be used in patients over the age of three years. Malamed states that it is effective in the management of very apprehensive, excited, agitated, and emotionally disturbed children, including those suffering from autism and other severe behavioral problems.⁷ In the experience of the authors, hydroxyzine tends to be somewhat unpredictable in its action, sometimes resulting in paradoxical hyperexcitability. Not the least socially pleasing side-effect of hydroxyzine is its propensity for inducing intestinal flatulence. As reported previously, hydroxyzine is used quite frequently in combination with chloral hydrate for the management of the recalcitrant pediatric dental patient.²⁵

PROMETHAZINE

Promethazine is a phenothiazine derivative, most frequently employed in combination with other sedative drugs such as chloral hydrate, hydroxyzine, meperidine, although published reports have documented varying degrees of respiratory depression and other adverse effects when administering meperidine, promethazine and chlorpromazine in combination for sedation in pediatric patients.³¹ Promethazine is not particularly effective as the sole agent for sedation, although it does help in calming the lesser degrees of anxiety.

CO-MEDICATION

The use of various drugs in combination, when treating the recalcitrant pediatric dental patient is perfectly rational. Permutations frequently employed include chloral hydrate or meperidine in conjunction with hydroxyzine, promethazine, and lidocaine. The antihistaminic actions of hydroxyzine and promethazine work well in counteracting the nausea and itching characteristic to narcotic agents such as meperidine. Likewise they control the gastric irritation characteristic of chloral hydrate. One advantage of this technique is that their synergetic actions permit reduction of the dosages of the individual drugs to levels well below standard recommendations. Indeed, the dosages used would be subclinical on an individual basis; but used in combination, the effect of each is potentiated. Perhaps the most common error is to overmedicate, especially with lidocaine or any of the other local anesthetics. It could be that the local anesthetics are used so frequently that they are not considered drugs by most students and practitioners. Nothing could be further from the truth.

Newer sedative agents

The most promising developments in the field of sedative agents are the benzodiazepines and their off-shoots. The benzodiazepines are the most effective drugs currently available for the management of anxiety.⁷ Three agents that warrant close attention are diazepam, lorazepam, and midazolam. Without a doubt diazepam (Valium[®]) enjoys the greatest general fame as an anti-anxiety agent. Its major drawback as a sedative in pediatric dentistry is its protracted duration of action (the half-life is said to be as long as 20-50 hours) which results in a definite "hangover" effect. It is also reported to produce local veno-irritation when administered intravenously. Diazepam is definitely valuable in the treatment of status epilepticus and as a skeletal muscle relaxant. Accordingly, this discussion will review lorazepam and midazolam as potentially effective sedative agents in pediatric dentistry.

LORAZEPAM

Lorazepam is a long-acting benzodiazepine that has gained considerable popularity as an antiemetic agent for adults with cancer.^{32,33} In children it has been used

most commonly as a preoperative sedative and as an anticonvulsant agent.³⁴⁻³⁷ Little has been documented on the pharmacokinetics of lorazepam in children; but Relling *et al* reported that lorazepam may produce a selective amnesic effect on episodic memory without significantly impairing long-term memory or attention.³⁸

Lorazepam is absorbed slowly following oral administration, attaining peak plasma levels in two hours. Having a half-life of six to seven hours, it would appear to be well suited to sedation in young children where rapid attainment of full alertness is not critical. Perhaps the greatest advantage of lorazepam is the fact that it leaves no active metabolites in the body. All in all, it would appear to be an excellent agent for insuring a good night's sleep before the sedation procedure, with a booster dose administered two hours preoperatively.

The usual recommended oral dose for children, for anxiety and sedation, is 0.05 mg/kg/dose (range 0.02-0.09 mg/kg) every four to eight hours.³⁹

It is important to note that all sedative-hypnotics and anti-anxiety drugs (including the benzodiazepines) are potential respiratory depressants. In the usual therapeutic doses required for oral use in healthy patients, the benzodiazepines alone do not produce any significant respiratory depression and do not potentiate the depressant effects of opiates.⁷

It should also be noted that the benzodiazepines produce little or no changes in cardiovascular function following oral administration in healthy ASA-I patients. Indeed they frequently are used to allay anxiety and depression in patients suffering from cardiac disease.

The clinical implications of the two foregoing paragraphs are that prudence dictates that the clinician observe full monitoring precautions of cardiac and respiratory status when administering any benzodiazepine.

MIDAZOLAM

Midazolam, an imidazobenzodiazepine derivative was synthesized in 1976 by Fryer and Walser.⁴⁰ It has unique properties when compared with other benzodiazepines, being water soluble in its acid formulation, but highly lipid soluble *in vivo*.⁴¹ Compared with other benzodiazepines, it has a rapid onset of action and high metabolic clearance, its effect lasting only two hours or less. It has been found to produce reliable hypnosis, amnesia and anxiolytic effects when administered orally, intramuscularly, or intravenously. Midazolam has been found to have many uses in the perioperative

period including premedication, anesthesia induction and maintenance, and sedation for diagnostic and therapeutic procedures. It is preferable to diazepam in many clinical situations because it produces a rapid non-painful induction and lack of venous irritation. It is of clinical interest to this discussion that midazolam shows considerable promise when administered by the intranasal route and sublingual routes.¹³⁻¹⁵ Various reports have documented the intranasal administration of sedative drugs as an effective premedication procedure before general anesthesia for babies, infants, and children.⁴²⁻⁴⁵ More recently the intranasal route has been investigated as an avenue by which to administer midazolam for sedation in pediatric dental patients.¹⁴ Compared with intravenous sedation, intranasal administration is easier when dealing with violently combative patients. Not only is the necessity for an injection avoided, but the drug takes effect faster and with greater accuracy than oral administration since it diffuses directly into the venules, rather than being transported via the portal vein, as in the case of intrarectal and sublingual administration.

It has been reported that respiratory depression due to midazolam is greater than that of diazepam.⁴⁶ With this potential disadvantage in mind, both clinician and staff should show the greatest respect for midazolam when administering the drug. The ease of administration by the intranasal or sublingual routes should not be cause for lack of caution. Careful monitoring of vital signs in accordance with all guidelines for general anesthesia and intravenous sedation should be strictly followed. Of particular importance is the constant need to monitor oxygen saturation (SaO₂) with a pulse-oximeter. Carbon dioxide levels (PaCO₂) may be monitored electronically using a capnometer.

The recommended dose for administration of midazolam by the intranasal or sublingual route is 0.2 mg/kg. It is manufactured as 1.0 mg/ml and 5 mg/ml stock solutions. For an average 20 kg child this would require an intranasal dose of 0.80 ml of the 5 mg/ml solution. The recommended oral dose is 0.7 mg/kg.

Reversal of midazolam and benzodiazepine induced sedation

FLUMAZENIL

In December 1991, the FDA approved flumazenil, a benzodiazepine receptor antagonist, for use in reversal

of midazolam and benzodiazepine induced sedation in the following cases:

- Where general anesthesia has been induced and/or maintained with benzodiazepines.
- Where sedation has been produced with benzodiazepines for diagnostic and therapeutic procedures.
- For the management of benzodiazepine overdose.

The use of flumazenil in the treatment of benzodiazepine overdose, however, is not without risk. It may precipitate seizures in cases where tricyclic antidepressants or other drugs that lower the seizure threshold have been ingested in combination with the benzodiazepine. It has an extremely short duration of action, which necessitates frequent titration. There is a very real risk of re-sedation occurring should the action of the flumazenil wear off before that of the benzodiazepine. Accordingly its use should only be directed by the most skilled and appropriately qualified clinicians.

KETAMINE

Ketamine hydrochloride is a phencyclidine derivative with a long-standing reputation as a safe and effective anesthetic for various procedures.⁴⁷ It is a rapid-acting, nonnarcotic, nonbarbiturate drug, reported to have a wide margin of safety.^{48,49} Ketamine produces a cataleptic state with profound analgesia and anesthesia. Its action is primarily on the thalamus and cortex, rather than on the reticular activating system.⁷ As a result the patient appears to be dissociated from the environment rather than asleep. Although respirations are not usually depressed with proper dosages, profound stimulatory, cardiovascular changes are usually produced with accompanying tachycardia and increases in blood pressure.

Very little information exists regarding the oral administration of ketamine in pediatric dentistry. One study documented its safe use in outpatient pediatric dentistry over a period of twelve years.⁵⁰ More recently, the use of ketamine has been documented as an oral premedicant before anesthesia in children.⁵¹ A preliminary study by Alfonzo-Echeweri and co-workers reports that oral ketamine, 6 mg/kg, provides high-quality sedation for young children undergoing outpatient dental surgery procedures.⁵² In spite of the above reports, it is the opinion of these authors that, pending considerable further documentation, ketamine should be used under the direct supervision of clinicians ex-

perienced in administering general anesthetics and in maintenance of an airway.

MONITORING THE PEDIATRIC PATIENT DURING SEDATION PROCEDURES

Whenever pharmacologic methods are used, those problems associated with physiologic changes in patients receiving drugs affecting the central nervous system are primarily dose-related.⁵³ Once specific CNS effects have been induced with a given pharmacologic agent, it is essential that they be monitored, to maximize efficiency and minimize adverse reactions.

When drugs are used in pediatric dental practice, it is essential to consider their effects on the respiratory and the cardiovascular systems. Without a doubt, respiratory function is the greatest cause for concern. The intake of oxygen and output of carbon dioxide by the lungs is a critical part of the metabolic process. Drugs used in the pediatric dental patient primarily result in hypoventilation, leading to hypercarbia and/or hypoxemia. In no way can counting respiratory rate or measuring tidal volume accurately gauge ventilatory function. It was only the institution of studies on carbon dioxide response that revealed the actual cause of respiratory depression by the narcotic analgetics. For many years their apparent lack of effect on ventilation, as judged by observation of tidal volume and respiratory rate, led to the erroneous belief that they were nonrespiratory depressants. Respiratory depression leads to carbon dioxide accumulation which actually increases ventilation (rate and volume) and so creates a false impression of adequate respiration. In effect, respiratory depression has already taken place and the hypercarbia soon will be accompanied by hypoxemia. All these factors may well serve to mask the effects that one is trying to achieve with the sedative drugs. The lack of cooperation and hyperactivity of the child may well delude the clinician into assuming that more sedation is required, when the problem is actually caused by increasing carbon dioxide and decreasing oxygen resulting from hypoventilation. Such errors only lead to the numerous reports of tragic errors resulting in child mortality reported in the literature.^{2,54}

While modern electronic monitoring devices such as the pulse-oximeter and vital signs monitor are invaluable for measuring pulse rate and blood gas saturation levels, it is essential never to neglect good clinical judgment, supplemented by such simple devices as the precordial stethoscope which constantly monitors

changes in respiratory function (breath sounds) as well as cardiovascular activity.

As previously noted, it is totally inappropriate for less than two people to be involved in administration of sedative drugs in pediatric dentistry. These two persons are the operator and an assistant highly-trained in monitoring procedures. Electronic monitoring devices, although highly desirable and of inestimable value, should never be the sole means of patient monitoring. As stated by Way, "It is not enough that a monitor be present in the operatory but rather that the information from the monitor and the information processing by the observer be brought together in a manner that permits clinical judgments to be made about the patient's condition."⁵³

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THE FLU VIRUS IN ACTION

One of the human body's chief defenses against influenza is antibodies, the Y-shaped molecules that attach to very specific sites on the surface of a virus, in lock-and-key fashion. In this part of the immune defense, the body tests the viral particle for distinctive locks on its surface, and then manufactures a large quantity of keys. When antibodies are attached to the protruding HA spikes of the viral particle, it cannot latch onto a living cell and enter it.

Faced with human immune systems that can quickly manufacture keys, the virus counters with an exceptional capacity to change the lock through mutation. In human cells, the genetic code is carefully safeguarded against mutation by being wound into two-stranded helices of DNA. Only when a segment of code is needed to manufacture a particular protein is it translated into the more fragile single strands of RNA. But the influenza virus consists only of strands of the less stable RNA. This allows it to mutate 100,000 to 1 million times more rapidly than the DNA in human cells. Most of the mutations, of course, are worthless. But nature tries everything, at random, and sooner or later, one of the mutations changes the shape of the locations where antibodies attach. A change in a single molecule—if it is exactly the right one—will defeat the antibody immune response. This process is called genetic drift, and it is one reason that one year's flu vaccine may not be effective against the next year's virus. Fortunately, there are several sites on a flu virus where different antibodies attach. The usual effect of genetic drift is a slow and continual reduction in the effectiveness of the immune response.

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Dental management of child and adolescent patients with schizophrenia

Arthur H. Friedlander, DDS
Ida Kreinik Friedlander, RN, BSN, MS
Spencer Eth, MD
Earl G. Freymiller, DMD, MD

Schizophrenia is a chronic psychiatric disorder in which thought disturbances and severely disordered behavior lessen an individual's ability for self care and to interact effectively with others. Onset of the disorder most commonly occurs during adolescence or young adulthood. Before the development of florid psychotic symptoms, most of these youngsters will exhibit some form of aberrant behavior and peculiar thinking during childhood. Persons suffering from schizophrenia often manifest a significant incidence of dental pathology and special need for care. Dental management may require

modification because of the psychiatric disorder and the medications used to treat it.

PRESCHIZOPHRENIC BEHAVIORAL PATTERN

The majority of youngsters who develop schizophrenia in late childhood or adolescence display subtle signs of disturbed development from infancy, although not all children with developmental deviations become schizophrenic.¹⁻⁴

Characteristics in infants

Preschizophrenic infants may have hypotonic muscle tone or be excessively quiet and underactive, while spending long periods of time staring at various objects. They may have difficult temperaments and abnormal patterns of interactions with their mothers, such that they appear distressed when being cuddled and when alone.

Characteristics in toddlers

Some toddlers who wander aimlessly, flittering about from one activity to another, later become schizophrenic. Other early prodromal symptoms include difficulty with chewing solid food, and language that may be delayed, sparse, and limited to short utterances.

Dr. Arthur Friedlander is Director, Quality Assurance, Dental Service, UCLA Medical Center, Associate Professor of Oral and Maxillofacial Surgery, School of Dentistry, University of California, Los Angeles, and Chief Dental Service, Sepulveda Veterans Administration Medical Center, Sepulveda, CA.

Ida Friedlander is a Public Health Nurse, Department of Health Services, County of Los Angeles, Canoga Park, CA.

Dr. Eth is Assistant Professor, Psychiatry and Biobehavioral Sciences, School of Medicine, University of California, Los Angeles, Clinical Associate Professor of Psychiatry, School of Medicine, University of Southern California Los Angeles, CA; and Acting Chief of Psychiatry, Veterans Affairs Medical Center, West Los Angeles, CA.

Dr. Freymiller is Assistant Professor, Oral and Maxillofacial Surgery, School of Dentistry, University of California, Los Angeles and Residency Program Director, Oral and Maxillofacial Surgery, UCLA Medical Center, Los Angeles, CA.

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Characteristics in preschoolers

As preschoolers some preschizophrenic children suffer from unusual fears, social anxieties, and panic attacks. They are unusually concerned and preoccupied with thoughts about bodily functions, machines, ghosts, monsters, aggression and death. Their behavior is chaotic and fluctuates between clinging and tantrums brought about by changes in diet, scheduling, or physical setting.

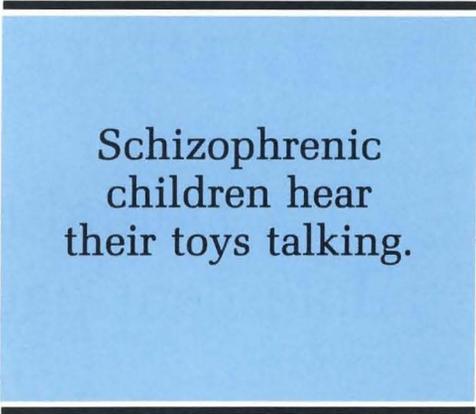
Characteristics in school-age children

In grade-school some children who are destined to become schizophrenic are unable to form friendships because they fail to appreciate the opinions and feelings of others. Their immature and labile personality provokes the other children to tease or avoid them. During learning activities in class, they are unable to sustain attention and process information appropriately. At this stage of development many of these children evidence varied degrees of abnormal language. It is often overly elaborative with excessive associations that are poorly related and difficult to interpret. Words are frequently linked by rhyming, and aberrant variations in stress, pitch, and rhythm of speech tend to obfuscate meaning.

In junior high school the child at risk for schizophrenia is often excessively worried, fearful, shy and withdrawn.⁵ Girls tend to be exceedingly sensitive, moody, introverted and passive, while boys tend to be unpleasant, aggressive, and self-centered. Teachers often identify these youngsters as having attentional, cognitive, and perceptual-motor difficulties.

SCHIZOPHRENIA

The "positive" florid symptoms of schizophrenia most often reported are auditory hallucinations, delusions, and a formal thought disorder.⁶ Hallucinations are an experience of sensory perception in the absence of an actual external stimulus. These children may report hearing their toys, pets, dead relatives and God talking or commenting on their behavior. On occasion the voices may make insulting remarks (e.g. "stupid") and commands (e.g. "jump off the roof", "murder your stepfather"). Although auditory hallucinations usually predominate, visual, tactile and olfactory hallucinations may be described as well. Delusions are fixed, false ideas without a rational explanation and may be persecutory (being spied on), grandiose (believing one has



Schizophrenic
children hear
their toys talking.

magical powers) or self-referential (thinking that the negative aspects of a television program are specifically directed at one), in nature. Not infrequently, these youngsters believe that their thoughts are being broadcast and that their feelings and impulses are not under their control. The older and sicker the child, the more complex are the hallucinations and delusions.

Schizophrenic children also think and reason illogically. This thought disorder is readily apparent when youngsters present their ideas verbally. They inappropriately use causal ("because," "so that," "if") linguistic constructs (e.g. "I left my jacket in her room because her name is Ann"), their explanations are unfounded (e.g. "I start wheezing and that's when I relax"), and they make simultaneously contradictory statements (e.g. "I don't like the story but I liked it as a story").⁷ They also rapidly shift ideas between unrelated topics (loose associations) [e.g. Interviewer: "Why do you think that's a reason not to like Tom?" Child: "And I call my mom sweetie"]. Use of neologisms (a new word or condensed combination of several words, whose meaning is known only to the child such as the term footglove for sock), is very common, as is disordered syntax and inadequate use of pronouns. These symptoms are often accompanied by a failure to achieve expected levels of personal development (academic progress, peer relationships, and self care/personal hygiene).⁸

The typical course of schizophrenia consists of a lengthy prodromal phase culminating in an acute episode of psychosis lasting several months, followed by remission of the frank symptoms of hallucinations and delusions with medication, and finally a long period of residual symptoms of thought disorder and constricted affect. Most often, there is further overall deterioration with each cycle until, after many years the disorder

“burns itself out,” leaving a residual state. This residual state is characterized by “negative” symptoms and low functioning. Negative symptoms include reduced interest or curiosity in the environment and a flattened or blunted affect, such as the absence of demonstrable emotions to people and events, a monotonous voice, and expressionless face. Chronic schizophrenics may question their identity and lack the drive to follow a course of action through to its final conclusion.

Diagnosis of the disorder rests on the psychiatric history, behavioral observations, and mental status examination. There are no physical findings or laboratory tests to confirm the diagnosis of schizophrenia.

Epidemiology

The lifetime prevalence of schizophrenia in the general population is approximately 1.3 percent, but its onset during childhood (ages two to twelve) is extremely rare, with only 1.75 to 4 per 10,000 children being affected.⁹ Males constitute approximately 75 percent of children with the disorder before age twelve. During adolescence there is an explosive rise in the incidence of the disorder among both boys and girls; and by middle adulthood schizophrenia is equally common in both sexes.

Etiology

The etiology of schizophrenia is not yet known, but many converging lines of evidence from family, twin and adoption studies implicate hereditary factors as important in this disorder.¹⁰ A child of a schizophrenic parent has a 10 percent chance of developing the disease, and if both parents are schizophrenic the likelihood rises to over 40 percent.¹¹ Investigators speculate that what is genetically transmitted is not the disease

itself, but a vulnerability or predisposition to it.¹² These studies have not identified a specific constitutional defect, but suggest that the risk of schizophrenia is not specifically associated with prenatal and perinatal factors, parental psychopathology other than schizophrenia, or the style of the parent-child relationship.

Neurophysiologic deficiencies (blood flow and glucose metabolism/oxygen use) and neuropsychological/cognitive deficits related to the schizophrenic's prefrontal cortex have been found.¹³ When normal individuals are given mental tasks to perform, computer generated images of the prefrontal cortex “light up”, indicating an increase in chemical activity; but, the brains of schizophrenic patients remain quiescent as though they are unable to meet the physiological demands.

The “positive” symptoms (hallucinations, delusions, disordered thought processes) are possibly the result of heightened post-synaptic dopamine sensitivity, and they are ameliorated by drugs that block dopamine receptor binding sites within the central nervous system.¹⁴ The “negative” symptoms (blunted affect, social isolation) are possibly the result of cerebral atrophy and/or an imbalance in cholinergic and dopaminergic neuronal systems.¹⁵

MEDICAL MANAGEMENT OF SCHIZOPHRENIA

All youngsters presenting with schizophrenic-like symptoms should receive a thorough pediatric and neurologic evaluation in order to identify any organic factors contributing to the psychiatric condition. Medical diseases that can mimic schizophrenia and, therefore, must be excluded, include drug or toxic-induced psychosis, seizure disorders, central nervous system lesions, metabolic disorders, and infectious diseases.

The “neuroleptic family” of medications or antipsychotic drugs (Table 1) are most often prescribed for

During adolescence there is an explosive rise in the incidence of schizophrenia.

Table 1 □ Commonly used Antipsychotic/Neuroleptic Agents

Generic name	Commercial name
haloperidol	Haldol
loxapine	Loxitane
thioridazine	Mellaril
thiothixene	Navane
fluphenazine	Prolixin
trifluoperazine	Stelazine
chlorpromazine	Thorazine
clozapine	Clozaril

children and adolescents with schizophrenia. Haloperidol (Haldol) and fluphenazine (Prolixin) have been shown to be particularly effective in acutely psychotic adolescents as they are potent dopamine antagonists.¹⁶

The most commonly encountered adverse reactions to these medications are movement disorders of an acute or delayed onset. Movement disorders arise when the classic neuroleptic medications block dopaminergic receptors in the basal ganglia that are instrumental in regulating motor activity through the extrapyramidal tracts. During the first few days or weeks of treatment, approximately 50 percent of patients develop acute extrapyramidal syndromes (EPS). Patients often develop muscle spasms of the neck and back (dystonic reactions) and a motor restlessness with symptoms of pacing, fidgety movements, and shifting position while sitting or standing (akathisia). A drug-induced parkinsonism may also develop after a few weeks of therapy. This is characterized by fine tremor, rigidity, and bradykinesia. Tardive dyskinesia (TD), a persistent movement disorder, occurs in approximately 25 percent of patients treated with neuroleptic agents for more than several months. Usually irreversible, it is characterized by rhythmic involuntary movements of the orofacial muscles and the extremities.^{17,18} Anti-Parkinsonian drugs (Table 2) are often prescribed, to prevent or control the acute extrapyramidal syndromes. Most of these medications have powerful anti-cholinergic effects, especially when they are used in conjunction with neuroleptics.

Another common and troublesome effect of neuroleptics in children and adolescents is sedation. Sedation may interfere with learning and social relations and may exacerbate negative symptoms. Sedation typically appears during the first 4 weeks of treatment and rarely persists beyond twelve weeks unless the dosage is increased.

Clozapine (Clozaril), is an "atypical" antipsychotic medication recently approved for use in the United States; it has been used in Europe since 1975 for the management of the patient with treatment-resistant

Table 2 □ Anti-Parkinsonian Medications

Generic name	Commercial name
benztropine	Cogentin
trihexphenidyl	Artane
biperiden	Akineton
amantadine	Symmetrel
diphenhydramine	Benadryl

schizophrenia. The drug is termed "atypical" because it is the first neuroleptic medication shown to be effective in treating both the "positive" and "negative" symptoms of the disorder. This therapeutic quality may arise from its preferential blockade of dopamine receptors in the prefrontal cortex, while having only minimal effect on the dopamine receptors in the basal ganglia, which are implicated in causing movement disorders (EPS, TD). Clinical studies have shown that patients treated with this medication have a lower number of hospital readmissions, shorter lengths of hospital stay, and a decreased number of outpatient visits.¹⁹⁻²¹ About 1 percent of patients receiving clozapine develop bone marrow suppression, however, with agranulocytosis or granulopenia. This potentially fatal adverse effect has precluded distribution of the medication for general use through retail pharmacies. The drug is available only for those who are sixteen years of age or older and only from designated home health care agencies that perform weekly white blood cell counts.

Supportive psychotherapy is indicated as an adjunct to medication, in order to assist the youngster's impaired psychological and social functioning. The therapist functions as a helper, teacher, comforter, and model for identification. Together they develop strategies to strengthen the patient's abilities to communicate and relate to others, perceive reality, and regulate affect. Family interventions are devised to assure the appropriate level of family involvement and interaction, and to enhance communication among family members. A well-integrated treatment program may also include attendance at a therapeutic day school where specialized instructors provide social skills training and special education (including speech therapy and gross and fine motor training).

Orofacial findings

Children and adolescents seen during an acute phase of the disorder usually evidence a total disregard of proper oral hygiene and invariably have severe marginal gingivitis. Those with a history of prolonged bouts and frequent relapses of the disorder have the most

The therapist
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model.

advanced cases of periodontitis and numerous decayed and missing teeth.²²

Antipsychotic medication induced movement disorders can be responsible for significant morbidity in the orofacial region. Neuroleptic induced dystonic reactions (spasms of the tongue and muscles of mastication) are most frequently seen in adolescent (10 to 19 years old) boys.^{23,24} The involuntary orofacial movements of tardive dyskinesia present as chewing, tongue protrusion and vermicular movements, lip smacking, puckering and pursing, rapid eye blinking and blepharospasm.²⁵ The neuroleptic medications are not only dopamine antagonists, but they are also capable of cholinergic blockade which frequently manifests as xerostomia. The incidence and severity of xerostomia is often increased by concomitant administration of anticholinergic anti-parkinsonian agents (Table 2). In some individuals the neuroleptic medications have been implicated as the cause of an obtunded gag reflex.²⁶

A unique and unexpected finding is the sialorrhea shown by patients being treated with clozapine. Although clozapine is a potent anticholinergic agent, day and nocturnal hypersalivation is common. In some patients the problem is so severe that they are unable to manage the fluid load properly, and soil their clothes. Cessation of excess salivation is usually noted within two weeks of the initiation of clozapine therapy.

Youngsters with schizophrenia frequently display unexpected facial expressions. Young children often exhibit a puzzled frown, a scowl or an exaggerated squint. A grimacing smile is quite prevalent among adolescent schizophrenics.²⁷

Minor physical anomalies of the orofacial region may be noted in children with schizophrenia. Prevalence rates have not been determined, but an enlarged head circumference, epicanthic folds (vertical skin folds covering the tear ducts), hypertelorism (wide spacing of the eyes) and abnormal position or configuration of the ears are frequently noted. Commonly encountered anomalies of the oral cavity include a steep palatal vault, fissured tongue, geographic tongue and abnormally large maxillary incisors.²⁸ The stability and validity of these findings have been confirmed in studies of adult schizophrenic populations.²⁹

Youngsters with schizophrenia frequently have delusions centering on the mouth. One six-year-old claimed that his jaws would eat the therapist in order to punish her for leaving him and to keep her safe inside. Another child endowed her saliva with magical properties, and when she smeared it on a staff member would murmur "you're mine."

Dental management considerations

Before starting therapy, the patient's psychiatrist should be consulted. Information requested would include the patient's current psychological status, current psychotropic medication regime, and any abnormal findings on physical examination or laboratory studies. Children and adolescents who have received high dose or long-term therapy with the neuroleptic agents may have developed side effects of dental concern. These agents can adversely affect the cardiovascular system causing tachycardia, fluctuations in blood pressure, and orthostatic (postural) hypotension. In unusual cases the hemopoietic system may become depressed with a decrease in the number of white blood cells, red blood cells, and platelets.³⁰

Patients with schizophrenia are likely to present with a unique set of factors that leads to the development of advanced dental disease. Schizophrenia is often associated with deterioration in personal grooming and self-care skills, including a disinterest in performing appropriate preventive oral hygiene. Most neuroleptic medications cause hyposalivation by blocking (through anticholinergic action) parasympathetic stimulation of the salivary glands. The incidence and severity of effect is often increased by the concomitant administration of anticholinergic anti-parkinsonian agents.³¹ Hyposalivation results in an intensification of periodontal disease and in rapid caries progression, because of adverse changes in the oral environment. Some children asso-

ciate their dry mouth with problems of mastication, speech, and swallowing. Neuroleptics affect central appetite and satiety centers, often resulting in weight gain and a fondness for sweets and carbonated beverages.³² Schizophrenic patients exhibit high rates of cigarette smoking with associated discoloration of the teeth and fingers and increased risk of oral and pulmonary neoplasia.³³

Preventive dental education for this unique group of patients is paramount. Hygiene instruction sessions are conducted before a large mirror. Verbal instructions, modeled demonstrations (the dental hygienist brushes and flosses her own teeth) and colorful posters are useful to describe proper tooth brushing and flossing techniques.³⁴ As the patient's skills improve, the hygienist reinforces these actions with abundant praise. Disclosing solution stains are used to motivate patients to monitor, evaluate and correct deficiencies autonomously. Unfortunately, a significant number of patients lack the ability or motivation to perform oral hygiene procedures independently. Some sporadically and others continually refuse to brush or floss their teeth. Others who have previously demonstrated their proficiency with brush, paste and floss suddenly appear to forget how to use these devices properly. On rare occasions, patients have become hostile toward the hygienist during the training session, necessitating the postponement or permanent cancellation of the session.

Patients able to cooperate with a dental hygienist are scheduled at six-week intervals for a year, in order to evaluate their continued compliance with the program. At three-month intervals, a clinical examination, oral prophylaxis, acid rinse, and application of a fluoride gel are performed. On occasion the hygienist or dentist may observe signs of a possible recurrence of the psychiatric disorder. The most consistent sign is deterioration of oral and personal hygiene. In these instances, the treating psychiatrist is advised so that appropriate intervention can be instituted.

Artificial salivary products are prescribed (and sugarless gum and candies recommended) for those with signs or symptoms of xerostomia. These products appear to make most children and adolescents more comfortable and relatively more compliant with their medication regimen and with proper oral hygiene techniques.

Dental treatment (utilizing local anesthesia) consists of subgingival scaling, root planing and curettage, caries control and dental restorations. Use of a local anesthetic agent with a vasoconstrictor will not cause adverse effects in a normotensive patient receiving

neuroleptic medications.³⁵ In our practice we administer 2 percent lidocaine with 1/100,000 epinephrine, but limit the dosage and avoid an intravascular injection by use of an aspirating syringe. With these precautions we have not encountered significant complications such as hypertensive episodes. During treatment the airway is assiduously protected because of the propensity for an impaired gag reflex.

Adverse interactions between medications used in dentistry and neuroleptic agents may produce morbid reactions. The antipsychotic medications may add to or potentiate the action of other central nervous system depressants, such as narcotic analgesics, barbiturates, and general anesthetic agents. When these agents are prescribed concurrently, complications such as hypotension, orthostatic hypotension, and respiratory depression may arise.³⁶⁻³⁸

CONCLUSION

Dental disease and mental illness are the most prevalent health problems in the United States. Dentists must be prepared to treat psychiatrically impaired patients even if the experience is time consuming and stressful. Collaboration with a psychiatrist in the management of the patient can alleviate much of the doubt and anxiety associated with providing dental care to these individuals. As health care professionals, we must also be able to recognize individuals with the premorbid and florid signs and symptoms of schizophrenia and provide them with appropriate referral sources for definitive diagnosis and treatment.

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PRIVILEGE AND HEALTH

Dealing with the social causes of disease and responding to its medical effects are not mutually exclusive. We should do both. People already burdened by poverty and lack of education should not also carry a disproportionate share of illness. Americans live in a society that tolerates great disparities in wealth and privilege. The social and political costs are enormous. We are now learning that the medical costs are also very high.

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An assessment of the success of meperidine and promethazine sedation in medically compromised children

Kevin L. Haney, DDS, MS
Alton G. McWhorter, DDS, MS
N. Sue Seale, DDS, MSD

The behavior of most pediatric dental patients can be managed through use of the simple tell-show-do technique, which requires an attentive patient able to assimilate instructions given in an age-appropriate manner. Handicapped children, however, may be unable to cooperate for dental procedures, due to mental or physical disabilities that limit their ability to comprehend or act out instructions. Additionally, chronic illness may sensitize the child to the medical/dental environment, leading to poor cooperation resulting from fear. In these cases, conscious sedation techniques that include inhalation agents, sedative-hypnotics, benzodiazepines, phenothiazines or narcotics may be attempted.

One currently used narcotic technique combines meperidine with a phenothiazine, promethazine. Meperidine has both analgesic and anesthetic properties and is commonly used for the conscious sedation of uncooperative children requiring dental treatment.¹ The combination with promethazine, a sedative and antiemetic agent, achieves a moderate level of sedation and increased pain threshold.

The literature concerning this technique is minimal, and most of the well-designed studies supporting its use have been in healthy children. Studies using this

drug combination in children who are physically or medically compromised are fewer still, and there are none in the recent literature.

In 1961, Album evaluated the effectiveness of orally administered meperidine alone and in combination with promethazine to sedate handicapped patients for dental treatment.² The dose for those receiving meperidine alone was 50 mg. For those receiving meperidine and promethazine in combination, the dose was 25 mg of each. The dosage was not calculated by weight, but was given in general quantities and supplemented if necessary. The majority of patients required more than the initial dose, and Album reported an 80 percent success rate for both sedation regimens. While the success rate appears high, the following factors must also be considered in the interpretation of these data. There were different dosage regimens used within the handicapped population, and some patients were apparently given IV promethazine and meperidine. Occasionally mention was also made of comedication with secobarbital. Additionally, broad patient-selection criteria, inclusion of both normal and handicapped patients, and a wide range of ages (6-18 years) color the results.

Rosen and Rosenstein (1966) studied the use of orally administered meperidine, promethazine, and scopolamine and three other combination regimens in a population of thirteen cerebral palsy patients.³ The patient's medical and dental history in combination with the authors' previous experience determined which of the four drug regimens the patient received. Thirty-three

Dr. Haney is with the Public Health Service/Indian Health Service; Dr. McWhorter is Assistant Professor, Department of Pediatric Dentistry and Dr. Seale is Professor and Chairman, Department of Pediatric Dentistry, Baylor College of Dentistry.

separate doses of the four regimens were administered orally and the authors reported that seventeen of thirty-three sedations were considered successful in reducing fear and anxiety, primarily in patients from Group I (meperidine, promethazine and scopolamine) and Group IV (triflupromazine HCl and scopolamine). With twenty-seven sedations, good to excellent results were seen in a reduction of uncontrollable movements, again primarily from Groups I and IV. It was proposed that individualized regimens based upon the pharmacology of the drugs used could produce successful results in patients with similar physical characteristics. This deserves further consideration, especially if information concerning the patient's physical or mental diagnosis or routinely administered medications could be used to predict success with certain sedation regimens.

Meperidine and promethazine have been used for many years in mentally and physically compromised children in the dental clinics of two children's hospitals in Dallas, Texas. This retrospective study reviewed the data from the sedation logs of these patients over the past 2.5 years. The purposes of this study were to:

- Determine the success rate and safety of this regimen in modifying the behavior of medically and mentally compromised patients to facilitate dental treatment.
- Determine the relationship of the child's mental or physical status and previous hospital experience to the success of the sedation.
- Analyze the significance of the medical diagnosis on the success of the technique.
- Evaluate the patient's medication regimen with regard to success rate.
- Determine the effect of multiple sedations and different operators on outcome.

MATERIALS AND METHODS

Patient Selection

The sedation regimen consisting of meperidine and promethazine has been used for many years in the pediatric dentistry advanced education program of Baylor College of Dentistry. Two of the teaching clinics in the program are located in the pediatric hospitals of Texas Scottish Rite Hospital for Children (TSR), where the patient population is primarily from the orthopedic and neurologic services and Children's Medical Center of Dallas (CMC), a tertiary medical care facility. The patient-eligibility criteria for dental care in both of these institutions require that the child have a medical, men-

tal or physical condition that has a significant impact on the provision of dental care. Diagnoses commonly represented in these populations include: cerebral palsy, mental retardation, cardiac disease, chronic liver disease, childhood cancers, and spina bifida. All dental patients at these hospitals are under the care of pediatric specialists from multiple disciplines for long-term medical follow-up.

The medical and dental records of all pediatric dental patients receiving conscious sedation, using meperidine and promethazine between December 1, 1988 and April 30, 1991 at the dental clinics of TSR and CMC were selected for retrospective review. The guidelines for selecting patients for sedation at both institutions were essentially the same and all decisions to use sedation were reviewed and approved by an attending staff pediatric dentist before sedation of the patients. Criteria used for patient selection to be sedated included:

- Uncooperative behavior demonstrated at a previous appointment.
- Treatment needs requiring numerous lengthy appointments.
- Young age, and/or
- Severity of illness.

Indications for sedation were listed on the sedative record sheet for each patient.

Sedation Protocol

Sedation procedures were explained to all parents and consent was obtained. When appropriate, medical consultations were performed before the procedure. At the sedation appointment, baseline vital signs were taken and NPO orders confirmed before oral administration of meperidine at 1.0 mg/lb and promethazine at 0.5 mg/lb.

Approximately one hour later, vital signs were again obtained and recorded before treatment. During treatment, pulse, oxygen saturation, and assessment of behavior were recorded at ten-minute intervals and blood pressure and respiration rate were recorded every thirty minutes until treatment was completed. Nitrous oxide was also used in most cases at an initial concentration varying from 30 to 50 percent for the injection and then titrated downward to effect. Following completion of dental treatment, postoperative vital signs were obtained and recorded. The operator's overall assessment of success of sedation was recorded as well.

In addition to the vital signs, the sedation record contained the operator's assessment of the patient's be-

havior when the medications were administered, as well as at the start and completion of treatment. Additional information relative to the success of the sedation was written in the progress notes of the patient's hospital chart.

Data Collection Procedures

When this retrospective study was begun, assessment of the records concerning the sedation appointments revealed that the use of conventional behavior scales such as the Frankl Scale would not provide an accurate overview of the sedation.⁴ In this special patient population, other factors had to be considered. For example some patients were placed in the papoose board for treatment only to prevent uncontrolled movements resulting from their medical condition. Additionally, many of the cerebral palsy patients were not verbally communicative. A rating system based on the ability to complete treatment combined with the behavior of the patient, therefore, was designed.

A simplified Success Index (SI) was developed to consolidate information concerning a single sedation appointment and allow an independent examiner to read all entries concerning the appointment and determine whether the sedation was successful. It was discovered that the appointments could be easily divided into three categories. Category 3 described a highly successful appointment, required minimal or no promptings and corresponded to excellent. Restraints may have been used, but only for uncontrolled movements due to the patient's medical condition. Category 2 described a moderately successful appointment in which treatment could be safely provided with minimal restraint for resistant behavior and corresponded to fair or good. Category 1 described an unsuccessful sedation appointment in which treatment was either completed with great difficulty or aborted and corresponded to inadequate. For the purposes of this retrospective study, a successful appointment was deemed to be one rated as SI 2 or 3. Detail descriptions of these categories are found in Table 1.

All dental patients in this study were patients of record of the hospital where the clinic was located, and the medical chart provided an accurate history of the medical management. Variables that were examined for their effect on the outcome of sedation were defined from this information (Table 2). The medical history allowed patients to be assigned to a Medical Diagnosis Category based on the types of disorders that affected dental management. Specifically the patients were as-

signed to one of four categories, depending on whether there was a physical or neurologic component to their diagnosis as assigned by the physician. Longitudinal progress notes allowed further categorization of the patients with physical and neurologic components, according to the degree of involvement, as follows: Physical Impairment Status—ranked from 1 to 3 according to the patient's ability to ambulate; and Neurologic Impairment Status—ranked from 1 to 3 according to the child's ability to meet developmental milestones. Previous Hospitalization Experience was also ranked from 1 to 3 according to the number and recentness of admissions. Finally patients were categorized according

Table 1 □ Success Index (SI).

SI	Definition
1	Sedation is judged a failure. Treatment is either aborted or completed with great difficulty; however, when completed the operator has rated the effects of the sedation as ineffective in modifying uncooperative behavior or controlling movement even with patient restraint. Corresponds to inadequate.
2	Treatment can be completed but with mild to moderate difficulty. The patient cooperates with behavior modification techniques or with restraint in addition to sedation. Corresponds to fair/good.
3	Treatment can be completed with no or only minimal prompts. This may include those patients requiring restraint due to their inability to control movement due to their disease process, yet who are otherwise cooperative. Corresponds to excellent.

Table 2 □ Definition of Categories.

Physical impairment status	
1	= none: able to walk to chair unassisted
2	= minor: can walk to chair with minimal assistance
3	= multiple: multiple limb involvement; unable to transfer to chair without complete assistance; may demonstrate uncontrolled movement in the dental chair
Neurologic status	
1	= normal child: has accomplished age appropriate milestones
2	= mild involvement: can be trained to accomplish most goals (educable)
3	= severe involvement: dependent upon others for total care
Previous hospitalization experience	
1	= none
2	= surgery within the past year
3	= multiple admissions since 1 year of age
Medications	
1	= no regularly administered medications
2	= receiving medications that possess central nervous system actions or side effects
3	= receiving medication that do not possess central nervous system actions or side effects
Medical diagnosis	
1	= physical disease without a significant neurologic component
2	= neurologic disease without a significant physical component
3	= disease with combined physical and neurologic components
4	= disease without a physical or neurologic component

to physician prescribed medications. Those patients taking medications were further categorized according to the effects of their prescriptions on the central nervous system.

The effect of each category's impact on success of sedation was analyzed statistically. The effect of the three ranked variables was analyzed with respect to the SI by using the Spearman rho correlation coefficient, and the impact of concurrently administered medication and Medical Diagnosis Category was analyzed using chi-square analysis.

Many patients were sedated for dental treatment more than one time during the study period. To determine whether behavior remained the same, improved, deteriorated or was variable, the SI for the series of appointments were examined using chi-square analysis.

Care for the sedated patients was provided by eighteen pediatric dental residents and three instructors from an advanced training program in pediatric dentistry. It was decided to determine whether the sex of the operator had an impact on the success of the sedation. The operators were divided according to gender, and the impact of this factor on the success of the sedation was determined, using chi-square contingency table analysis. A significance level of $p < .05$ was set for chi-square analysis.

The percentage of successful sedations, those rated as an SI 2 or 3, was calculated for each hospital and then for the combined population. The success rates for the two hospitals were compared to determine whether a significant difference existed because the groupings by Medical Diagnosis Category were different for the two hospitals. This was the only examination of the populations as separate entities.

RESULTS

One hundred forty-three tertiary care patients (52 from CMC and 91 from TSR) were sedated with meperidine and promethazine for dental treatment during the study period. Patient ages ranged from two years, one month to eighteen years with a mean of six years, five months. The distribution was as follows: seventy-six patients in the two to five year-old range; fifty-seven in the six to nine year-old range; eight in the ten to thirteen year-old range; and two in the fourteen to eighteen year-old range.

Eighty-four patients were sedated only one time, while the remaining fifty-nine were sedated from two to six times for a total of 198 sedations. The combination of the two yielded 282 total sedations for review.

Analysis of success rates for CMC revealed 109 of 127 appointments were designated as SI 2 or 3 for a success rate of 85.8 percent. At TSR, 107 of 155 (69 percent) appointments were designated successful. Chi-square contingency table analysis revealed a significant difference between SI for the sedation appointments at the two institutions ($p = .0001$) (Table 3). Further analysis revealed that sedations were significantly more likely to be highly successful, SI 3, at CMC ($p = .0001$). When the sedations at both institutions were combined, 216 of 282 were designated as SI 2 or 3 for an overall success rate of 76.6 percent.

The ranked categories of physical impairment status, neurologic impairment status and hospital experience were compared to SI using the Spearman Rho correlation coefficient, and low correlation values (.12, -.09, and .24 respectively) were found. Medical Diagnosis Category (MD) was compared to SI using chi-square contingency table analysis and revealed a significant difference ($p = .0002$) (Table 4). Multiple chi-square analyses revealed that patients with neither physical nor neurologic impairment (MD 4) were significantly more likely to have highly successful sedations than patients with neurologic impairment (MD 2; $p = .0009$) or those with both physical and neurologic impairment (MD 3; $p = .0001$).

Physician prescribed medication category (MC) was compared to SI, using a chi-square contingency table analysis. There was no significant difference in SI for patients receiving no medications (MC 1) when compared to patients receiving non-CNS affecting medications (MC 3). The data for MC 1 and MC 3 were collapsed and compared to children receiving CNS affecting medications, MC 2 (Table 5). Evaluation of this new grouping using a chi-square contingency table

Table 3 □ Total Sedations TSR versus CMC (N = 282).

	SI 1	SI 2	SI 3
TSR	48	52	55
CMC	18	18	91

$p = .001$
chi-square = 128.46
DF = 2

TSR = Texas Scottish Rite Hospital for Children
CMC = Children's Medical Center of Dallas
SI 1 = Failure of Sedation
SI 2 = Moderate Success
SI 3 = Excellent Results

SI 1 vs. SI 2: NS
SI 1 vs. SI 3: $p = .0001$
SI 2 vs. SI 3: $p = .0001$
NS = Not Significant

Table 4 □ Medical Diagnosis Category Compared to Success Index (N = 282).

	SI 1	SI 2	SI 3
MD 1	4	7	14
MD 2	17	16	18
MD 3	22	24	23
MD 4	23	24	90

p = .0002
 chi-square = 26.492
 DF = 6

SI 1 = Failure of Sedation
 SI 2 = Moderate Success
 SI 3 = Excellent Results
 MD 1 = Physical Impairment Only
 MD 2 = Neurologic Impairment Only
 MD 3 = Both Physical and Neurologic Impairment
 MD 4 = Neither Physical nor Neurologic Impairment

MD 1 vs. MD 2: NS
 MD 1 vs. MD 3: NS
 MD 1 vs. MD 4: NS
 MD 2 vs. MD 3: NS
 MD 2 vs. MD 4: p = .0009
 MD 3 vs. MD 4: p = .0001

NS = Not Significant

Table 5 □ Physician Prescribed Medications Compared to Success Index.

	SI 1	SI 2	SI 3
MC 1 + 3	46	51	126
MC 2	21	20	18

p = .0016
 chi-square = 12.825
 DF = 2

SI 1 = Failure of Sedation
 SI 2 = Moderate Success
 SI 3 = Excellent Results
 MC 1 = No Physician Prescribed Medications
 MC 2 = CNS Acting Medications
 MC 3 = Non-CNS Acting Medications

SI 1 vs. SI 2: NS
 SI 1 vs. SI 3: p = .002 (chi-square = 9.561)
 SI 2 vs. SI 3: p = .0082 (chi-square = 6.983)

NS = Not significant

analysis revealed a significant difference between the combined groups (MC 1 + 3) and MC 2 (p = .0016). Further analysis revealed that patients receiving centrally acting drugs were significantly less likely to have either a moderately successful (p = .0082) or a highly successful appointment (p = .002).

Evaluation of the 198 appointments representing multiple sedations for fifty-nine patients was done to determine whether trends in behavior would become evident. A chi-square analysis revealed that the patient's behavior was significantly more likely to be variable, that is, to improve one time and deteriorate the next (p = .0001) or remain the same (p = .0095) than to improve or deteriorate consistently.

The only complication encountered was nausea and

vomiting. For the combined group, twelve episodes were reported for an incidence of 4.3 percent.

Operator Influence on Success

The twenty-one operators providing treatment during the 282 sedation appointments included eighteen pediatric dental residents and three program instructors. There were 133 sedations performed by male operators and 143 performed by female operators. A chi-square analysis revealed no significant difference existed between these groups when sex of the operator was compared to SI.

DISCUSSION

The present study was designed to allow the comparison of multiple medically related parameters in a population of medically and physically compromised children, to determine whether any affected the outcome of a sedative regimen intended to modify behavior and facilitate dental treatment. While the overall age-range appears to be wide (two years, five months to eighteen years), 93 percent of the patients treated were under ten years of age. The older children who were sedated presented with severe neurologic involvement and were, therefore, reasonable candidates for sedation.

The success rates found in this study (CMC, 85.8 percent; TSR, 69 percent; combined, 76.6 percent) are comparable to those of previous studies that used meperidine and promethazine in pediatric dental populations, and demonstrate the validity of the regimen in a population of medically compromised patients.^{2,3,5,6}

Examination of the multiple identified variables that might affect the success of the sedation revealed that the Medical Diagnosis Category did show a correlation to SI. Those patients with a neurologic component to their medical diagnosis were less likely to have highly successful sedation appointments. This may reflect the inability of the neurologically impaired child to comprehend the nature of his/her treatment, follow commands, and cooperate with the operator. The majority of patients with neurologic disorders in the present study were diagnosed with cerebral palsy, which is reported to have a 50-60 percent rate of mental retardation in addition to a high occurrence of physical impairment. Examination of the group that was both physically and neurologically compromised demonstrated no significant difference in success rate when compared to those children having only neurologic

compromise, indicating that the neurologic component is the more relevant of the two. When the degree of involvement was examined, a mild correlation was found between the degree of physical impairment and success, and neurologic impairment and success. A definitive relationship, however, did not exist. Children with only a physical impairment represented just 7.45 percent of the 282 total sedations, and this small sample size may have influenced the results.

When the impact of concurrently administered medications upon success was assessed in order to determine whether medications, exhibiting either direct or indirect CNS actions, would affect the sedation outcome, a significant relationship was found. Children taking CNS acting medications were significantly less likely to have highly successful appointments than children taking medications with no CNS actions ($p = .0075$). A large number of the children sedated had seizure disorders, which were often treated with medications such as phenobarbital. The prolonged use of CNS acting medications results in development of tolerance to the effects of the drug.⁷ The decrease in success of sedation for patients being treated with centrally acting medications is possibly a result of this tolerance. A second reason for decreased success in these children may be that certain seizure medications, phenytoin and phenobarbital, have been shown to decrease the oral bioavailability of meperidine.⁸

Categorizing the children according to number of previous hospital admissions was done in an attempt to correlate increasing numbers of admissions with an increase in negative behavior. An extremely low correlation was found, indicating that multiple hospital

admissions may have had little effect on behavior at a dental appointment. There are two possible explanations for this finding: first, children under tertiary care may be accustomed to the hospital and clinical environment and, therefore, desensitized; and second, both institutions are pediatric hospitals and have departments specifically designed to facilitate the child's transition to hospital care. These programs acquaint the child with the hospital setting by providing age-appropriate education regarding specific treatments that are intended to decrease the child's anxiety about the overall experience.

A statistical analysis of vital signs was not included in this report. All patients remained awake and responsive throughout treatment, however, and were dismissed with vital signs within normal limits. Nausea and vomiting were the only complications reported with an occurrence rate of 4.3 percent.

Another significant and interesting finding from this study was the apparent lack of impact of the use of multiple operators upon the success of the sedation. The operators ($N = 21$) who provided the treatment during the study period were eighteen residents and three program instructors from an advanced training program in pediatric dentistry; operators of different experience, therefore, provided treatment. The fact that the sex of the operator had no effect on success and that the patient's behavior did not vary greatly during multiple sedations with different operators indicated that subtle variations in operator technique appear to have no effect on outcome of sedation for patients in this population.

In the present study, the finding that the children's

The patient with a neurologic affliction,
using drugs that act on the central nervous
system, is not a likely candidate for
successful sedation.

behavior was more likely to be variable or remain the same even with different operators is interesting. Anecdotal reports appear to indicate that children who begin to demonstrate poor behavior at successive appointments continue to deteriorate, and for that reason, patients who have a poor initial sedation experience are not given a second chance for treatment with oral sedation. Behavior of patients in the present study was more likely to remain the same or be variable than to improve or deteriorate, demonstrating that it is difficult to predict behavior at future appointments. It might be suggested that children with marginal results should be given a second chance with sedation, therefore, before moving on to another treatment modality.

The results of this study support the concept that development of specific criteria, based upon individual analysis of the patient's status, will increase the chances for a successful sedation. The present study suggests that a prediction of success rate can be made, if assessment of the patient with regard to neurologic status and types of medications prescribed is performed. The neurologically involved patient taking centrally acting medications would be the least likely candidate for a successful sedation.

CONCLUSIONS

- The regimen of orally administered meperidine (1.0 mg/lb) and promethazine (0.5 mg/lb) was successful in modifying the behavior of a combined population of neurologically, physically, and medically compromised patients for dental treatment 76.6 percent of the time.
- Children having a neurologic component to their medical diagnosis or those taking physician prescribed medications with CNS actions were sig-

nificantly less likely to have successful sedation appointments.

- The degree of neurologic impairment was not correlated with success of sedation.
- The most common complication encountered was nausea and vomiting, which occurred in 4.3 percent of the combined population.
- Behavior of patients receiving multiple successive sedation appointments was more likely to remain the same or be variable than to improve or deteriorate over the course of treatment.
- The use of multiple operators and operator sex were not significantly related to the success of the sedation appointment.

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CHARACTERISTICS OF DENTAL CARIES IN PRIMARY MOLAR TEETH FROM PREHISTORIC TIMES TO THE 18TH CENTURY IN ENGLAND

A total of 1,974 primary molar teeth from the skeletal remains of 373 children from Prehistoric times to the 18th century were examined for caries prevalence and site characteristics. Results showed that caries in primary teeth was initiated more often at the cemento-enamel junction than the contact point in most time periods and that caries prevalence values recorded were comparable to those in other reports based upon much smaller sample sizes. Caries prevalence and site characteristics for primary molar teeth were found to be similar to those of permanent dentitions of corresponding periods, a finding that contradicts many previous studies. This study showed a higher caries prevalence in primary molars during the Romano-British period than recorded previously.

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Experience with midazolam as sedative in the dental treatment of uncooperative children

Tim C. Krafft, MD, DDS

Norbert Krämer, DDS

Karl-Heinz Kunzelmann, DDS

Reinhard Hickel, DDS

Children's dental treatment is subject to some inherent limitations that are not present in the treatment of adults. In particular the fact that children resist or refuse treatment gives cause to a number of difficulties. In the long run, treatment forced on a child leads to negative results.¹⁻³ Children once subjected to such treatment are persuaded only with difficulty to revisit a dentist, even if only for a regular check-up examination.

The alternatives often seem to be limited either to leaving the refusing child untreated or to using general anesthesia to control the child's behavior. In our clinic, for example, due to lack of capacity, general anesthesia can only be offered, however, after a waiting period of several months. General anesthesia is then a poor compromise between the need for treatment and the difficulties associated with the lack of capacity to serve. Follow-up treatment and procedures requiring several

sessions are not possible. Neither the child nor the parents can adapt to a treatment schedule involving such delays.

An increasing number of patients undergoing dental treatment were sedated with intravenous diazepam. The latter, a drug known for about a decade, may be administered in various forms. It has the disadvantage of a long half-life of elimination (24-48 hours), however, and the formation of active metabolites with a "second peak" effect.^{4,5} In our clinic, we have been accumulating practical experience in children's dental care since 1988.⁷⁻¹⁰ A clinical investigation was initiated in order to evaluate oral versus rectal application of midazolam and to report on favorable dosages.

PATIENTS AND CLINICAL PROCEDURE

Between June 1989 and March 1991 we treated seventy-two uncooperative children, ages 1.3 to 9.3 years, in a total of 182 sessions. In these sessions midazolam was administered for sedation (Figure 1). The children were divided into two groups. In the first group, the compound was administered orally to forty children, in ninety-one sessions, with an initial dosage of 0.7 mg/kg of body weight. The drug was dissolved in a favorite beverage and offered to the children. In the second group, midazolam was administered rectally to forty-seven children, also involving ninety-one sessions, with

Dr. Krafft is in the Department of Oral and Maxillofacial Surgery (Head: Prof. E.W. Steinhäuser, MD, DDS) of Erlangen-Nuremberg University.

Drs. Krämer and Kunzelmann are in the Department of Restorative Dentistry and Periodontology (Head: Prof. A. Petschelt, DDS) of Erlangen-Nuremberg University.

Dr. Hickel is in the Department of Restorative Dentistry and Periodontology (Head: Prof. R. Hickel, DDS) of Munich University.

For reprints contact Dr. Tim C. Krafft, Department of Oral and Maxillofacial Surgery, Glueckstrasse 11, D-91054 Erlangen, Germany.



Figure 1. Picture showing the respective positions of members of the operating team relative to the patient.

a dosage of 0.6 mg/kg of body weight. In the second group, fifteen of the children had already been given the sedative per os during their first sessions. The rectal application was accomplished by means of a thin rubber tube, which was attached by its olive-shaped end and led out of one side of the child's clothing (Figure 2). In both groups, midazolam was administered in accordance with clinical requirements.

All the children included in the study had come to the dental emergency department with acute complaints. Their level of cooperation was from poor to bad. In extreme cases, we could not examine well enough to determine their oral status. The parents were informed of the treatment and its risks. The children were examined by their family practitioners regarding their general physical condition with respect to anaesthesia.

For each child, at least one parent was present for the whole period of preparation and treatment. During the treatment, the child's head lay on the lap of the dentist. He was supported by his dental assistant, and two persons were assigned, as required, to keep the child calm during phases of exacting dental preparations (Figure 1). The beginning of the treatment was marked by the need for use of local anaesthesia. Sedation was supervised by a colleague experienced in the management of emergency cases; and the oxygen saturation of the blood was continuously monitored by means of a pulseoximeter. Following treatment the chil-

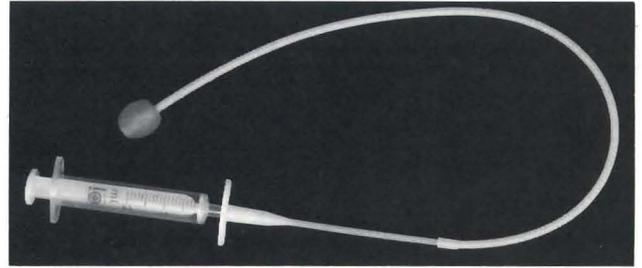


Figure 2. Silicone olive for rectal application of midazolam.

dren remained under observation until they were awake and could be safely discharged to the care of their parents.

Before and during treatment, the child's emotional status was recorded in accordance with the criteria of Breikopf and Büttner (1986).¹ Those authors suggested that the patients be classified in order to facilitate the statistical evaluation of the effectiveness of the treatment methods. The classification, which we applied according to Breikopf and Büttner, is shown in table 5; it was determined by a person observing the patients and not involved in the treatment itself. That observer also evaluated the patients' treatability during the sessions. The corresponding classification can be seen in Table 6. The statistical evaluation was done by SPSS/PC + V 3.0. By means of the t-test, the significance of the difference between the two treatment groups was determined.

RESULTS

The two treatment groups were uniform as regards sex, average age, weight, indications for treatment, and the course of treatment. The majority of the children required treatment for multiple carious lesions (Table 1).

Before the first sedation, the children had reacted in various ways to our initial contacts. For eighteen children we were able to perform only minimal steps of dental hygiene or some dental cleaning with polishing paste and rubber cup. Forty-three of the children

Table 1 □ Treatment situation.

Special case history	Number
"Nursing-Bottle" syndrome	30
Multiple carious lesions in posterior teeth	28
Acute pulpal symptoms	8
Trauma, emergency	6

refused any further treatment after determination of their oral status. For eleven children even this was not possible. The two groups were uniform as far as the types of treatment administered before the first sedation.

Individual dosages, total dosage of midazolam, and the total duration of treatment differed significantly between the two groups (Figure 3, Table 2). When midazolam was administered rectally, we were able to administer smaller doses and less frequently. Moreover, treatment duration is clearly shorter with rectal application, due to a quicker effect.

For thirty-two children, treatment was achieved in one session. For all other patients, multiple sessions were required (Table 3). As regards the number of sessions required for treatment, there was an equal distribution of individuals in the two groups. The treatments also included extractions and prosthetic restorations (Table 4). Here again the two groups were similar.

With the first (oral) group crucial problems arose in the administration of midazolam, due to its unpleasant taste. Moreover, the start of treatment, i.e., administration of a local anesthetic, required a delay of thirty

minutes after the child was given the sedative. In contrast, rectal application, with its faster absorption, made it possible to start treatment ten minute after application.

The children did not accept the rectal application as negatively as the oral application. Furthermore, in the

Table 2 □ Average times of treatment.

	Rectal	Oral	Level of significance	Separate variance estimate
Treatment start	15 min	33 min	F = 14.91, p < .001	t = 10.74, p < .001
Sedation duration	45 min	79 min	F = 3.14, p < .001	t = 7.03, p < .001
Treatment duration	31 min	48 min	F = 2.08, p < .001	t = 7.03, p < .001

Table 3 □ Frequency of sedation per patient.

Frequency of sedation	Number of patients
One sedation	32
Two sedations	12
Three sedations	9
Four sedations	9
Five sedations	5
Six sedations	—
Seven sedations	2
Eight sedations	3

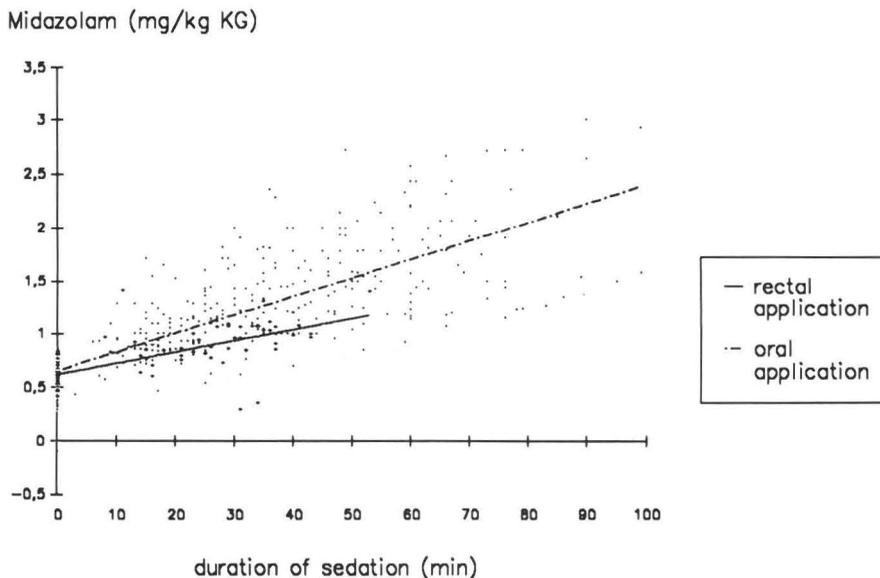


Figure 3. Midazolam (dosage-time-relation)

The closest approximation to the fitted curve results in a straight line ($y = aO + alx$); parameters of the curve:

for oral dosage: $a = 0.7$; $al = 0.02$, standard estimation error: 0.337,

Pearson coefficient: $r = 0.78$ ($R^2 = 0.61$);

for rectal dosage: $aO = 0.6$; $al = 0.01$, standard estimation error: 0.156,

Pearson coefficient: $r = 0.71$ ($R^2 = 0.51$) =

rectal group, reapplication was possible without interruption of treatment. The children in the oral group strongly protested further application of the midazolam solution during sedation. Statistical assessment of the data reveals that the sedative effect of midazolam was independent of varying emotional tensions observed before treatment. There was no correlation between agitation before treatment and more difficult treatment or between drowsiness before treatment and easier treatment (Tables 5 and 6). Induced amnesia did not cover application of the drug.

Paradoxical reactions were observed in three cases in the oral group. Low respiratory function in two children, revealed by 80 percent oxygen saturation as measured by the pulsoximeter, could be easily corrected by the application of oxygen.

The evaluation of the situation, as provided by the independent observer, was the same regarding both groups.

DISCUSSION

Up to this point, publications have not appeared concerning children's dental treatment under oral or rectal sedation with midazolam, particularly not including restorative and prosthetic procedures. Wilton *et al* (1988) reported on the rectal application of midazolam in children as a premedication before general anesthesia.¹¹ The authors employed varying dosages and came to the conclusion that 0.35 mg/kg of body weight is the most favorable dosage for premedication. Even Schou and Atanassof (1986) report on adequate preoperative sedation of children, making use of rectal doses of 0.35 to 0.40 mg/kg of weight.¹² Our rectal dosage of 0.6 mg/kg, and the oral dosage of 0.7 mg/kg were clearly higher.

Table 4 □ Types of treatment.

Dental procedures	Number, absolute	Mean value	Standard deviation	Minimum	Maximum
Fillings/crowns	366	1,99	1,45	0	9
Pulp treatments	179	0,79	0,90	0	4
Extractions	130	0,51	1,10	0	5
Impressions for prosthetics	18	—	—	—	—
Trepanation	16	—	—	—	—
Prophylaxis	11	—	—	—	—
Surgical interventions (incisions, tooth reposition)	6	—	—	—	—

Table 5 □ Classification of the emotional status before treatment.

Classification	Illustration	Oral	Rectal
Irritated	Awake, restless, crying	39	31
Normal	Awake, calm	36	54
Inactive	Tired, hardly moving	4	5
Sleepy	Without reaction, drowsy, awakable	1	—
No specification		11	1
n		91	91

Table 6 □ Classification of treatability.

Classification	Illustration	Oral	Rectal
Very good	Sleeping, awakable, treatment as under general anaesthesia	2	—
Good	Drowsy, tired, cooperative, longer treatment possible without restraint	16	25
Satisfying	Awake, calm periods of treatment of three to five minutes possible	50	34
Poor	Awake, calm crying, treatment only possible with restraint	17	31
Bad	Awake, shouting, aggressive, treatment impossible	5	1
No specification		1	—
n		91	91

0.35 mg/kg of body weight is the most favorable dosage when used as a premedication.

This higher dosage is required by the circumstances of dental treatment.

In the case of premedication for general anesthesia, all forms of stimulation should be avoided, to allow the child to calm down. It is the moment when an injection is given or a respiration mask is put on the face that requires optimal sedation. In dental treatment, however, the situation is quite different. Here the local anesthetic is injected first; only later is the hard surface of the tooth treated, which involves considerable noise and vibration. In the treatment of carious dentine with a low-speed revolving drill, patients feel annoying vibrations of medium frequency. Such extreme stimulation leads to stress for the patient and results in greater alertness. The aim, therefore, is to provide optimal sedation. This is achieved roughly thirty minutes after rectal application according to both Wilton *et al* (1988) and Schou *et al* (1986) at the point of maximum irritation.^{6,7}

The aspiration of rinsing fluid is counteracted by continuous suction. The little patients retain alert responses, and the cough reflex can be easily stimulated.

One great advantage of children's treatment under sedation is that it is feasible to repeat application of the drug, which is not true for general anesthesia. A sedative is not a great problem for the patient. It constitutes a low burden. Another positive aspect is the effective amnesic properties of midazolam. The children did not recall the difficulties associated with their refusals to drink the sedative liquid. In no case was there any increase in resistant behavior in subsequent treatment sessions. On the contrary, the children began to feel more at ease.

Due to the possibility of extending treatment over a series of sessions, new perspective and the possibility of more extensive dental treatment arise with the use of midazolam. In contrast where treatment employs general anesthesia, there are definite time limits involved, and only the most essential procedures can be undertaken. Under sedation, however, even restorative treatments, such as construction of crowns and dentures for children, can be performed. Children who could have received only the most essential treatment under general anaesthesia in view of their refusal of further treatment, can under sedation be provided with extensive dental treatment. We do want to stress, however, that out of consideration for the safety of the children, emergency facilities for intervention must be

at hand, when employing midazolam for the sedation of uncooperative children.

Regarding the comparative evaluation of the two treatment groups, we can also state that rectal application was found to be more favorable. This is due to shorter delay between application and effect, the lower total dosage involved, and the greater ease of repeating the use of the drug.

In some respect, the treatment of children, using the sedative midazolam is a superior alternative to dental treatment of children under general anesthesia. Primary teeth can often be saved from extraction, and thus remain in place to perform various important tasks such as mastication and fulfill their roles in speech development or in space maintenance.

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PREVENTION

Caries protection after orthodontic band cementation with glass ionomer

Mauricio Marcushamer, DDS
Franklin Garcia-Godoy, DDS, MS
Daniel C.N. Chan, DDS, MS

Glass ionomer cements (GIC) have been suggested as restorative materials and bases for composite and amalgam restorations.¹⁻⁶ GIC adhere to dentin and enamel, have stable matrix structure, release fluoride, reduce microleakage and prevent secondary caries.³⁻¹⁷

GIC have been recommended for a variety of procedures including occlusal, interproximal, labial, and lingual restorations; preventive glass ionomer restorations; tunnel restorations; and cementation of stainless steel crowns and orthodontic bands.¹⁸⁻³¹

The GIC adhesive properties, compressive strength, fluoride release, and prevention of secondary caries have prompted their recommendation as luting agents for orthodontic brackets and bands.^{18,32-37}

The purpose of this study was to evaluate the resistance of the enamel to an artificial caries challenge after removing orthodontic bands cemented with a GIC.

MATERIALS AND METHODS

Ten extracted human caries-free molars stored in 10 percent buffered formalin were cleaned with periodontal curettes and flour of pumice, using a rubber cup in a slow-speed handpiece. They were then rinsed with

deionized fluoride-free water (<0.02 ppm) and stored in plastic scintillation tubes with fluoride-free water.

The teeth were randomly divided into two groups of five teeth each:

Group 1: Cementation with GIC (FujiCap II).

Group 2: Cementation with a zinc phosphate cement (Mizzy).

Both cements were handled according to manufacturer's instructions. Before cementing the bands, an area of 5 x 5 mm was masked with adhesive tape on the lingual surfaces of all teeth. The orthodontic bands were cemented over this adhesive tape. After band cementation, the occlusal and gingival margins of the band were delineated with a bur on the tooth surface.

The teeth were thermocycled (200 cycles, 5-55°C, 30-second dwell time) and stored in distilled water for 24 hours. Then the bands and adhesive tape were removed and the teeth again stored in distilled water for a week, changing the water daily. The teeth were then varnished with the exception of a 5 x 5 mm window (including previously exposed and covered areas) on the buccal and lingual surfaces.

All teeth were then placed in an acidified gel (pH 4.5) for five weeks to produce artificial caries. At least three sections from the exposed and covered areas were made from the buccal and lingual challenged areas with a Silverstone-Taylor hard tissue microtome. The sections were then ground to approximately 100 µm. Polarized microscopy and image analysis were used to interpret the results.

Dr. Marcushamer is a postdoctoral student, Department of Pediatric Dentistry; Dr. Garcia-Godoy is Professor, Department of Pediatric Dentistry; and Dr. Chan is Assistant Professor, Department of Restorative Dentistry, University of Texas Health Science Center at San Antonio, San Antonio, TX.

A t-test was used to evaluate the statistical difference between the groups.

RESULTS

Group 1 showed 16.7 percent of the sections evaluated with enamel lesions versus 66.7 percent for Group 2 ($P=0.0001$).

In Group 1 the enamel surface exposed to the glass ionomer cement displayed minimal lesion formation while the control site of the same specimens revealed caries-like lesions (Figure 1).

In Group 2 the enamel surfaces and the control sites exposed to the zinc phosphate cement showed caries-like surface lesions, revealing no protection to the caries challenge (Figure 2).

DISCUSSION

The superior bond strength of orthodontic bands fastened with glass ionomer cements versus zinc phosphate has been demonstrated.³²⁻³⁶

Cements other than zinc phosphate have been used to secure orthodontic bands to teeth. Most of the cements did not provide a strong bond, however, and

the cements disintegrated in the oral environment. This breakdown produced enamel decalcification beneath the bands or around its margins, leading to incipient carious lesions.³⁸

The occurrence of enamel decalcification beneath orthodontic bands has been reported.^{34,38-40} These lesions are caused by the loss of mineral substance in the surface or subsurface of the enamel.⁴¹

Fluoride-releasing dental materials are effective in preventing secondary caries or caries on adjacent teeth.¹⁷ Some fluoride-releasing materials can reduce enamel solubility and acid production by bacteria that initiate caries.⁴²⁻⁴⁵

Fluoride released from glass ionomers concentrates in the enamel of the teeth that have been in contact with a glass ionomer cement for two weeks.⁴⁶ Fluoride inhibits enamel demineralization and also increases the initial rate of remineralization.⁴⁷⁻⁴⁹ Glass ionomer cements, with their fluoride content, have been shown to decrease enamel demineralization under orthodontic bands as compared to bands fastened with a zinc phosphate cement.³⁶ Although the amount of fluoride released by glass ionomer cements is small, the fact that it bonds to the tooth surface may be the reason for a localized continuous release providing the enamel

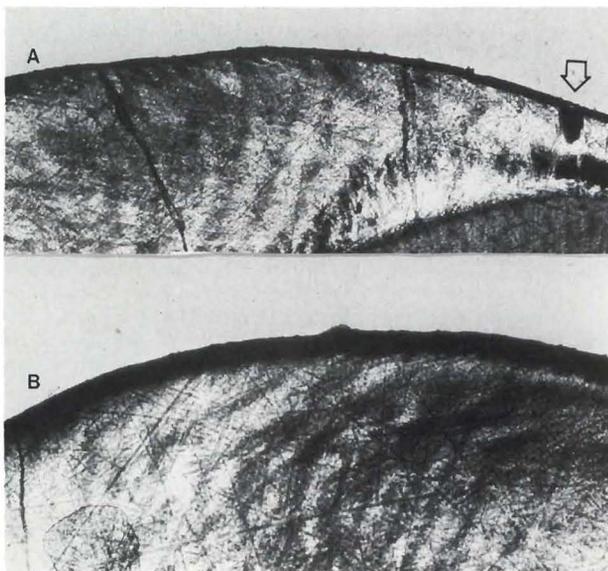


Figure 1. Longitudinal ground section of enamel surface A) exposed to glass ionomer cement showing minimal lesion formation and B) control site showing caries-like surface lesion. Arrow indicates area not protected by the glass ionomer cement with subsequent demineralization. Ground section imbibed in water. Polarized light 40x.

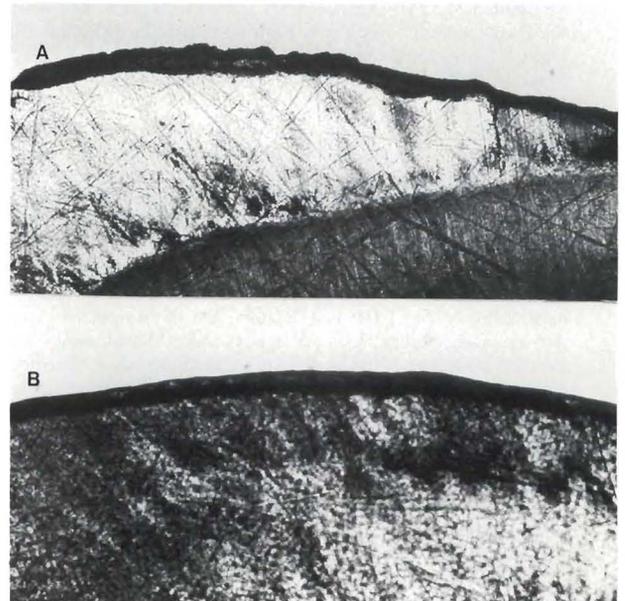


Figure 2. Longitudinal ground section of enamel surface A) exposed to zinc phosphate cement and B) control site. Both sides revealed caries-like surface lesion after artificial caries challenge. Ground section imbibed in water. Polarized light 40x.

with a higher caries resistance.^{12-14,50} The fluoride effect from glass ionomer cements has been shown to contribute to the reduction of demineralization.³⁵

Another advantage of the glass ionomer cementation of orthodontic bands is the failure mode, if the band becomes loose. When a band cemented with glass ionomer becomes loose or is removed with orthodontic pliers, most of the cement remains bonded to the enamel.³⁴ This failure mode permits the enamel to uptake the fluoride from the glass ionomer cement and offers the additional advantage of resistance to caries as documented in the present study.⁴⁶ This latter result is of clinical relevance because 50 percent of patients who received orthodontic treatment had white spot lesions on their teeth.⁴⁰

CONCLUSION

The present study demonstrated that the GIC provided a higher resistance to artificial caries challenge than the zinc phosphate cement after band removal. Coupled with the results of other studies, the present study supports the use of the glass ionomer tested for orthodontic band cementation.

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TOWARD A SOCIAL POLICY FOR HEALTH

Reform of the medical care system in the United States is now a political and economic priority. In the current debate, the terms "health care" and "medical care" are often used interchangeably, reflecting a cultural view that they are synonymous. As a result, health care reform is viewed primarily in medical terms.

"Health care" and "medical care," however, are not synonyms. Health care permeates all aspects of daily life. It centers on the prevention of illness. Health care includes social elements such as good housing and sanitation, a safe work environment, stable interpersonal relationships, sufficient income, and education. Medical care, in contrast, is only one aspect of health care. It centers on the diagnosis and treatment of disease after it has developed.

People in the United States expect their medical care system to address both health and medical problems, without clearly distinguishing between them. By viewing social problems as medical problems, we arrive at the erroneous conclusion that reform of the medical care system is the best route to improved health.

I shall explore here why our society, as well as the medical profession, has encouraged the "medicalization" of social ills. In brief, this approach has been less complicated than addressing the real problems. It has also been lucrative for individual practitioners and health care institutions. But . . . this strategy no longer works. And it is far too expensive. An alternative approach—one that permits the medical care system to focus on medical problems, not social problems—should be more affordable and more likely to improve the health of the population.

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CLINIC

Comparison of two methods for evaluating the occlusal marginal adaptation of posterior restorations

C.M. Kreulen, DDS, PhD

W.E. van Amerongen, DDS, PhD

P.J. Borgmeijer, DDS, PhD

H.B.M. Akerboom, DDS, PhD

The behavior and the quality of dental restorations have been the subjects of many clinical studies. In terms of quantification it is difficult, however, to define these concepts precisely. This lack of definition has been overcome by the evaluation of several measurable characteristics that were designed to reflect the clinical appearance and performance of the restorations under investigation.¹ These measurements of characteristics require valid procedures and reliable results.

One of the characteristics that has generally been accepted as a measure of the quality of restorations is the marginal adaptation.² The occlusal margins of restorations can be assessed both directly, clinically; and indirectly, outside the clinical setting. Assessment with mirror, probe, and operating lamp is probably the most frequently used direct method of evaluating the occlusal margins of restorations. In addition, indirect methods have been described that used clinical photographs or impressions. In these studies, observational assessments were made, sometimes supplemented by profilometry, stereomicroscopy, or SEM.³⁻⁵

This paper presents a comparison between a direct and an indirect method for evaluating the marginal ad-

aptation of both amalgam and resin composite Class II restorations. The direct method used modified Ryge criteria, while the indirect method made use of a photographic technique.⁶ The reliability of the methods is studied by determining the interobserver agreement. An impression of their validity is obtained by comparing the results of the two methods with assessments where a 'definitive yardstick' (or 'golden standard') was used.⁷

MATERIAL AND METHODS

The present study was carried out as part of a clinical investigation into Class II resin composite restorations.⁸ A total of 183 direct resin composite→ and 61 Class II amalgam● restorations of 'standard' size was applied in accordance with a detailed treatment protocol.⁸ Evaluations of the marginal adaptation were generally conducted within three months after application.

C.M. Kreulen Department of Pediatric Dentistry Academic Centre for Dentistry Amsterdam (ACTA) Louwesweg 1 1066 EA Amsterdam, The Netherlands.

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→Herculite XR (Kerr)
Clearfil Ray Posterior (Cavex Holland / Kuraray)
Visiomolar (ESPE)
●Tytin (Kerr)

Direct evaluation method

Direct assessments of the occlusal marginal adaptation were independently performed by three observers, combined to form three observer-pairs. In order to examine the marginal adaptation, the occlusal outline of the restorations was divided into 'sections' (Figure 1). The marginal adaptation of the sections was assessed in accordance with a four-point scale and ratings were recorded by a dental assistant (Table 1).⁸ Where there was a difference of two points (or more) between observers, a forced consensus was obtained. With a difference of one point, the final rating was determined as the average of the two scores. Thus, ratings of 1, 1.5, 2, 2.5, etc. were possible. Assessments were made under equivalent conditions, with the same instruments. The observers were calibrated by clinical consensus training sessions before and during the study. No observer agreement was determined at the start of the study.

Preparations for indirect evaluation

After tooth cleaning, impressions of the restorations were made using individual impression trays. The trays consisted of the following parts (Figure 2):

- A brass U-shaped bar; length 4.5 cm, width 1.5 cm, height 4 mm, thickness 2 mm. In the middle there was an oblong slot, and the two sides were perforated.
- (Individual) occlusal resin stops* at each end of the bar, which were not in contact with the teeth to be observed.
- Two removable resin side-wings and an occlusal top. The side-wings were clipped to the bar and the occlusal top fitted into the oblong slot.

These individually adapted impression trays were made with the help of full arch gypsum casts of each patient.

To make the impression, the occlusal surface of the restored teeth was covered with a layer of light body impression material.† Next, the tray was positioned, the remaining space was filled through the oblong occlusal slot (using a syringe) with medium body impression material, and the occlusal top was fitted. The impression obtained was mesially and distally boxed and poured in transparent epoxy resin.- Polymerization of the resin was performed at 37°C for 24 hours.

* Formatray (Kerr)

† Extrude (Kerr)

- Araldite D (Ciba-Geigy)

After polymerization, the side-wings (and the occlusal top) were removed and the resin model could easily be taken out of the impression without distortion of the silicone material.

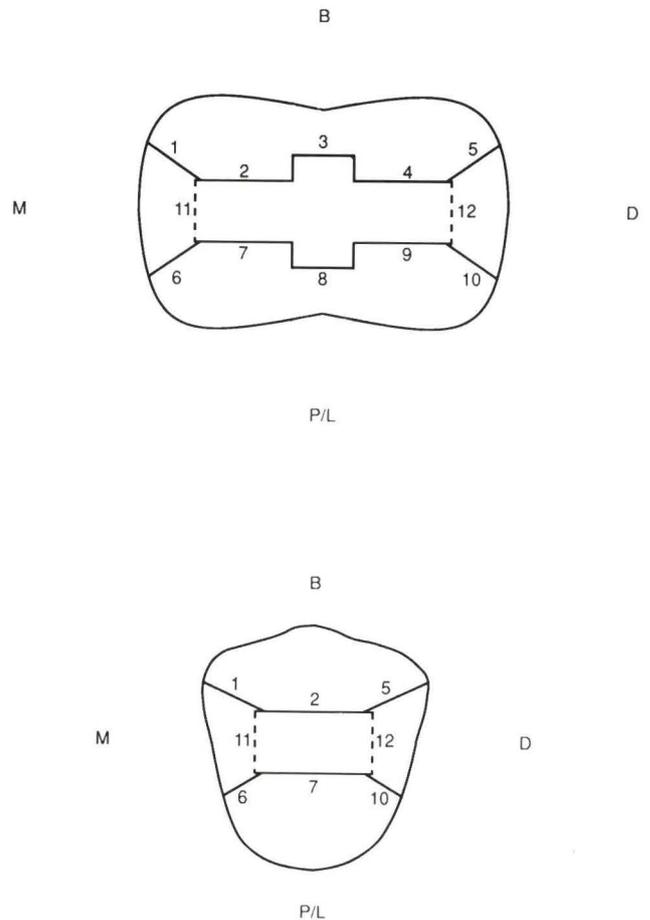


Figure 1. Division of the occlusal outline of a restoration into sections; molar (left) and premolar. B = Buccal, P/L = palatal/lingual, M = mesial, D = distal.

Table 1 Criteria applied during direct, clinical evaluation of the marginal adaptation.

Rating	Description of the criterion
1	No visible evidence of a crevice along the section of the margin, no catch of an explorer.
2	Visible evidence of a crevice along the section of the margin, an explorer catches slightly.
3	An explorer penetrates into a crevice but no dentin or base is exposed.
4	An explorer penetrates into a crevice, dentin or base is exposed.

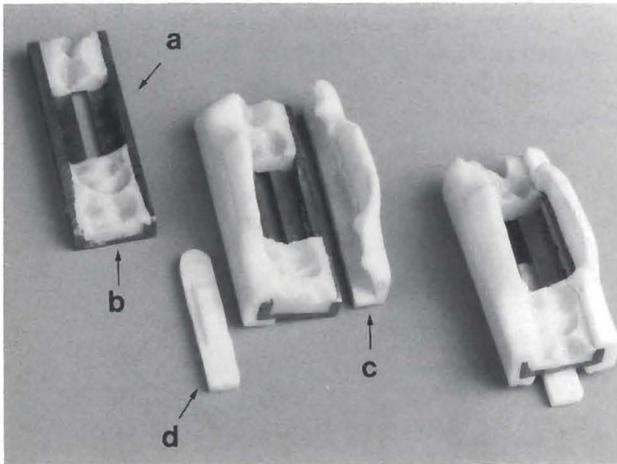


Figure 2. The individual impression tray.
 a = brass U-shaped bar
 b = occlusal resin stop
 c = removable side-wing
 d = occlusal top.

Indirect evaluation method

After removal of the epoxy models, the excess of impression material that remained beyond the brass bar was cut off, in order to obtain a good view of the occlusal surface. The interproximal impression material was also cut off. The brass bar was placed under a stereomicroscope, to which a camera with a black-and-white film inserted was fitted. Two light sources provided floodlighting from the left or the right at an angle of 45°, so that under- or overextended margins were displayed by shadowing. Each impression was photographed twice, with illumination from either side. The enlargement of the object after the total procedure (including printing of the photographs) was 9x.

Photographic assessment of the occlusal marginal adaptation was independently performed by two operators. The boundaries of the sections of the occlusal outline were marked on the photograph. The sections were assessed on a four-point scale in accordance with a standard series of photographs (Figure 3, Table 2). The determination of the final rating was identical to that for the direct method. Assessments were made under equivalent circumstances without additional enlargement equipment. Before the start of the study, the observers were trained with the help of the standard series of photographs.

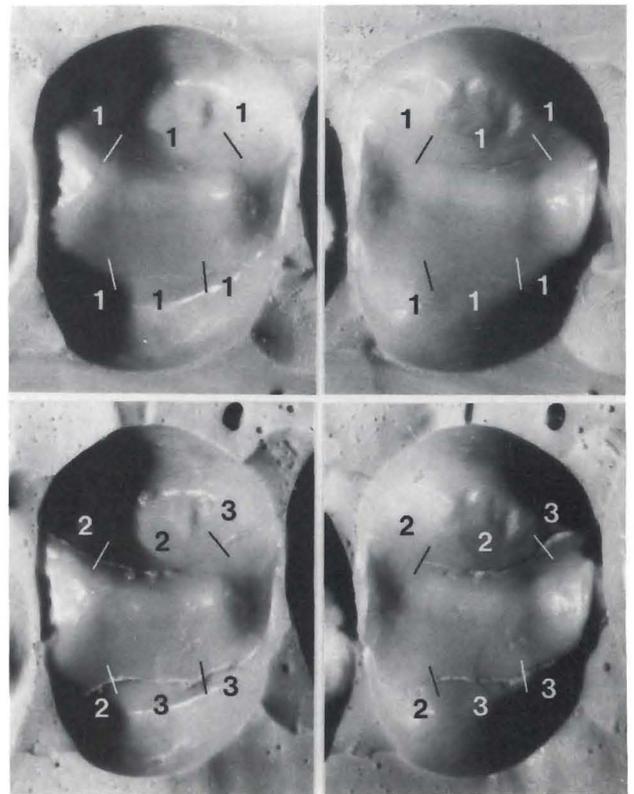


Figure 3. The standard series of photographs for the purpose of indirect assessments. The figures represent the ratings of the sections concerned (Table 2).

Table 2 □ Criteria applied during indirect, photographic evaluation of the marginal adaptation.

Rating	Description of the criterion
1	Margin not or slightly visible (shadowing/reflection* less than 0.5 mm).
2	Margin visible (shadowing/reflection between 0.5 and 1 mm).
3	Margin clearly visible (shadowing/reflection between 1 and 2 mm).
4	Margin and crevice highly visible (shadowing/reflection more than 2mm).

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

Yardstick measurement

On the basis of ratings of the same section of the same restoration by the two methods, epoxy models were sampled. The selection consisted of 125 sections: 30 showing equal inter-method ratings (both ratings 1 or 2), 65 with slightly different ratings (e.g. direct = 1 and

indirect = 1.5, or vice versa), and 30 showing unequal ratings (direct = 1 and indirect = 2, or vice versa), all randomly chosen. These models were gold-plated, and Figure 4 shows an example. The boundaries of the sections as shown on the photographs were reproduced on the models and the marginal adaptation of particular sections was evaluated qualitatively by means of a stereomicroscope (enlargement ten times). Two observers assessed the models by consensus according to a standard series. A scale of measurement was used that theoretically reflects the ratings of the two methods (Table 3): a rating of 1 was given when the transition between the enamel surface and the restoration surface could not be detected. If this transition was slightly visible a rating of 1.5 was given, and a 2 was given to clearly detectable margins without formation of a crevice.

Statistical procedure

The reliability of the methods was checked by determining the interexaminer agreement (intra-method agreement) using the percent-wise agreement and kappa values. Comparison of the results of the two methods was based upon the same statistical characteristics, and the Pearson product-moment correlation coefficient (inter-method agreement). The results of the two methods were compared with the results of assessment of the resin models (yardstick measurement). For cases that were rated with a single score on the yardstick, the mean rating for each of the two methods was determined.

RESULTS

Intra-method agreement

Table 4 shows the values of reliability characteristics for both the direct and the indirect methods. This includes all of the sectional assessments. The indirect method appears to show a greater degree of agreement between observers (97 percent), with a higher kappa value, than the direct method (85 percent). In percentage terms the agreement between the three pairs of observers ranged from 80 percent to 91 percent for the direct assessments. In this study, the lowest percentage agreement is associated with the highest kappa (0.45).

Inter-method agreement

Table 5 shows the frequencies of the average ratings with agreement between the two methods and those



Figure 4. An example of a gold-plated model.

Table 3 □ Criteria applied during the 'yardstick measurement' of the marginal adaptation.

Rating	Description of the criterion
1	No transition between enamel and restoration visible.
1.5	Transition between enamel and restoration is slightly visible.
2	Transition between enamel and restoration is clearly visible; no formation of a crevice.

Table 4 □ Reliability characteristics of the direct (clinical) method and indirect method of assessment of the marginal adaptation per section. Range of the three pairs of clinical observers in parentheses (N = 1597).

	Direct	Indirect
Kappa	0.43 (0.34-0.45)	0.87
Percentage agreement	85% (80%-91%)	97%

Table 5 □ Inter-method agreement, based on average ratings.

		Indirect ratings					Total
		1	1.5	2	2.5	3	
Direct ratings	1	1119	26	84			1229
	1.5	166	12	62			240
	2	68	10	46		2	126
	2.5			1			1
	3		1				1
Total		1354	48	193	2		1597

without. The weighted kappa value is low (0.28), with a percentage agreement of 74 percent. The Pearson correlation coefficient reveals a positive correlation between the two methods ($r = 0.33, p < 0.01$). More negative data have been collected with the direct, clinical method. Remarkable is one case where no deficiency was observed with the indirect method, whereas with the direct method a rating 3 was given.

Comparison with the yardstick

The ratings yielded by the direct and indirect methods for the 125 sections selected are compared with the ratings of the yardstick in Table 6. The correlations between the direct and the indirect methods with the yardstick are $r = 0.30$ and $r = 0.39$, respectively. For the three rating categories of the yardstick, the corresponding mean rating of each of the two methods is shown in the table. In cases where the yardstick rating is 1 or 1.5, these values of the yardstick are most closely approximated by the indirect method (1.07 and 1.47, respectively). It appears that the difference between the means of the indirect and the direct method, which is found where the yardstick equals 1, is reduced for higher values of the yardstick.

DISCUSSION

Generally the marginal adaptation of restorations is judged for the outline as a whole. Ratings are thus based upon the worst part(s) of the outline, without it being possible to define the site of the observation afterwards. This could interfere with the determination of interobserver agreement, since equal ratings could be based on deficiencies observed at different sites along the outline. Furthermore, when evaluative methods are then compared in a clinical study, the site of a deficiency observed by one method cannot be independently located by the other method. The sectional observation method permits the independent comparison of assessments made, using both methods.

In this study one evaluative method was based on tactile judging of the marginal adaptation, while the other used visual observation of the margin. It can be debated whether the methods actually detect (either by tactile or visual means) all the deficiencies in the

Table 6 □ The direct and indirect ratings compared to the ratings of the yardstick. For the cases where the yardstick yields the ratings 1 (N=23), 1.5 (N=51), or 2 (N=51), the mean (standard deviation in parentheses) of the direct and indirect method is shown.

		Yardstick*		
		1	1.5	2
Direct ratings*	1	14	21	9
	1.5	5	21	15
	2	4	9	27
Mean rating		1.28 (0.39)	1.38 (0.37)	1.68 (0.39)
Indirect ratings*	1	21	18	7
	1.5	1	18	15
	2		15	29
Mean rating		1.07 (0.23)	1.47 (0.41)	1.72 (0.36)

* the criteria are shown in Tables 1, 2, and 3

marginal adaptation. By comparing the methods it may be possible to trace differences between their results to inadequacies in the two approaches. Consequently, a definitive yardstick that measured according to a corresponding approach was used. Moreover, this yardstick was expected to detect all deficiencies within the limits of the accuracy of the approach. Possibly other techniques could have been used as a yardstick, such as profilometry or scanning electron microscopy. With SEM an essentially different (too detailed) approach is introduced, which interferes with a fair comparison. Figure 5 shows an example of this difference: with both the direct and the indirect method, the gap formation was not recorded. Profilometry represents a form of tactile measurement, but the measuring stylus is not able to trace all the margins, due to insufficient space between the cusps.

With both methods the ratings of the observers were averaged. The view that this reveals the 'truth' somewhere in between the ratings of the two observers is confirmed by the yardstick rating of 1.5 (Table 6). This rating of 1.5 was created as a real intermediate position

Reliability of methods was checked by determining the interexaminer agreement.



Figure 5. SEM photograph of a marginal gap which was not detected by direct and indirect assessment (640x).

between the ratings 1 and 2. Where the yardstick rating is 1.5, the means of the two methods approach this value, although there is a considerable standard deviation in each case. Furthermore, calculation of the interobserver agreement based on the raw data is acceptable, since differences of two points (or more) did not occur during assessments with the two methods (no consensus had to be reached in any of the cases). In the case of the direct method, it is difficult for observers to make a clear distinction between a particular section and the adjacent section. Summing the scores for buccal or palatal sections could eliminate differences due to subjective definition of the boundary of each section, but it proved not to be a reason for the differences between observers or methods (data not shown).

The indirect, photographic method appeared to be more reliable than the direct, clinical evaluative method (Table 4). The indirect method shows the most agreement with the yardstick when few (yardstick = 1) or no deficiencies (yardstick = 1) in the marginal adaptation are detected (mean ratings, Table 6). Based on the values of this table, the sensitivity of the indirect method is higher than that of the direct method where the yardstick rating is 1 (91 percent, and 61 percent

respectively). In this study, the specificity of the two methods hardly differs (indirect 75 percent, direct 71 percent). The values of 1.5 and 2 of the yardstick are associated with comparable sensitivity and specificity of the two methods. Thus a lower degree of deficiencies is detected best by the indirect method. As the degree of deficiencies increases, the difference between the means of the two methods, conditionally determined by the yardstick, seems to be reduced.

SEM reveals small marginal gaps which may not be detected by either of the two methods (Figure 5). Thus SEM would be an appropriate method for observing marginal deficiencies; but due to its labor-intensive nature, it is more suitable for application to small numbers of restorations. In this clinical investigation, with a relatively large number of restorations, the choice was made to use less sophisticated methods with a different level of precision. Direct, clinical assessments are easy to perform. On the other hand, the situation is not established, and remeasurement, therefore, is not possible. The indirect, photographic method does not have this disadvantage. If few deficiencies are expected, this method is favorable, although the choice of method is not clear if more deficiencies occur.

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Evaluation of occlusal marginal adaptation of class II resin-composite restorations

C.M. Kreulen, DDS, PhD
W.E. van Amerongen, DDS, PhD
H.B.M. Akerboom, DDS, PhD
P.J. Borgmeijer, DDS, PhD
R.J.M. Gruythuysen, DDS, PhD

Marginal adaptation is generally considered to be one of the characteristics in determining the quality of restorations.^{1,2} Underextending of the restoration exposes the subsurface enamel to oral fluids, as a result of which plaque retention can occur. Overextended restorations may also give rise to plaque accumulation, and their occlusal margins are susceptible to fracture. A good marginal adaptation helps to prevent marginal fracture of either the restoration or the enamel. Furthermore, gaps between the restorative material and the tooth structure could result in leakage.

Studies on the performance of resin composite restorations reveal excellent occlusal marginal adaptation of restorations ranging from 71 percent to 100 percent at baseline.³⁻⁷ All of these studies used modified Ryge criteria to assess the marginal adaptation directly. In a previous paper, direct clinical evaluations using modified Ryge criteria were compared by using an indirect photographic technique.⁸ Based on those results, this photographic technique was preferred to evaluate the margins of resin composite and amalgam restorations

in the present clinical study. This paper describes the results of assessment of the marginal adaptation of Class II resin composite and amalgam restorations and some possible factors of influence are examined.

MATERIAL AND METHODS

This study assessed the marginal adaptation of 183 resin composite and 61 amalgam restorations. A series of four materials → was randomly allocated to series of four "standard-size", conservative, Class II restorations for each patient (56 patients in total; age 24 years [s.d. 5]). Cavity distribution was dependent on the teeth that needed restorative treatment. The overall design of this study has been described elsewhere, including an outline of the restorative procedures.⁹ Three dentists were involved, all of whom made equal numbers of restorations of each restorative material. Selectively bevelled occlusal margins were applied for the composite restorations. To complete the restorations, finishing and polishing of the resin composites was done using x-fine diamonds, rubber cups and points, and polishing paste. The amalgam restorations were finished using carbide

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Prepared in: the Department of Pediatric Dentistry, Academic Centre for Dentistry Amsterdam (ACTA), The Netherlands.

→ Herculite XR (Kerr)
Clearfil Ray Posterior (Cavex Holland/Kuraray)
Visiomolar (ESPE)
Tytin (Kerr)

finishing burs, rubber cups and points, and polishing paste.

All restorations were recorded in accordance with the indirect method described earlier, generally within three months after placement.⁸ The occlusal surfaces of the impressions were photographed twice by means of a stereomicroscope, one exposure being floodlit from the right side, and one from the left. This procedure results in photographs (enlargement 9x) in which shadowing reveals deficiencies in the marginal adaptation. Marked on the black-and-white photographs, the occlusal outline of each restoration was divided into sections along the margin in order to locate the deficiencies observed (Figure 1). The sections were assessed for their marginal adaptation according to a four-point scale (Table 1).⁸ Two trained and calibrated observers independently rated the photographs with the help of a standard series. Joint decision-making was applied, if the ratings differed by more than 1 scale-point. Agreement between the two observers was 97 percent, with a kappa value of 0.87.⁸

A value of adaptation for each restoration is obtained that represents the mean of all sections included in the occlusal outline of the restoration (referred to as 'mean marginal adaptation'). Each value is based on the average of the ratings awarded by both observers per section. The figures for marginal adaptation should provide information on the quality of the occlusal marginal adaptation, considering the restoration as a unit. A mean value of 1 indicates an excellent marginal adaptation. In cases of higher values, at least one section is rated 2 or more by one of the observers. Frequency distributions of the deficiencies observed will be presented. In processing the data, the influencing factors considered are: the restorative material, the dentist, the type of tooth, and the type of restoration. Their influences are studied using Chi-square tests. Taking into account slightly skewed distributions of the variables, type of tooth, and type of restoration, logistic regression analyses were also performed.

As well as considering the restorations as units, each section is also regarded as such. This enables the localization of the parts of the outline that show the most deficiencies. Furthermore, marginal cavity design may have an influence on the results. Nonbevelled parts of the outline of resin composite restorations are located at the cuspal slopes (sections 2,4,7, and 9). Since the boundaries between bevelled and nonbevelled parts are located more or less similarly to the boundaries of the specific sections to be observed, it is possible to study differences in adaptation between the two mar-

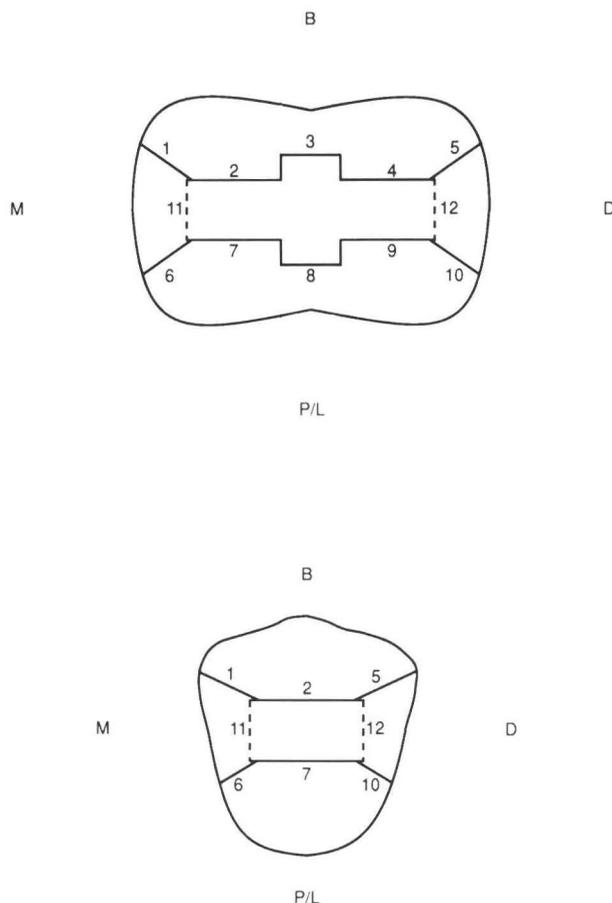


Figure 1. Division of the occlusal outline of a restoration into sections; molar (left) and premolar. B = Buccal, P/L = palatal/lingual, M = mesial, D = distal.

Table 1 □ Criteria applied during indirect, photographic evaluation of the marginal adaptation.

Rating	Description of the criterion
1	Margin not or slightly visible (shadowing/reflection* less than 0.5 mm)
2	Margin visible (shadowing/reflection between 0.5 and 1 mm)
3	Margin clearly visible (shadowing/reflection between 1 and 2 mm)
4	Margin and crevice highly visible (shdowing/reflection more than 2 mm)

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

ginal cavity designs. In contrast to the mean marginal adaptation, the rating of each section is based on the least favorable score given by one of the two observers.

RESULTS

Mean marginal adaptation

Figure 2 shows the mean marginal adaptations for Class II resin composite restorations and Class II amalgam restorations. In the case of the resin composites, the distribution of the data is positively skewed, with most of the restorations having an excellent marginal adaptation (64.5 percent). The distribution of the amalgam restorations is less skewed and consequently the percentage of restorations with an excellent marginal adaptation is much smaller than with composites (21.3 percent). With resin composite, two molars had one

section rated as 3 (1.1 percent); no amalgam sections were rated as 3 or more. If a division is made between excellent and nonexcellent occlusal marginal adaptation, the 1.1 percent of the resin composite restorations can be included in the group with sections having ratings of 2, the 'nonexcellent' group. As a result 35.5 percent of resin-composite and 78.7 percent of amalgam restorations are rated as nonexcellent. This difference is significant (Chi-square, $p < 0.001$).

The factors influencing the marginal adaptation are depicted in Table 2. The results of the two-way division of the mean marginal adaptation ratings (excellent/nonexcellent) are presented. In the case of resin composite restorations, the influence of the operator on the

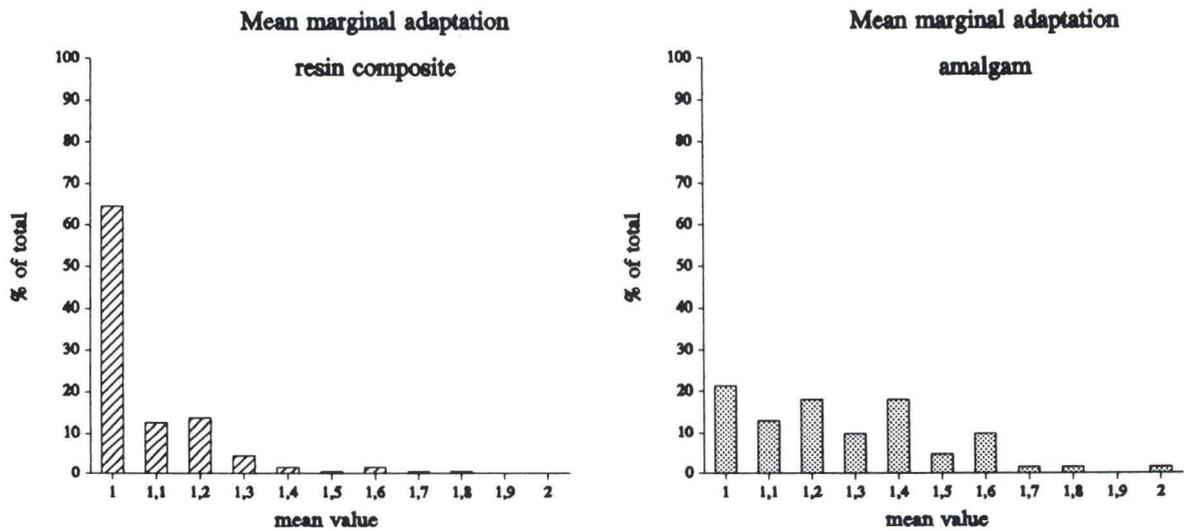


Figure 2. Frequencies of the mean marginal adaptation of Class II restorations: resin-composite (left), $N = 183$, and amalgam, $N = 61$.

Table 2. Influence of the factors examined on the mean marginal adaptation.

		Dentist			Type of restoration		Type of resin-composite			Type of tooth	
		1	2	3	Two-surface	Three-surface	Herculite XR	Clearfil Ray	Visio-molar	Pre-molar	Molar
Resin composite	N	60	60	63	124	59	61	61	61	123	60
	mean = 1	76.7%	38.3%	77.8%	63.7%	66.1%	63.9%	72.1%	57.4%	71.5%	50%
	mean > 1	23.3%	61.7%	22.2%	36.3%	33.9%	36.1%	27.9%	42.6%	28.5%	50%
	p-value	< 0.001			n.s.*		n.s.			< 0.01	
Amalgam	N	20	20	21	42	19				28	33
	mean = 1	30%	5%	28.6%	19%	26.3%				25%	18.2%
	mean > 1	70%	95%	71.4%	81%	73.7%				75%	81.8%
	p-value	n.s.			n.s.						n.s.

*n.s. = not significant mean = 1 : mean marginal adaptation equals 1, refers to an excellent marginal adaptation mean > 1 : mean marginal adaptation more than 1; at least one section is not rated as excellent.

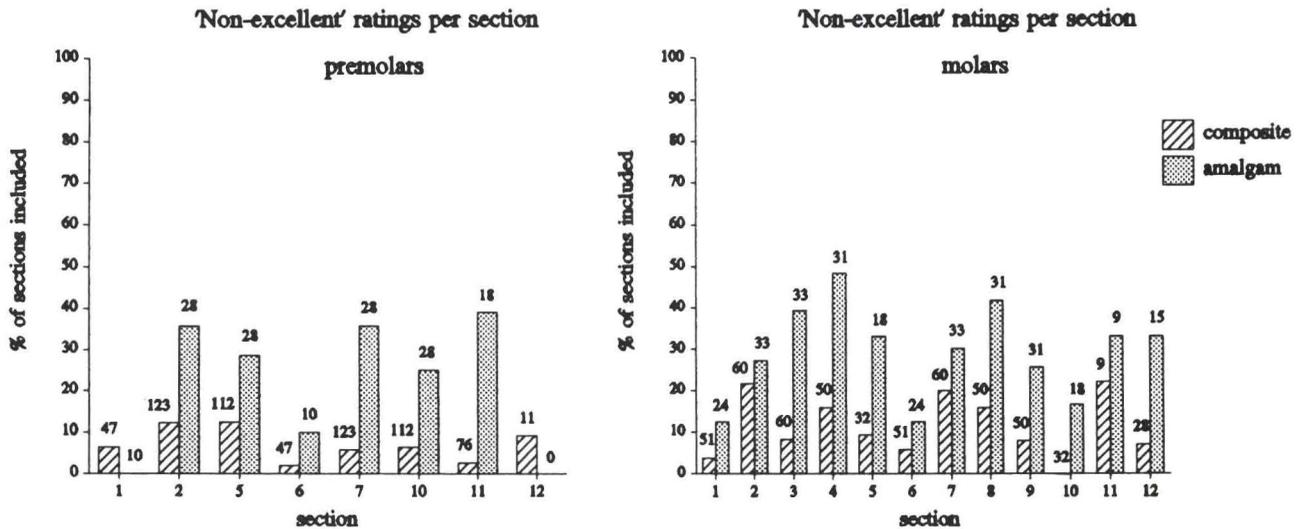


Figure 3. Frequencies of 'nonexcellent' ratings of premolar (left) and molar sections (right) for Class II resin-composite and amalgam restorations. Above each bar the total of each section is shown.

mean marginal adaptation is significant (logistic regression, $p < 0.001$). This is primarily due to dentist 2, who produced the most restorations with deficiencies. Premolars show fewer marginal deficiencies than molars (logistic regression, $p < 0.01$). Restorations with two or three surfaces do not differ in their mean marginal adaptation. Nor does the type of resin composite material appear to affect the results. In the case of amalgam restorations, none of the factors observed has a substantial influence (logistic regression, $p < 0.05$ for all three factors).

Marginal adaptation per section

Figure 3 shows the frequency distributions of the nonexcellent marginal adaptations of premolars per section for both resin composite and amalgam restorations (the left graph); the graph to the right similarly represents the molars (section 12 was not included in any of the premolar amalgam restorations). If the dovetail sections are excluded (sections 11 and 12), sections 1 and 6 generally show the most excellent ratings. The (bevelled) sections of the distal box of resin composite restorations in molars (5 and 10) also tend to show fewer deficiencies on average. Most deficiencies in the composite marginal adaptation are found in premolars with sections 2 and 5, of which section 2 is a nonbevelled margin. In molars these are observed in sections 2, 4, 7, and 8; here three of these sections are nonbevelled margins. Thus, if a distinction is made between bevelled and nonbevelled sections, Table 3 can be con-

Rating per section*	Bevelled	Nonbevelled	Totals
1	665	407	1070
2	53	59	114
Total	718	466	1184

*1 = excellent marginal adaptation
 2 = nonexcellent marginal adaptation

structed. The results indicate a significant difference in deficiencies in marginal adaptation between bevelled and nonbevelled margins.

DISCUSSION

The frequency of restorations showing excellent occlusal marginal adaptation in this study is low (64.5 percent with resin composites, and 21.3 percent with amalgams) compared with the results of other clinical studies of composite restorations in which the percentage of those in the excellent group varied from 71 percent to 100 percent at baseline (clinical assessments, Alpha rating according to the Ryge criteria). The difference could be explained partly by absence of a sharp boundary between the Alpha and the Bravo rating, if the (modified) Ryge criteria are applied. This indicates that strict criteria in clinical research are needed in order to compare results of different research groups. Furthermore, the difference could be due to the delay elapsing between placement and assessment of the res-

torations in this study (mean 75 days, s.d. 50), compared to other studies.

It is worth discussing whether the dentists were skilled in using both materials. In this study, the amalgam restorations can be used as a reference, since the same indirect photographic evaluative method was used in a study of amalgam restorations.¹⁰ Three dentists participated in that study (one of whom also participated in the present study) and the mean marginal adaptation at baseline was found to be 1.35 (s.d. 0.28). In the present study the amalgam mean marginal adaptation was 1.28 (s.d. 0.24). The effect of the dentist as observed in the present study could have a substantial influence on the differences between various studies of composites. This lends support to the view that clinical research on restorative materials should not be performed by one operator, in order to prevent unknown operator effects.

The presence or absence of an occlusal bevel could additionally account for differences between studies. Views on the ease of finishing nonbevelled or bevelled margins differ widely.^{5,11} In particular, marginal excess of composite material is thought to remain easily undetected in the case of a bevelled margin. If the marginal cavity design has an influence, studies that use these two concepts should produce different values of marginal deficiencies. This assumption is, however, not clearly supported by literature. In the present study the dentists seemed to experience an opposite effect produced by these two marginal designs upon finishing: the bevelled margins showed significantly better adaptations than did the nonbevelled margins. Probably the use of a contrasting extra-marginal nail polish was relatively effective in detecting marginal excess during finishing in the bevelled areas.⁹

The influence of the type of tooth restored with resin-composite can probably be attributed to the difference in the number of sections per tooth. The outline of a molar restoration contains more sections than that of a premolar. It follows there is a greater chance that the mean marginal adaptation of a molar will be rated, therefore, as nonexcellent compared to a premolar. The difference between resin-composite and amalgam restorations is due to a higher proportion of deficiencies found in all amalgam sections and not to a few sections in particular (Figure 3). This may be caused by differences in material properties that have an influence during polishing of the margin. The three resin-composite materials did not show significant differences in their mean marginal adaptation. Surprisingly two resin composite restorations in molars each showed a section rated 3. One was a bevelled marginal section, the other non-bevelled. This is assumed to be a dentist's fault.

On the basis of the indirect method of evaluation, the occlusal marginal adaptation of Class II resin-composite restorations is not excellent in all cases; but in view of clinical circumstances, the percentage of good adaptations is considered to be satisfactory. Stangel *et al* described small baseline defects leading to marginal fractures after two years.¹² The section method used in this study enables defects to be located more precisely, making the study of such changes in marginal adaptation possible.

CONCLUSIONS

- Assessments on direct Class II resin-composite restorations shortly following their placement, reveal the dentist to be an important factor in the quality of marginal adaptation.
- In this study, the resin-composite restorations showed substantially better marginal adaptation than amalgam restorations after a mean period of three months.

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Specialist clinicians' perceptions of dental fluorosis

Paul J. Riordan, BDS, MPH

It has long been accepted that growing up in areas with fluoridated water at caries preventive levels entails a risk of very mild fluorosis.¹ Reports of dental fluorosis in children in communities that have fluoridated drinking water confirm that the risk continues.²⁻¹² North American authors have suggested that the prevalence of fluorosis has increased since the widespread adoption of water fluoridation though this is not a universal finding.^{2,10,12} Burt has suggested the increase may be a cohort effect which peaked in North America after implementation of various recent strategies aimed at reducing fluoride intake.¹³ Implicated sources of fluoride include fluoride in water, supplements, and fluoridated toothpaste; the use of infant formula with high fluoride content; and the spread of fluoride by foods processed in fluoridated areas.^{13,14} Whereas the availability of fluoride when fluoridation was first introduced was not sufficient to bring about much unsightly fluorosis, the cumulative effect of exposure to additional sources of fluoride may have been an increase in unsightly fluorosis in child populations.⁹ Fears have been expressed in several countries that fluorosis levels today might threaten the credibility of health agency officials and the continued implementation of water fluoridation.^{9,12,15-19} This would put at risk a very important disease control strategy.

Changes in fluorosis levels over extended periods of

time are difficult to estimate.¹⁰ Problems include the delay between exposure to elevated fluoride levels and the resultant fluorosis; examiner reliability from one observation period to the next; the use of different indices to measure fluorosis; and the fact that, typically, researchers pay attention to an issue for only a limited period of time. In North America, comparisons of the prevalence of fluorosis reported in early studies with modern surveys indicate slight increases in prevalence and severity; there are inherent problems, however, with comparing the findings of different examiners at different times.¹⁰ No historical studies of fluorosis have been conducted in fluoridated areas of Australia. Using the Thylstrup-Fejerskov index of fluorosis (this index requires teeth to be cleaned and dried before fluorosis is diagnosed on the basis of the appearance of the enamel), fluorosis prevalence in twelve-year-olds in fluoridated Perth, Western Australia, was recently estimated to be about 40 percent.^{8,20} A subsequent study of seven-year-olds in Perth reported a prevalence of 48 percent, suggesting that prevalence may be rising still.⁹ The prevalence of more severe levels of fluorosis (graded on the Thylstrup-Fejerskov index as $TF \geq 2$) was 11 percent among twelve-year-olds and 17 percent among seven-year-olds in the same studies, suggesting that the prevalence of more severe fluorosis may be increasing in Perth.²⁰

Clinicians are likely to notice many conditions occurring in the community in which they operate. They can also influence their patients' behavior. In Western Australia, the only dental clinicians outside the school dental service who see many older children are the

Dr. Riordan is with the Health Department of Western Australia and the Dental School, University of Western Australia, Perth, Australia.

registered orthodontists. Using interview methods the present study was undertaken to record their assessment of trends in the prevalence of enamel mottling, their knowledge of the links between mottling and fluoride intake, and the extent to which they felt these issues to be problems among their patients.

SUBJECTS AND METHODS

The purposes and methods of the study were explained to the President of the Western Australian branch of the Australian Society of Orthodontists, who gave the study his support. There are thirty-seven registered orthodontists on the "List of Registered Dentists 1992".²¹ Two have registered addresses outside Western Australia. The Western Australian-based orthodontists each received a letter explaining the purpose of the study. First contact with each potential participant was made by telephone within a week, and all interviews were conducted within three weeks of the letter being sent. The year of each respondent's dental qualification was noted from the List of Registered Dentists 1992.

Interviews were conducted on the telephone by one interviewer. A semi-structured schedule was used to guide the discussion, but respondents were not constrained by the format.²² Responses to prepared questions were noted as were other comments and opinions triggered by the questions. Interviews were conducted mostly in business hours, but usually at a time of the respondent's choosing. Most interviews required about twelve to fifteen minutes.

Questions put to participants are listed in Table 1. It was explained that questions pertained to child and teenage patients and to permanent teeth only. A final open question invited any opinions or comments the respondents had concerning enamel defects. Except when respondents' answers anticipated later questions, the same order of questioning was adhered to. In particular, fluoride was not mentioned by the interviewer until late in the interview. The term fluorosis was not introduced at all by the interviewer; "enamel defects" was used to avoid suggesting responses, and care was taken to ensure that respondents understood that it was defects of enamel formation rather than iatrogenic defects that were of interest.

RESULTS

Thirty-four orthodontists (97 percent) participated in the study; one did not. The nonrespondent did not explicitly refuse to participate, but was impossible to

Table 1 □ Question items and distribution of responses provided by interviewees. It was explained that all questions related to child and teenage patients and to permanent teeth. Some questions invited more than one answer. No all respondents answered all the questions.

Item	Responses
Have you noticed defects of enamel formation in the permanent teeth of child or teenage patients frequently?	Yes: 34
Do you have any views about the causation of the defects you see?*	Hereditary causes: 4 Febrile conditions/Medication: 7 Fluoride: 23 Trauma: 4 No opinion: 2
Do you feel that the prevalence of defects of enamel formation has changed among your patients in recent years?	No change/don't know: 11 Yes (increase): 15 Yes (decrease): 3
Have you seen enamel defects which, in your opinion, are cosmetically displeasing? Frequency?	Yes: 24 > 1/month: 15
Have you seen enamel defects which, in your opinion, are co cosmetically displeasing that treatment would be indicated? Frequency?	Yes: 30 > 1/month: 4
Have patients/parents spontaneously raised questions about enamel defects? Frequency?	Yes: 33 No: 1 > 1/month: 17
Is there any single predominating cause of these enamel defects that comes to your mind? What?	Fluoride: 19 Hereditary defects: 2 Trauma: 3 Febrile conditions: 4
Do you associate the defects you have seen with the use of fluoride?	Yes (definitely): 22 Possibly: 9
It is known that fluoride can cause mottling of enamel, but is also prevents cavities. Do you think the enamel defects you have seen, if caused by fluoride, suggest that fluoride exposure should be reduced?	Yes: 7 No: 24 Don't know: 2
Do you think that fluoride intake, sufficient to cause enamel mottling, is under the patient's or parent's control?	Yes: 12 No: 16 Unsure: 6

* More than one response accepted.

reach by telephone despite attempts over several weeks. All but two respondents were men, and all but two were based in fluoridated Perth (0.8 mg/l). In addition to the two who worked outside Perth (in nonfluoridated country towns), several of the Perth-based orthodontists regularly conducted practice in different remote parts of Western Australia. No distinction was made between the respondents on the basis of where they practiced. The earliest year of graduation as a dentist was 1953, and as an orthodontist was 1960. The mean period since graduation as a dentist was 22.5 (S.D. 11.1) years. Nineteen had been trained as dentists within, and fifteen outside, Australia; many had trained as orthodontists in other countries. About a third were immigrants to Australia. All the respondents had regular clinical practice, but several of the older orthodontists worked just a few sessions per week.

The distribution of responses to the main questions is shown in Table 1. All respondents had noticed enamel

defects among their patients, and just over half of them thought that there had been a recent increase in prevalence. Fluoride was volunteered most frequently as a cause of the defects, but other causes mentioned were hereditary conditions, trauma, febrile diseases in childhood, and the use of medications. Tetracycline was mentioned specifically by several respondents. What they considered to be cosmetically displeasing defects had been seen by most respondents, but only about half reported seeing such conditions more than once per month among new patients. Many respondents reported that they had seen defects which, in the respondent's opinion, would warrant cosmetic dental care. A small number of respondents felt, however, that no esthetic treatment would be warranted, as it would entail risk or harm for the tooth. All respondents had had patients or parents who had spontaneously asked about the appearance of their dental enamel. The majority of respondents felt that patients were usually more concerned about enamel defects than were the respondents.

When asked whether they associated these enamel defects with the use of fluoride, about two thirds of respondents answered affirmatively and others felt that this was possibly the case. When asked, however, whether they thought that the enamel mottling they had seen, if due to fluoride ingestion, was reason to justify reducing fluoride exposure, only seven (19 percent) thought that this would be appropriate. Three respondents were very emphatic, and most of the others supported the view, that the improvements in children's dental health that had occurred in recent decades were so great that, if the price was some enamel mottling, then this was acceptable. More than half of the respondents felt that parents and children had no control over children's fluoride ingestion.

Those respondents who felt that fluoride was implicated in causing defects were asked which particular sources of fluoride were important causes of enamel defects in children in Western Australia. The responses are presented in Table 2. Water was the fluoride source reported by most of those who answered this item; fewer than half of the respondents identified use of supplements and toothpaste ingestion as important sources. Only one thought infant formula provided fluoride. Two respondents volunteered the opinion that fluoride supplement use was widespread in the fluoridated Perth metropolitan area. A small number expressed, in conversation, the view that water fluoride levels should be reduced to reduce the risk of fluorosis.

The mean period since graduation as dentists was related to the responses to some questions, but differences were not statistically significant ($0.05 < p < 0.10$). Those who felt that use of supplements was related to enamel mottling were more recent dental graduates (18.6 years since graduation) than those who thought supplements were unimportant (23.9 years); with regard to fluoride in water, the mean period since graduation of those who saw a link was 21.3 years, contrasting with the 27.8 years of those who believed there was no link.

Table 2 □ "Specifically, do you think any of the following fluoride sources are important causes of enamel defects?" Distribution of responses. (Those who felt fluoride was not related to defects did not answer this question.)

Source	F Supplements	F Toothpaste	F in Water	F in Diet	F in Air Pollution	F in Infant Formula
"Yes" (No.)	9	8	19	1	0	1
"Unsure" (No.)	10	13	3	20	18	13

It appears that parents are more sensitive about the cosmetic effects of fluorosis than dentists.

DISCUSSION

In Western Australia (population 1.6 m), routine dental care for about 90 percent of the schoolchild population is provided by the state government-operated School Dental Service.²³ This service, staffed by dental therapists and dentists, has supported two large epidemiological studies of dental fluorosis in recent years and many of its staff are thus sensitized to the issues involved.^{8,9} Private dental practitioners in Western Australia treat fewer than 10 percent of the children and teenagers and the group from which they draw their patients may be socioeconomically defined, so their opinions on enamel defects would be based on a subset of the child population. Apart from simple treatment involving removable appliances provided within the School Dental Service, however, virtually all orthodontic treatment is provided by the registered orthodontic specialists. Children make up the majority of the patients of most of the orthodontists, and the nature of clinical orthodontic work gives them an excellent opportunity to observe the dental enamel of their patients. The respondents in this study constituted almost the total population of orthodontists in Western Australia, so their representativity is beyond doubt.

An interview rather than a questionnaire was used because it was felt that a questionnaire might not have received the same attention as a telephone request for an interview. The good response rate suggests this strategy was successful and means that the findings are representative. A further advantage of the interview technique is that misunderstandings may be avoided.

Enamel mottling is just one of several conditions that result from disturbed dental enamel formation. It was apparent that more dramatic enamel defects, such as those with hereditary and systemic disease etiologies, were considered by many respondents to be more important, though not necessarily more frequent. Several felt that defects due to infant febrile diseases and medications (especially tetracycline) were more important causes of defects than fluoride. The majority of respondents named fluoride as one cause of defects, consistent with recent reports of a relatively high prevalence of fluorosis in metropolitan Perth.^{8,9} Several of the respondents described the type of enamel defect they associated with fluoride ingestion, using expressions like 'fine white lines' and 'white lacy patterns', which are reasonably descriptive of the condition.²⁴

Although they are based on the respondents' experience, the responses do not indicate clearly whether changes are occurring in the prevalence of enamel de-

fects. A majority felt that there had been an increase and several were emphatic that enamel mottling prevalence was increasing (one had independently contacted the Health Department to express his concern). On the other hand, several orthodontists had not noticed any defects which they ascribed to fluoride. Three respondents believed that the prevalence of enamel defects was decreasing. These three all graduated as dentists in the early 1960s and may have been comparing recent observations with the types of enamel defects, such as tetracycline discoloration, which were more common earlier in their careers. In a telephone interview, misunderstandings about the nature of enamel defects are not easy to clarify.

Virtually all of the respondents were emphatic that they had seen cosmetically displeasing enamel defects among their child patients, but only a minority saw such defects more frequently than about once per month. Most felt that such defects warranted esthetic treatment, though some were reluctant to suggest treatment as they felt that it led to other problems, such as poor gingival condition.

It was a perception among most of the respondents that their patients and/or parents were more concerned about enamel defects than were the respondents. This applied in particular to patients who had discolored enamel. It would appear that patients have a lower threshold of reaction to cosmetic defects. In a comparison of dentists' and lay persons' perceptions of photographs of enamel defects, Stephen *et al* reported that the lay persons scored more cases as esthetically unacceptable than did dentists.²⁵ It has been frequently stated by dental researchers that mild fluorosis is without esthetic significance and not a public health problem.^{26,27} This view may require modification, if in fact lay people disagree. Marthaler predicted that tolerance thresholds for mottled enamel will in future be indispensable for health policies.²⁸ Thresholds will be related to the magnitude of the caries threat: where caries is a great problem, people will be willing to accept some fluorosis as the price of prevention. Conversely, in societies with declining caries prevalences, fluorosis may be increasingly perceived as undesirable. This presents a challenge for health authorities. Lay people's opinions of dental fluorosis have not been studied well.

More respondents linked fluoride with defects, when asked specifically about this, than the number who volunteered that fluoride was a cause. In conversation there seemed to be a reluctance, however, to state that defects caused by fluoride were important. One respon-

dent's comment, "a bit of hypoplasia [sic] is better than a lot of carious teeth", sums up this feeling and also illustrates the somewhat vague distinction made between the terms hypoplasia and hypomineralization. In keeping with this "defensive" attitude to fluoride, the majority felt that the mottling they had observed did not constitute sufficient grounds for reducing exposure to fluoride. Although the term "fluoride exposure" was not defined and could include any fluoride source, it was understood by most respondents to mean fluoride in water, the source with which most of them were acquainted.

Those respondents who felt that fluoride was associated with enamel defects were asked to identify the principal sources of fluoride that might contribute to fluorosis in Western Australia. Fluoride in water was the only source identified by a majority of the respondents. Fluoride supplements were mentioned by about a third. In fluoridated Perth, supplements were little used by children and were not considered an important fluoride source according to several respondents. This is in accordance with information provided by parents of twelve-year-olds.⁸ A minority was aware of toothpaste as a fluoride source, but very few realized that infant formula is potentially an important source.^{13,29-34} Formula is believed to contribute to infants' fluoride intake in Australia, because most infant formula is manufactured using fluoridated water and reconstituted with fluoridated water.³⁵ To commence using formula early is known to be a fluorosis risk factor in Western Australia.^{8,9}

The respondents' uncertainty about the important sources of fluoride might account for the majority's belief that fluoride intake was not under the children's or parents' control. Use of discretionary fluoride sources is more closely associated with unsightly dental fluorosis (defined as TF score ≥ 2) than residence in a fluoridated area.⁹ Education of parents and dentists about the inappropriate use of discretionary fluoride sources should become a strategy to reduce prevalence of fluorosis. Although these orthodontists would not normally be dealing with children of an age to be at risk of getting fluorosis, some of the parents whose children they treat have other children young enough to be at risk of caries and who would expect a dentist to be able to give sound advice on these matters.

The findings of this study confirm that defects of enamel had been noticed by all the respondents. The orthodontists appeared to perceive enamel defects to be a smaller problem than did parents and patients. Whether parents and other lay people are more con-

cerned than dentists about the esthetic aspects of dental fluorosis should be investigated; if this proves to be the case, it would indicate that tolerance of fluorosis is less than dentists have assumed. The study does not indicate conclusively whether the prevalence is changing. Although many linked enamel defects to fluoride intake, many of the respondents had only general ideas about fluoride sources and might not be able to give current preventive advice to the parents of young patients. There seems to be a need, therefore, for courses to bring clinicians up to date with current issues in dentistry, such as fluorosis.

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EFFECT OF CITRATE ON PLAQUE pH

The use of drinks containing carbohydrates may initiate a fall in the pH of dental plaque [Duggal and Curzon, 1989], giving rise to a sequence of events that could lead to demineralisation of enamel and eventually dental caries. When used frequently, particularly by infants, the condition known as 'nursing bottle caries' may ensue. While the carbohydrate content is important recently attention has also been focussed on the acid content of the drinks in addition to their cariogenicity [Grenby *et al.*, 1990].

Edgar *et al.* [1975] compared the potential cariogenicity of different drinks and found that cola drinks that contain phosphoric acid, and orange juice, which contains a high level of citric acid, produce essentially the same plaque pH response. However moderate levels of citrates in tooth pastes have been shown to reduce the fall in the plaque pH after a sucrose challenge [Duke *et al.*, 1985, 1988]. It has been thought that factors, such as the citrate content in drinks, may modify the carbohydrate-derived acidogenic challenge of that drink. Duke *et al.* [1987] conducted a study to assess whether drinks formulated with relatively low levels of citrates or citric acid exhibited a reduced acidogenic response in the plaque. They concluded that moderate levels of citrate or citric acid in sugar-based drinks reduced the fall in the pH of plaque and thus reduced potential cariogenicity. However acidified citrate in a drink will tend to increase the titratable acidity, and if present in high enough levels will tend to reduce the pH in the vicinity, including that of plaque which may have been bathed in it thus overcoming its beneficial effect. This would mean that a natural juice such as pure orange juice, which contains a high level of citrate and has a high titratable acidity, will not be effective in reducing the fall in plaque pH as opposed to drinks which are formulated with moderate levels of citrate.

Pollard M.A. *et al*: The effect of different concentrations of citrate in drinks on plaque pH. *Caries Res*, 27:191-194, May-June, 1993.

ABUSE

A statewide survey of dentists' knowledge of abuse

Mary M. Von Burg, MS
Charles O. Hazelrigg, DDS
John A. Shoemaker, BA
Roberta A Hibbard, MD

Dr. C. Henry Kempe first coined the phrase "battered child" in the 1960s. Since that time, knowledgeable experts in the area of child abuse and neglect have been attempting and encouraging others to educate professionals in all disciplines to identify and report child abuse and neglect.^{1,2} In recognition of the importance of this, the State of New York has recently instituted child abuse training as a requirement for professional licenses.³

In 1989, 2.4 million children were victims of child abuse and neglect in the United States.⁴ In 1990 as many as 5,000 deaths resulted from maltreatment of children in the United States.⁵ In Indiana, 50,093 children were reported as victims of child abuse and neglect with 52 deaths.⁶

In Indiana, reports of suspected abuse and neglect come from: medical professionals, 8.6 percent; school/substitute caretaker, 20.8 percent; family/relative, 21.7 percent; judicial/social agency, 20.5 percent; friend/neighbor/landlord, 11.3 percent; anonymous, 13.7 percent; other (includes military and unknown), 3.4 percent. There are no statistics available in Indiana on how

many child abuse and neglect cases are reported by dentists, but numerous surveys have been done in other states that have identified the reasons why dentists are not reporting suspected abuse and neglect.⁷⁻⁹

In 1978 Becker surveyed 1,134 dentists in Massachusetts.¹⁰ Of the 537 responses, 242 (45 percent) were aware of their legal responsibility to report suspected child abuse, 149 (28 percent) knew the name of the agency to which to report, 403 (75 percent) saw orofacial trauma, 45 (8 percent) saw suspected child abuse and neglect cases, 22 (4 percent) had seen definite cases and only 4 (<1 percent) reported.

It is a common finding that when an individual is attacked for whatever reason, the head and facial areas are most often involved. Dentists are in a unique position to identify child abuse in their routine examinations.¹¹

Because several dentists had requested information on identifying and reporting child abuse from the Indiana State Board of Health, licensed dentists were surveyed to assess their knowledge and interest in attending educational seminars on child abuse. A ten-question, Likert-item survey was developed that asked them to respond to questions regarding their knowledge about child abuse (strongly agree to strongly disagree). They were also asked to indicate whether they wanted more information through seminars on child abuse and neglect.

Ms. Von Burg is with the Indiana University School of Medicine; Dr. Hazelrigg is with the Indiana Department of Health; Mr. Shoemaker is with the Indiana University School of Medicine; and Dr. Hibbard is with Indiana University School of Medicine.

METHOD

The questionnaires were mailed to 2952 licensed Indiana dentists. The dentists names and addresses were provided by the state licensing agency and the mailing included a letter from the Indiana State Board of Health asking the addressee to complete and return the questionnaire. About 50 percent (1491) of the questionnaires were returned. Of those, forty-seven were not included in the data analyses because of tardiness, incompleteness, or the respondent had retired or moved out of state. The results of the questionnaires were entered into a computer and frequency statistics were generated.

RESULTS

Table summarizes the responses on the 1444 analyzed questionnaires. A correct response includes either "strongly agree" and "agree" or "strongly disagree" and "disagree" depending on whether the statement is true or false. The two opposing choices and "neutral" are considered as incorrect responses. The "neutral" responses are included in the total percentages responding to the four incorrectly answered questions only.

A majority of respondents correctly answered six of the ten questions. About 88 percent knew that child abuse is not primarily associated with the stresses of poverty.^{11,12} Likewise, 80 percent knew that in most cases, children are not removed from their parents' home.¹³⁻¹⁴ The greatest majority (92 percent) were aware that children who have been abused do not tell someone soon after the abuse.¹⁵ Seventy-four percent incorrectly believed they could be successfully sued for reporting a case of suspected abuse, if the case was not substantiated in court.¹⁶ Sixty percent knew that the majority of child abuse cases are not handled in criminal courts.¹⁷ Fifty-five percent did not know that if a child readily states that an adult has caused harm, the accusation is usually true.¹⁸ Eighty-two percent of the respondents knew that the dentist should not interview the patient and parent together.¹⁹ Seventy-six percent of the respondents were aware that the State of Indiana mandates that dentists report suspected child abuse.^{20,21} Sixty-six percent did not know that trauma to the neck is usually nonaccidental.²² Fifty-five percent did not know that a strong correlation exists between dental neglect and the presence of physical neglect.²³

The median number of correct responses was six (mean = 6.418, SD = 1.731). Nearly 62 percent (892) of the respondents indicated an interest in attending

Table □ Percentage Responses on the 1444 Questionnaires

SA	A	N	D	SD	Question
(SA = strongly agree; A = agree; N = neutral; D = disagree; SD = strongly disagree)					
1%	5%	6%	50%	38%	Child abuse is primarily associated with the stresses of poverty and rarely occurs among middle or high-income families. (FALSE)
17%	63%	8%	9%	3%	In most cases of child abuse, children are not temporarily or permanently removed from their parents' home. (TRUE)
<1%	3%	5%	59%	33%	Children who have been abused usually tell someone soon after the abuse. (FALSE)
4%	21%	30%	31%	13%	Professionals who report a case of suspected child abuse can be successfully sued if the case is not substantiated in court. (FALSE)
1%	9%	29%	48%	12%	Most cases of reported child abuse are handled in the criminal courts. (FALSE)
5%	39%	33%	20%	2%	If a child readily states that an adult has caused harm, the accusation is usually true. (TRUE)
2%	5%	12%	47%	35%	If the dentist suspects abuse, the patient and the parent should be interviewed together. (FALSE)
24%	52%	17%	5%	2%	The State of Indiana mandates that dentists report suspected child abuse to the County Department of Public Welfare. (TRUE)
5%	28%	36%	24%	6%	Trauma to the neck is usually a result of non-accidental injury. (TRUE)
7%	38%	24%	24%	7%	A strong correlation exists between dental neglect and the presence of physical neglect. (TRUE)

NOTE 1: All percentages have been rounded to nearest whole percent.
 NOTE 2: Percentage responses do not include those who did not respond to the question.

educational seminars on the topic of child abuse and neglect.

DISCUSSION

The large percentage of returned questionnaires is considered excellent and lends credibility to the assumption that the results are representative of the knowledge of dentists on child abuse and neglect.

While the Indiana Department of Public Welfare does not keep separate statistics on dentists reporting child abuse and neglect (they are included in the category of "medical professionals"), it is worthy to note that 76 percent of the respondents did know that Indiana law mandates suspected child abuse to be reported to the proper authorities. The law in Indiana reads "any individual who has reason to believe that a child is a victim of child abuse and neglect shall make a report immediately to the local child protection service or law enforcement agency."²⁴

The overall performance of six correct responses out of the possible ten supports the position that dentists may need additional training in identifying and dealing with child abuse and neglect. It is positive result that a large percentage expressed interest in attending educational seminars on abuse and neglect.

Because dentists identified a need for more information on identifying and reporting child abuse and neglect, we are including basic information in this article that will be helpful.

It is important for dentists to remember the first step in preventing child abuse and neglect is recognition and reporting. Dentists and their staff must become familiar with indicators and symptoms associated with child abuse and neglect, reporting requirements for their area, and the telephone number to call to report. It is suggested that they read articles in literary journals, participate in workshops and seminars, and if there is not a Child Protection Team in their community that they consider organizing a multidisciplinary group to help solve the problems of working with child abuse and neglect cases.²⁵ When child abuse is suspected, the dentist must report the suspicion to the appropriate agency. If the local number is not available, call the National Child Abuse Hot Line 1-800-422-4453. If you believe the child is in a life threatening situation, call 911 or the local law enforcement agency. All states have laws granting immunity when a report is made in good faith.²⁶

It is recommended that dentists talk to the parents or caretakers to obtain their story on how the injuries happened, but not about their suspicions of child abuse. Talking to the parents regarding the abuse may cause further harm to the child or even death, especially if the parents are the alleged perpetrator(s). If the parents confront the dentist, explain that abuse is suspected and that it is the law that a report be made.

If the child is talking to the dentist about abuse and wants to disclose more, it is appropriate to listen and provide support to the child. Detailed observations should be made in the dental chart recording the date, time, location of the injury, size, number (if more than one), color (if bruise), and condition. An examination is of little or no value unless the findings are recorded permanently and accurately. It is also recommended that everything the child says be placed in quotes. If a camera is available, take pictures. Provide a picture of the entire child and then a closeup of the injury or bruise. Be sure to place information in the picture to identify the child (chart or patient number) and date (month, day, year). A ruler or tape should be included

in the photograph to establish size. It is also good to include something of a known color so that the photographs can be developed in true color.²⁷ It is helpful to have duplicate copies made for the investigating agency. A 35 mm camera provides the best picture. If no camera is available, draw pictures to show location and size of the injury(s) or bruise(s). A diagnostic-data-assessment form has been developed by Saxe and McCourt to assist in collecting and documenting information on suspected child abuse and neglect cases.²⁸

Do not try to solve the case. Let the investigating agency do their job. Assure the child that it is okay for them to tell you and that they did the right thing by telling. Do not make promises to the child or family that you cannot keep.

Dental professionals are becoming more aware of the importance of identifying and reporting suspected child abuse observed in their patients. New York now requires that all persons applying for, on or after January 1, 1991, initially, or for the renewal of a license, registration or limited permit to be a dentist or dental hygienist have completed two hours of coursework or training regarding the identification and reporting of child abuse and maltreatment. The coursework or training shall be obtained from an institution or provider approved by the department to provide such coursework or training.³ Other states should follow this lead.

This study used only 10 basic questions covering a number of concepts important in child abuse and neglect. It has not assessed any detailed knowledge of a variety of issues including epidemiology, identification, intervention or treatment. It is a start, however, in documenting the need for additional education of dentists in this troublesome field. The dentists themselves identified their need and desire for additional information (62 percent) on identifying and reporting child abuse by indicating an interest in attending educational seminars on the topic of child abuse and neglect. With this information, we can now plan educational programs that will give dentists and their staff additional training and provide an opportunity to assess their knowledge in the other issues identified above.

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THE GIFT OF LIFE

One group of bacteria have truly made the gift of life to all plants and animals on earth. The structural proteins in every animal and plant cell are constructed from the basic 20 amino acids, so named for the combination of two hydrogen atoms and one nitrogen atom that forms an essential component of all amino acids, and thus of all plants and animals. Although the atmosphere of the earth is four-fifths nitrogen, this bountiful source of supply is utterly useless to us in that form. All advanced life-forms require nitrogen-fixing bacteria to perform the pivotal task of combining one atom of nitrogen with two atoms of hydrogen required for amino acids. In humans, the bacteria's output is obtained through the protein in our diet.

There is hardly an imaginable niche in life that bacteria do not occupy. Both grazing animals and termites rely on bacteria to break down the cellulose in grasses into starch; no animal can perform this critical chemical task. Bacteria inhabit any handy pool of water, live by the billions in a spoonful of soil, and can be found proliferating on counter tops, doorknobs, mop buckets and window shades. It is not surprising that an astonishing variety of bacteria specialize in human beings. Unlike many other places on earth, the relationship is in no real sense mutually beneficial. At best they are harmless parasites in humans, at worst toxic and deadly predators.

Moore, T.J.: *Lifespan*.

New York: Simon and Shuster, 1993, p 39.

Your next pediatric dental patient may have been physically or sexually abused

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

The need is for increased numbers of practitioners to develop an appreciation that...problems develop even in the 'best of families'—even in the families of some pediatric practitioners."¹

Physical abuse of children has become so common place that it is only when the death of a child occurs that the news media may carry the story, and then only when it is gruesome. In 1986 there were approximately nine deaths per 100,000 infants and three deaths per 100,000 children between one and four years, due to undetermined injury or homicide.² In 1987 there were more than two million reported cases of child maltreatment, including deprivation of necessities, minor and major physical injuries, and sexual and emotional maltreatment.³

In the past, I have read and dutifully reported these and related data in the *Journal of Dentistry for Children* in an effort to stimulate an increasing concern for the plight of the children in our nation.^{4,5} But these and other statistics pale in comparison with the 1992 report by the Crime Victims Research and Treatment Center that 61 percent of the 12.1 million women (one in every eight women) who had experienced forcible rape, had been victimized before they reached eighteen years of age. Almost 30 percent had been raped before the age of eleven years; i.e. four million women had been raped at the age of ten or under, almost two

million had been raped by the age of five or under {Figure}.⁶⁻⁸

The reported rape of children takes on an added tragic dimension when a mid-1980s study of children (13-17 years of age) in the State of Massachusetts is considered. While 16 percent of the perpetrators were strangers, 40 percent were friends and acquaintances, 18 percent were parents or step parents, 14 percent were other relatives and 10 percent were co-workers, school personnel and health professionals.⁹

The following presentation will review available data on child abuse in an effort to go beyond the need to increase "just" our awareness. Rather the intent is to dramatize the need to consider the reality that a history of physical, sexual or psychological abuse may exist and should be considered as practitioners seek to establish a relationship of trust with their next pediatric patient. Yes, even patients who are less than ten or five years of age, and those who come from the "best of families," may have been abused and molested.

THE EXTENT OF THE PROBLEM

- Between 1976 and 1987, the number of abused and neglected children increased by 225 percent (Table 1). "An estimated 30 percent of individuals who were physically or sexually abused or extremely neglected as children become abusive parents themselves."¹⁰
- One child in ten born in the United States (or 375,000 infants) annually is exposed to illegal drugs in the womb.¹¹

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

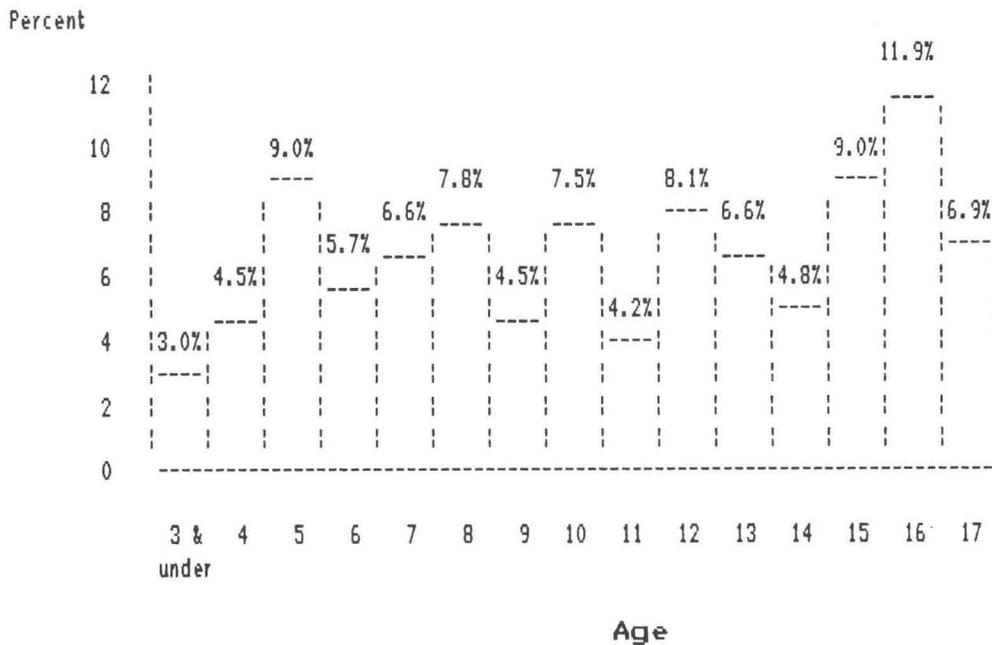


Figure. Age distribution of victims as recalled by adults who said that they were first raped as a child: 1990.⁸

Table 1 □ Number of abused and neglected children: 1976-1987.¹⁰

Year	Number
1976	669,000
1977	838,000
1978	838,000
1979	988,000
1980	1,154,000
1981	1,225,000
1982	1,262,000
1983	1,477,000
1984	1,727,000
1985	1,928,000
1986	2,086,000
1987	2,178,000

Table 2 □ Rates per 1,000 children of forcible rape victims by age and race: 1987.¹²

Age	White	Nonwhite	Totals
10	.00	.05	.01
11	.03	.07	.04
12	.02	.18	.06
13	.08	.38	.15
14	.11	.49	.20
15	.13	.68	.25
16	.15	.78	.30
17	.22	.83	.35
Total	.10	.45	.18
Number	665	820	1,485

Note: Data are for 12 states (AL, AZ, CA, HI, IA, MD, MS, NJ, PA, SD, UT, VA) representing 28.5 percent of the youth population at risk
 Includes 33 cases where the perpetrators were females

- In New York City, five thousand infants are reported annually to child protection services for prenatal exposure to drugs. In a one day survey of ninety-two city hospitals housing infants without a home to which they could go, 69 percent had been affected by maternal drug use.
- Studies of children living in battered women's shelters found that as much as 50 percent of the children were physically or sexually abused.⁹
- More than 800,000 children experience nonfatal injuries related to child maltreatment. Seventeen percent sustain serious injuries involving life threatening conditions or potential long term impairment.⁹
- Female children are emotionally, sexually and physically abused more often than their male

counterparts. There is greater incidence of forcible rape of nonwhite children than their white counterparts (Table 2). (Note: the number of reported rapes of females between twelve and fifteen years of age varied greatly from year to year [Table 3]. It is estimated, however, that approximately only half of rapes of children are reported.¹⁴)

- A study of children confined within the District of Columbia juvenile justice system reported that 85 percent had a history of child abuse, usually at a very young age. Another study reported that on average there was a 20 percent I.Q. point differ-

Table 3 □ Number of reported rapes of females between 12-15 years of age: 1973-1988.¹³

Year	Number
1973	11,000
1974	22,300
1975	13,200
1976	17,100
1977	20,900
1978	17,100
1979	18,400
1980	9,600
1981	20,600
1982	18,100
1983	14,110
1984	23,870
1985	7,030
1986	8,220
1987	11,550
1988	4,210

ence between abused or neglected children and other children.¹⁵

- There are wide variations in the rate of reported cases of child neglect and abuse per 1,000 children in the various states. The rates ranged (in 1987) from 7.1, 16.2, and 17.8 cases per 1,000 children, respectively, for the States of Pennsylvania, Hawaii, and New Mexico, to 54.5, 56.9, and 59.8 cases per 1,000 children, respectively, for the States of South Dakota, Nevada and Missouri.¹⁶ (The variations by region are reviewed further in a previous presentation in the *Journal of Dentistry for Children*.¹) Between 1988 and 1989, thirty-eight states reported increasing number of cases of child abuse and neglect, ranging from a 1 percent increase in the States of Arkansas and Louisiana to an 87 percent increase in the State of Washington. Only five states reported a decrease and six reported no change. The most significant decline was noted in the State of Hawaii (30 percent). It was attributed "...to vigorous prevention efforts by the public, private and military sectors"¹¹ (Table 4).
- Drug or alcohol abuse by parents, poor parenting skills, poverty or low income, lack of affordable housing, and unemployment are the five leading factors that contribute to increased child abuse and neglect (Table 5). Children in families with incomes below \$15,000 are four times more likely to be abused and seven times more likely to be neglected than children in other families.⁹
- There is no relationship between child maltreatment and race.⁹
- A report on a national study of family's views of varying problems indicated that in 1988, there were 354,100 family abductions of children, 3,200

Table 4 □ Rate (per 1,000 children) of child abuse and neglect reports and percent change in reporting rates by state: 1987-88, 1988-89.^{11,16}

	Rate per 1,000 children 1987	Percent change	
		1987-88	1988-89
Alabama	27.7	7%	16%
Alaska	49.9	-7	-2
Arizona	44.2	12	22
Arkansas	46.0	1	1*
California	50.8	11	10*
Colorado	48.7	8	4
Connecticut	26.9	10	0
Delaware	36.3	0	-6
Dist. of Columbia	44.0	0	20
Florida	40.5	6	19
Georgia	36.8	-8	22*
Hawaii	16.2	-19	-30
Idaho	42.4	0	0
Illinois	30.4	3	9
Indiana	20.0	5	28
Iowa	35.0	4	4
Kansas	40.9	-12	-4
Kentucky	42.3	3	2
Louisiana	28.1	0	1
Maine	35.8	-1	-2*
Maryland	19.1	7	5
Massachusetts	39.2	17	15
Michigan	45.1	-3	2
Minnesota	24.6	1*	na
Mississippi	20.2	9	0
Missouri	59.8	-8	8
Montana	43.6	7	4
Nebraska	29.0	-2	0
Nevada	56.9	31	61*
New Hampshire	25.6	15	12
New Jersey	27.4	13	2*
New Mexico	17.8	9	49
New York	39.4	17	7
North Carolina	20.2	-4	27
North Dakota	23.6	na	0
Ohio	40.9	7*	13*
Oklahoma	24.7	1	0
Oregon	48.0	6	15
Pennsylvania	7.1	9	6
Rhode Island	38.4	11	16
South Carolina	22.3	-1%	5%
South Dakota	54.5	3	2
Tennessee	35.6	na	6
Texas	20.0	-3	12
Utah	28.9	-1	12
Vermont	22.6	7	8*
Virginia	34.4	5	5
Washington	33.7	-24	87
West Virginia	27.4	3	1
Wisconsin	23.5	6	na
Wyoming	28.2	3	2
U.S.	34.0	4%	10%

* estimate

Table 5 □ Ranking of factors that contribute to increased child abuse and neglect.¹⁷

Factor	Rank
Drug or alcohol abuse by parents	1
Poor parenting skills	2
Poverty/low income	2
Lack of affordable housing	3
Unemployment	4
Mental health of parents	5
Poor marital/interpersonal skills	6
Teen parents	7
Difficulty identifying families at risk	7
Lack of support for families at risk	8
Lack of affordable child care	9
Unplanned/unwanted pregnancy	9
Health or behavior of children	10
Bureaucratic/legislative obstacles	11

to 4,600 non-family abductions, 450,700 runaways, and 438,200 lost, injured or otherwise missing children and 127,100 throwaway children {e.g. the child has been told to leave the household, the caretaker refused the return of a child or the child had been abandoned or deserted). Additional findings from the study indicated that:

- One million children were malnourished.
- 188,000 were infected with gonorrhea.
- Between 10,000 and 20,000 were infected with the AIDS virus.
- Over one million children experienced a parental divorce each year.
- Three million were estimated to be severely emotionally disturbed.
- Over 12 million lived in poverty.
- Two thousand children had been murdered.
- 15 million lived in single parent families.¹⁸

IS THERE ANYTHING FAVORABLE TO REPORT?

The public increasingly is becoming aware of the consequences of physical and emotional abuse of children. In 1975, less than 10 percent of adults were aware of child abuse problems. By the early 1980s, 90 percent of adults reported an awareness of the problem. In the 1990s:

- Virtually all adults reported an awareness of the problem of child abuse.
- Ninety percent of the public believes that corporal punishment in schools is inappropriate (compared to less than 50 percent in the 1970s).
- Ninety percent of the public believes that yelling and swearing at children can lead to long-term emotional problems. Seventy percent believe that physical punishment can lead to physical harm.
- Fewer parents claim that they yell or swear at their children (a 15 percent reduction since 1988).
- Fewer parents claim that they use hitting as a form of discipline (a 13 percent reduction since 1988).¹⁸
- Although the State of New York has not adopted a general system of mandatory continuing education requirements for dental licensure, dentists are required to attend an approved session on the recognition and reporting of child abuse before the renewal of their license registration will be approved.

While we may have begun to recognize the issue of child abuse, considering the magnitude of the problem

and the reality that the incidence continues to increase, it would be wishful to think that somehow we are addressing the problem.

"There is a lot more rape than has been reflected by Federal statistics, and that observation is more important than whether these are the exact numbers."⁶

In the interim the pediatric dentist must consider the possibility that even the youngest of patients {both female and male and even those from the "best of families") may have been physically, sexually, and psychologically abused.

The need is to consider this possibility as you seek to establish a relationship of trust with your next pediatric patient.

"The problems are frightening, the needs are staggering, and most of it isn't new... We've got to help our children and their parents, or we have no future."¹⁹

"We need to do something to address the 6,000 kids who are neglected and abused every day."²⁰

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WHAT DO ANXIOUS PATIENTS THINK?

According to Beck's cognitive model of emotional disorders the cognitive content of anxious people reflect the themes of danger or harm to the individual. The present data offer support for this theory, and it is interesting to note that most of the reported thoughts appeared to correspond in nature with those identified by other investigators among patients with generalized anxiety disorder. Remarkably, the proportion of patients reporting thoughts related to collapsing, dying or the inability to cope, was the same as found here (59%). These results suggest that the perception of losing control is an important factor, which is involved in divergent forms of anxiety. Various authors have stressed the importance of perceived control with respect to dental pain and anxiety and it seems that perceived control decreases the intensity of pain, aversiveness and discomfort by decreasing uncertainty.

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DEMOGRAPHICS

Single parent families

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

In the past fifty years, except for the "baby-boom" in the late 1950s and early 1960s, the average numbers of children (<18 years of age) per household* and family** decreased by 40 percent and 24 percent, respectively (Table 1).¹ In 1991 a third of households included one or more of the householder's children, compared to 45 percent in 1970. But even more dramatic than the decrease in the numbers of children in households and families has been the evolving structure of families in the past two decades. A previous presentation in the *Journal of Dentistry for Children* emphasized available data through the mid and late 1980s on the increasing numbers of single parent families, greater numbers of women in the workforce, and the potential impact on pediatric dental practice.²

Additional data through the early 1990s are available now, permitting further consideration of the 10.1 million single parent living arrangements (29 percent of all 35 million one and two parent family groups, compared to 13 percent of the total in 1970). The current number of single parent families represents an increase

of 6.3 million over the 1970s total of 3.8 million single parents. The following presentation will emphasize the extent of change, the marital status of the householder, residence of the family, educational attainment of the householder, age of children and other characteristics of the 6.5 million white, 3.2 million black, and 1.2 million Hispanic† single parent families.

SOURCE OF DATA

The Bureau of the Census conducts a monthly survey of the civilian noninstitutionalized population of the United States. The sample is updated continuously to account for new construction. About 60 thousand occupied households are eligible for interview every month. Interviewers are unable to obtain interviews at about 2,600 of these units because the occupants are not found at home or are unavailable for other reasons. All data for this presentation, unless otherwise stated,

†May be of any race.

*A household consists of all persons who occupy a housing unit. A house, an apartment, or a single room is regarded as housing unit when it is occupied or intended for occupancy as separate living quarters. The term "householder" refers to the person (or one of the persons) in whose name the housing unit is owned or rented.

**A family is a group of two persons or more persons who are related by birth, marriage or adoption and residing together. The vast majority of households are family households, but the portion has declined from 81 percent in 1970 to 70 percent in 1991.

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

Table 1 □ Average number of children per household and family: 1940-1991.¹

Year	Per household	Per family
1940	1.14	1.24
1950	1.06	1.17
1960	1.21	1.41
1970	1.09	1.34
1980	0.79	1.05
1991	0.69	0.96

were drawn from the extensive publication, "Household and Family Characteristics: March 1991."¹

INCREASE IN SINGLE PARENT FAMILIES

Families that are not maintained by married couples increased from 11 percent of all households in 1970 to 15 percent in 1991. Children (less than 18 years) were residents in about 61 percent of 11.3 million households led by women (with no spouse present) and 41 percent of the 2.9 million led by men (with no spouse present). While most single parents are householders who own or rent their living quarters, about 21 percent of single parents are residing in a household that belongs to someone else.

In 1970, 10 percent of white, 35 percent of black, and 26 percent of Hispanic families with children were parented by single women and men. By 1991, 23 percent of white, 63 percent of black, and 33 percent of Hispanic families with children were maintained by a single parent (Figure 1).

AGE OF CHILDREN

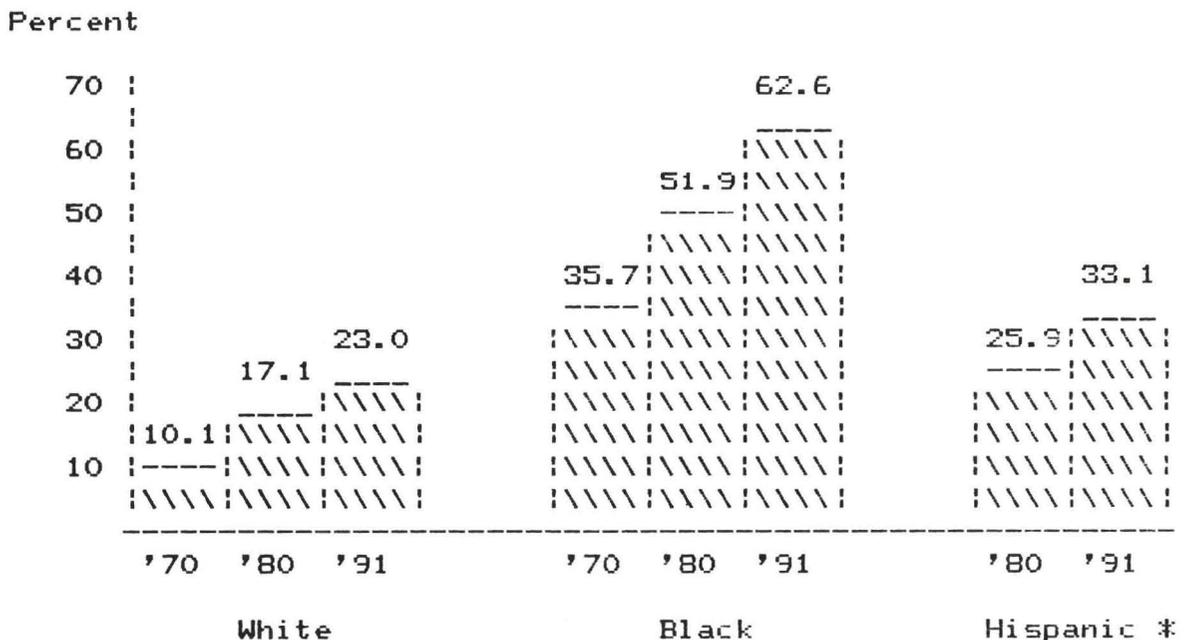
In 1991 there were more than 2 million white single parent families, 1.1 million black single parent families

Table 2 □ Number of families with children by race, ethnicity and age children: 1991.^a

	Married couple	Female householder	Male householder
(in millions)			
White			
< 3 yrs	6.5	.9	.2
3-5 yrs	6.6	1.0	.2
6-11 yrs	10.4	2.0	.3
12-17 yrs	8.9	1.9	.4
Totals < 18 yrs	21.5	4.3	.9
Black			
< 3 yrs	.5	.7	< .1
3-5 yrs	.6	.7	< .1
6-11 yrs	.9	1.1	< .1
12-17 yrs	.8	1.0	< .1
Totals < 18 yrs	1.9	2.3	.2
Hispanic			
< 3 yrs	.8	.2	< .1
3-5 yrs	.8	.2	< .1
6-11 yrs	1.2	.4	< .1
12-17 yrs	.9	.4	< .1
Totals < 18 yrs	2.3	.8	.1

Note: Totals represent families with child(ren) in one or more age group

and more than 400 thousand Hispanic single parent families with children less than six years of age. Overall there were 3.7 million white single parent families, 1.9 million black single parent families and .7 million Hispanic single parent families with preteenage children (< 12 years) (Table 2).



* May be of any race

Figure 1. Composition of family groups: one parent families with children by race and ethnicity: 1970, 1980, 1991.¹

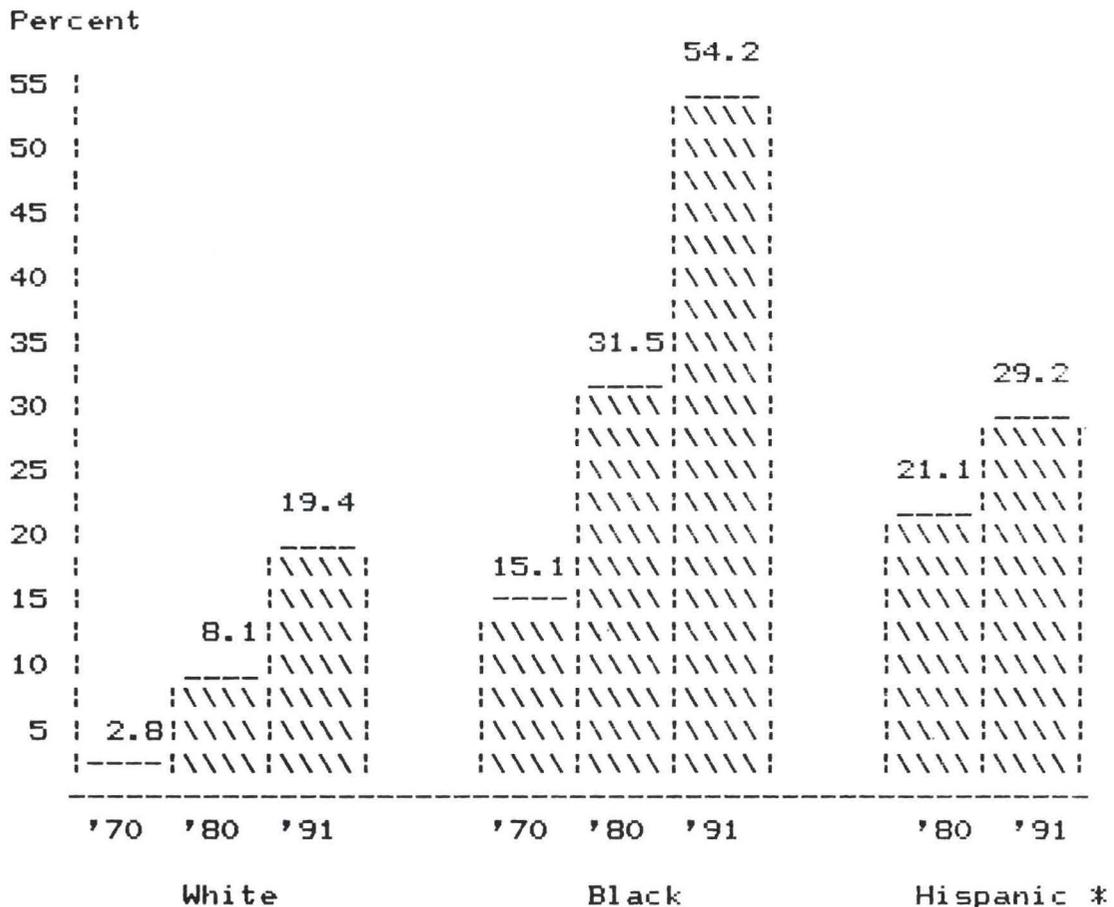
MARITAL ARRANGEMENTS

Single parent family arrangements may arise as a result of 1) divorce, 2) births before marriage, 3) a spouse absent due to marital separation, 4) death of a parent and 5) adoption. The most dramatic increases have been in the percent of single parent families maintained by mothers who were never married. Between 1970 and 1991, the percent of white families with children maintained by never married women increased from less than three 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 to 29 percent (Figure 2).

As a reflection of the dramatic increases in the number of never married female maintained families, in

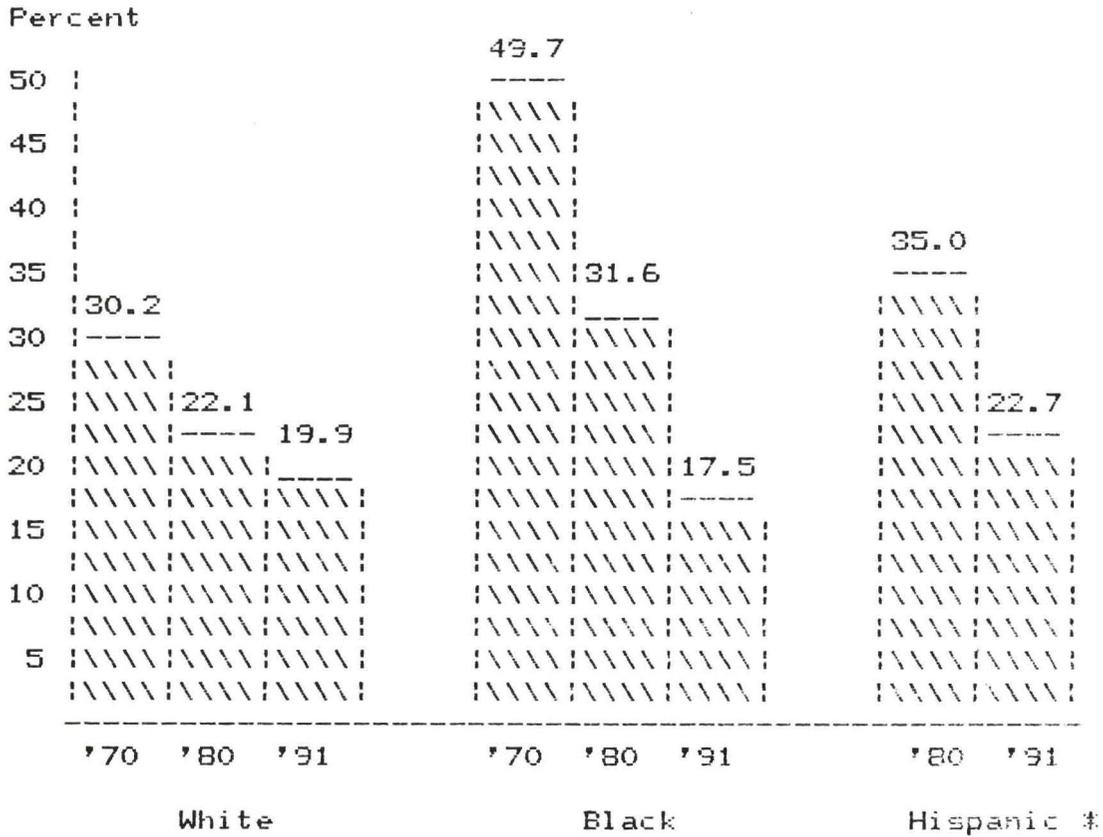
each of the three racial and ethnic populations, there have been marked decreases in the percent of one parent families where a spouse was absent or separated (Figure 3). During the same period there were increases followed by comparable decreases in the percent of the single parent families in which the mother was divorced (Figure 4). About six percent of one parent families (.6 million single families) resulted from the death of a parent.

There have been minor changes in the past twenty years in the relatively small percent of the single parent families that are maintained by fathers (overall increases from 10 percent in 1970 to 14 percent in 1991). Single father families are somewhat more prevalent among whites than blacks. In 1991, 16.3 percent of white, 7.4 percent of black, and 13.3 of Hispanic single parent families were headed by fathers (Figure 5).



* May be of any race

Figure 2. One parent families maintained by mother: (Never married) by race and ethnicity: 1970, 1980, 1991.¹



† May be of any race

Figure 3. One parent families maintained by mother: (spouse absent or separated) by race and ethnicity: 1970, 1980, 1991.⁵

BY RESIDENCE

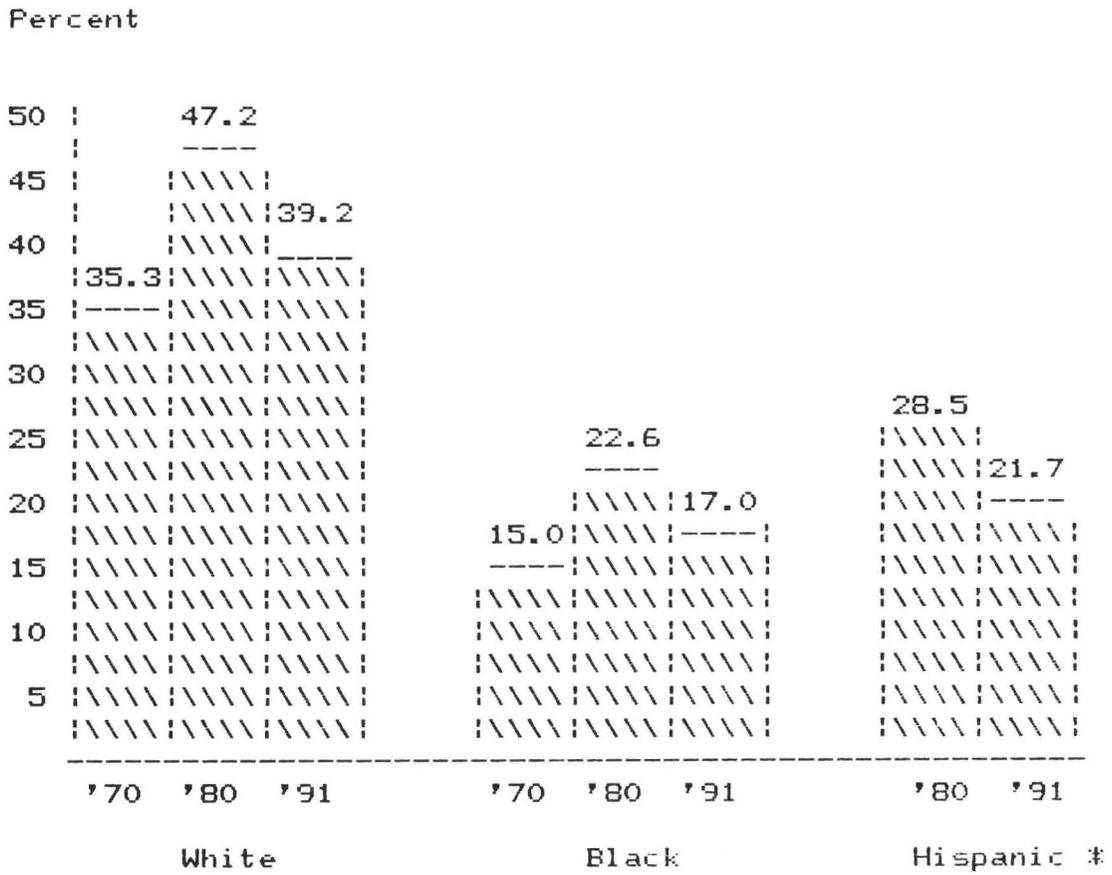
In 1991 in almost all metropolitan and nonmetropolitan areas, the average number of children in single female parent households was slightly less than the average number of children in married couple households. Only in the noncentral city areas of metropolitan communities was the average number of children in black female maintained families greater than their married counterparts. Other findings included:

- There was a greater average number of Hispanic children in married and single family arrangements than their white and black counterparts.
- The greatest number of children were in black married couple families living in nonmetropolitan areas.
- The smallest number of children were in families maintained by single males (Table 3).

Table 3 □ Average number of children (< 18 yrs) in families with children by residence, race and ethnicity: 1991.²

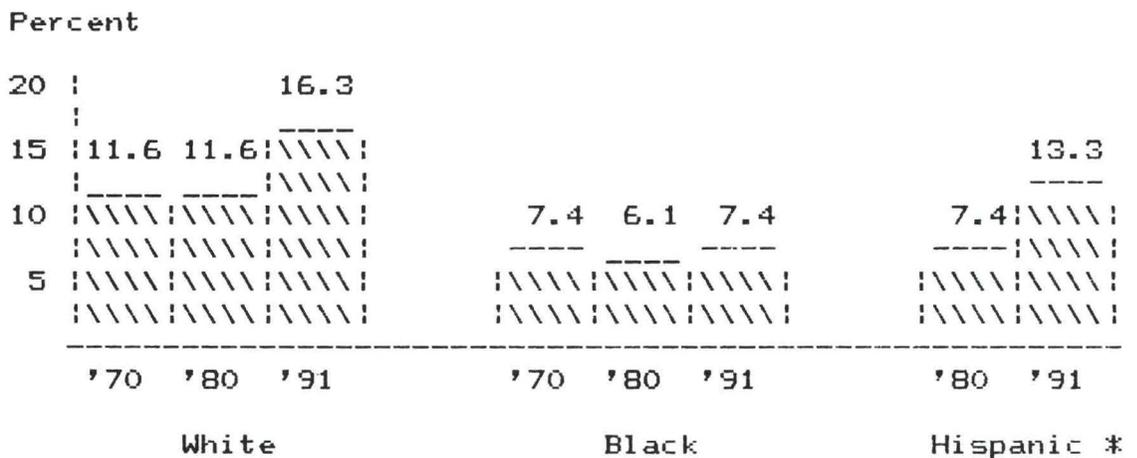
	Metropolitan		Nonmetropolitan
	Central city	Ring area	
White			
Married couple	1.87	1.87	1.86
Female householder	1.69	1.61	1.64
Male householder	1.56	1.48	1.45
Black			
Married couple	1.97	1.70	2.13
Female householder	1.92	1.88	1.82
Male householder	1.49	na	na
Hispanic*			
Married couple	2.16	2.19	2.18
Female householder	2.04	2.05	na
Male householder	1.69	na	na

* May be of any race



* May be of any race

Figure 4. One parent families maintained by mother: (divorced) by race and ethnicity: 1970, 1980, 1991.¹



* May be of any race

Figure 5. One parent families maintained by father by race and ethnicity: 1970, 1980, 1991.¹

BY EDUCATION OF HOUSEHOLDER

The average number of children (< 18 years) in white families (both married couple and single parent arrangements) decreased with increasing education of the householder. While this relationship was reported for black and Hispanic families, there were exceptions.

- Compared to their counterparts with varying levels of education, the greatest number of children were in black families and Hispanic female single parent families, where the householder had between one and three years of high school education.
- Compared to all other single parent families, black and Hispanic single female parent householders, with between one and three years of high school education, had the greatest average number of children (more than two children per family) (Table 4).

IMPACT ON PEDIATRIC DENTAL PRACTICE

"In part because of the continuing rise in out-of-wedlock childbearing, more than half of all children are likely to experience a period of living with a single parent during the 1990s, usually in reduced economic circumstances."³

The image of the single welfare mother with limited education and an enlarging brood of dependent children has become the *sine qua non* of any number of media exposes on the need for welfare reform. The recent approval by the federal government of the State of New Jersey proposal to revise drastically its welfare system is but one example of efforts to break the "welfare-cycle." The most significant component of the program is the provision to deny additional benefits to women who have more children while receiving welfare payments. The program also will require that welfare parents whose youngest children are at least two years of age (almost all of whom are single mothers) to participate in education, employment or job training programs.⁴

There is no question that many children reared in single parent families (in particular those with female householders) are supported economically by community social welfare programs or with limited earned incomes. For example, the median income in 1987 of two parent families with only the father employed and children less than six years of age was almost \$30,000; with both parents working it was almost \$38,000. The median income of single parent families with children

in the comparable age-group was \$6,400 and \$14,500, respectively, for female and male maintained families.‡ In addition there are the added difficulties that many single parents lack an adequate education and job training for realistic employment opportunities (Table 4).

The reality is, however, that the issue of single parent families extends far beyond the realm of particular minorities and ethnic groups or even family economics. The reality is that few of us are unacquainted with cases of single parents rearing one or more children. (Increasingly one hears of economically successful single women seeking to bear children, but with no intention of marrying the man who fathers the child.) The reality is that almost 29 percent of all 35 million family groups are single parent arrangements.

Few (if any) pediatric dental practitioners (or any other health practitioners) do not provide care to children reared in single parent families. As pediatric practitioners provide services to youngsters reared in a variety of family arrangements (including households with male and female parents, a single parent and same gender parents) even the terms used to communicate with pediatric patients may need to be adjusted to the particular family arrangement. Practitioners may feel awkward in using the most common of terms (e.g. "father" and "mother") when dealing with children in families with never married single parents or same gender parents.

"Taking a patient's history in today's world must move beyond the 'usual' dental, medical and social factors.

‡See a previous presentation in the Journal of Dentistry for Children for an extended discussion of the economic differences of single and two parent families.²

Table 4 □ Average number of children (< 18 yrs) in families with children by education of householder, race and ethnicity: 1991.¹

	Elementary	High School	College		
	0-8 yrs	1-3 yrs	4 yrs	1-3 yrs	4 + yrs
White					
Married couple	2.17	1.97	1.83	1.87	1.84
Female householder	1.92	1.95	1.54	1.62	1.46
Male householder	1.64	1.40	1.48	1.59	1.42
Black					
Married couple	1.85	2.09	1.92	1.86	1.82
Female householder	1.87	2.26	1.86	1.63	1.45
Male householder	na	na	1.48	na	na
Hispanic*					
Married couple	2.48	2.27	1.97	1.95	2.01
Female householder	2.07	2.24	1.93	1.95	na
Male householder	na	na	na	na	na

* May be of any race

The young child's home environment may be quite different from that which most practitioners can identify."²

The reality is that children reared in these nontraditional arrangements increasingly will be components of pediatric dental practices. It is relatively easy to be subjective and judgmental about the increasing numbers of varied family arrangements. From the perspective of the pediatric dental practitioner, the need is to learn as much as possible about these youngsters and

the difficulties they face, if we are to provide for their care in some understanding and supportive manner.

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MUTANS S AND LACTOBACILLI IN BREAST-FED CHILDREN

This study aimed to investigate the prevalence of selected components of the oral microflora in breast-fed children who developed rampant caries (resembling nursing caries) under hitherto unexplained circumstances. Dental plaque and saliva samples were collected from breast-fed children, aged between 1 and 2.5 years, with and without rampant caries. Mutans streptococci and lactobacilli were isolated from dental plaque of all children with rampant caries and from most caries-free children. None of the colonies of mutans streptococci resembled those of *Streptococcus sobrinus*. The mean counts of the mutans streptococci and lactobacilli were 100-fold higher in plaque samples from children with rampant caries as compared with caries-free children. No difference could be found between the numbers of mutans streptococci in plaque overlaying cavities and that from adjacent sound enamel. In contrast, the counts of lactobacilli in plaque were approximately 100-fold higher from cavities than from sound surfaces. The levels of mutans streptococci in saliva were directly related to the presence of rampant caries. The results show that caries-free and caries-active breast-fed children, aged 1 to 2.5 years, harbour mutans streptococci and lactobacilli on their teeth. Rampant caries in these children can occur in the absence of nursing bottles or any other feeding abuse during weaning and in the presence of an aciduric plaque microflora, as has been reported for children with nursing bottle caries.

Matee, M.I.N. *et al*: Mutans streptococci and lactobacilli in breast-fed children with rampant caries. *Caries Res*, 26:183-187, May-June, 1992.

CASE REPORT

Supernumerary rooted primary central incisors: Report of seven cases

Jack W. Morrow, DDS, MSD
Don L. Hylin, DDS, MSD

Every tooth develops with a specific number of roots considered normal for that particular tooth, and teeth that develop more than the normal number of roots have a condition referred to as supernumerary roots.¹ This condition is not to be confused with the conditions known as fusion or gemination. Fusion occurs when two tooth buds unite to produce one tooth, while gemination is the result of a single bud dividing to produce two teeth.

Supernumerary roots may occur on any tooth; the teeth that most commonly exhibit this abnormality, however, are the mandibular permanent canines and premolars¹. Reports of supernumerary rooted anterior teeth have been limited to the permanent dentition, or primary canines, though there have also been reported supernumerary roots in mandibular first primary molars.²⁻⁴ The following are case reports of seven patients demonstrating supernumerary rooted primary central incisors seen in a single private practice in Fort Worth, Texas over a six-year period.

REPORT OF CASES

Fourteen primary central incisors in seven patients were discovered during routine examination to have supernumerary roots. The children had no complaints and

findings on examination were unremarkable except for dental caries. All patients demonstrated bilateral involvement. Three patients were males and four were females; all were caucasian. Table summarizes the age at diagnosis, sex, and sibling status of the seven patients.

Table □ Patient summary.

Patient	Age at Dx	Sex	Siblings
1	4 yr. 6 mo.	male	none
2	4 yr. 5 mo.	female	none
3	4 yr. 2 mo.	female	1 affected, 1 unaffected
4	3 yr. 8 mo.	male	1 affected, 1 unaffected
5	3 yr. 10 mo.	female	1 unaffected
6	2 yr. 6 mo.	male	1 not examined
7	1 yr. 9 mo.	female	none

Figure 1 is the radiograph of patient 2 taken at age 4 yr. 5 mo. Figure 2 is the radiograph of patient 4 taken at age 3 yr. 8 mo. Figure 3 is the radiograph of patient 6 taken at age 2 yr. 6 mo. Patients three and four were siblings, and a third sibling did not exhibit the condition. The maxillary central incisors were the only teeth affected. In all cases, the anomaly is confined to the apical fourth of the root. There were no other dental anomalies present in any of the children involved. Medical histories on all of these cases were noncontributory. None of the children has had problems to date

Dr. Morrow is in private practice, 1533 Merrimac Circle, Suite 209, Fort Worth, TX 76107.

Dr. Hylin was in the Department of Pediatric Dentistry, Baylor College of Dentistry. He died in November, 1992.

with exfoliation of the involved teeth and none has developed supernumerary roots on permanent central incisors.

DISCUSSION

The finding of all these cases in a single practice leads the authors to suspect that this condition may occur frequently and has not been previously reported, because of the short time during which it may be diagnosed. The primary central incisor completes root formation at one and a half years and begins resorption at approximately four and a half years.^{5,6} Note that all patients in this report fall within the time frame of one



Figure 1. Patient 2 at four years, five months. Note the supernumerary roots on the primary central incisors.

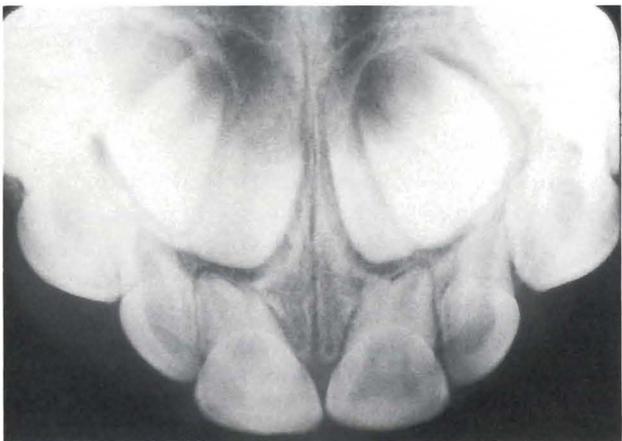


Figure 3. Patient 6 at two years, six months. Note the supernumerary roots on the primary central incisors.



Figure 2. Patient 4 at three years, eight months. Note the supernumerary roots on the primary central incisors.

and a half to four and a half years. The supernumerary root is in the apical fourth of the root and would likely have been resorbed, if radiographs were not taken before age five. The clinical importance of this finding lies in the fact that this anomaly could easily be misdiagnosed as an abscess, if seen during the earliest stage of resorption. When the dual apex was resorbed leaving the widened canal, this apex could mimic the appearance of an abscessed tooth. Children experience many episodes of trauma for which radiographs are routinely expected for diagnostic purposes. Early documentation of the maxillary anterior teeth before age four could allow for early diagnosis of this condition and prevent confusion with other conditions during the initial stages of root resorption. Additionally, extraction could potentially be more difficult or complicated by the presence of the supernumerary root. Since the supernumerary portion of the root is so near the apex, pulp therapy would not be affected and resorption would be expected to continue normally.

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ABSTRACTS

Loevy, Hannelore and Kowitz, Aletha A.: Alfred Kantorowicz, pediatric dentistry innovator. J Dent Child, 60:263-269, Special Issue, 1993.

Alfred Kantorowicz was born in 1880. He received his dental degree in 1900 and his medical degree in 1906. After World War I he became the director of the dental institute in Bonn, Germany. He was an amazing leader with a special interest in pediatric dentistry and was the developer of mobile clinics and preventive dentistry programs for children in Germany. In the 1930s and 1940s, he was instrumental in modernizing the dental curriculum in Turkey. He died in 1962 in Germany.

Pediatric dentistry; Mobile clinics

Braham, Raymond L.; Bogetz, Martin S.; Kimura, Mitsutaka: Pharmacologic Patient Management in Pediatric Dentistry - An Update. J Dent Child, 60:270-280, Special Issue, 1993.

This paper reviews the issue of sedation in pediatric dentistry in the light of recent controversies and rapidly increasing legal, professional and governmental regulations. Consideration is given to "Guidelines for safe administration of pharmacologic agents in dental practice". The various avenues of drug administration are reviewed with specific comment on recent approaches. Many of the older pharmacologic agents used for pediatric sedation are falling into disfavor. Chloral hydrate, in particular, would seem to be heading toward its demise. The benzodiazepines appear to have a very promising future as sedative agents. When administered and monitored appropriately, they have a wide margin of safety. Consideration is given to research and development into agents that reverse the action of sedative drugs. It is emphasized that contemporary electronic monitoring equipment in no way diminishes the necessity for sound and expert clinical judgment, supple-

mented by such simple devices as the precordial stethoscope and observation and communication in the form of simple commands.

Pediatric sedation; Pharmacologic advances; Safe-monitoring techniques

Friedlander, Arthur H.; Friedlander, Ida Kreinik; Eth, Spencer; Freymiller, Earl G.: Dental management of child and adolescent patients with schizophrenia. J Dent Child, 60:281-287, Special Issue, 1993.

Schizophrenia is a psychiatric disorder in which thought disturbances and aberrant behavior lessen an individual's ability to care for him or herself and to effectively work and communicate with others. The disorder affects 1 percent of the United States population. Onset of the florid psychotic symptoms most commonly occurs during adolescence or young adulthood, but most of these youngsters exhibit unusual behavior and peculiar thinking during childhood. Medications used in managing the disorder have numerous systemic and orofacial adverse side effects that must be recognized by dentists. Dental treatment strategies for the identification and management of these side effects are described as a method to improve compliance with oral hygiene techniques.

Schizophrenia, onset, characteristics; Medications

Haney, Kevin L.; McWhorter, Alton G.; Seale, N. Sue: An assessment of the success of meperidine and promethazine sedation in medically compromised children. J Dent Child, 60:288-294, Special Issue, 1993.

A retrospective study evaluated the success of orally administered meperidine (1.0 mg/lb) and promethazine (0.5 mg/lb) combined with N20:O2, and determined predictors of success in a

medically, physically and/or mentally compromised population. Behavior of 143 uncooperative patients (mean age 6.4 years) was evaluated during 282 sedations. A simplified Success Index rated outcome: 1-failure; 2-moderately successful; 3-highly successful. Variables were examined for effect on outcome of sedation: physical and/or neurologic component of medical diagnosis; previous hospital experience; medication category. Children taking medications with CNS actions were significantly less likely to have either moderately successful ($p = .008$) or highly successful appointments ($p = .002$). Children with a neurologic component to their medical diagnosis were significantly less likely to have a highly successful appointment ($p = .001$). Oral sedation was effective for this population (77 percent were successful) and certain characteristics of the patient's condition can predict success.

Meperidine; Promethazine; Behavior, evaluation; Oral sedation

Krafft, Tim C.; Krämer, Norbert; Kunzelmann, Karl-Heinz; Hickel, Reinhard. Experience with midazolam as sedative in the dental treatment of uncooperative children. J Dent Child, 60:295-299, Special Issue, 1993.

Shortage of capacity, and the limited range of therapies available for dental treatment of uncooperative children involve obvious problems which have given rise to new developments in treatment. Over the last two years, 83 children have been treated in 181 sessions after sedation with Midazolam. Rectal application is clearly superior to giving the drug orally. The results, and the good amnesic effect of Midazolam show that sedation employing this drug, while not a substitute for general anesthesia in every case, does constitute an important alternative in the treatment of uncooperative children.

Uncooperative children; Midazolam

Marcushamer, Mauricio; Gracia-Godoy, Franklin; Chan, Daniel C.N.: Caries protection after orthodontic band cementation with glass ionomer. J Dent Child, 60:300-303, Special Issue, 1993.

This study evaluated the resistance of the enamel to an artificial caries challenge after removing orthodontic bands cemented with a glass ionomer cement (GIC). Ten extracted caries-free molars were cleaned with a slurry of pumice and randomly divided into 2 groups of 5 teeth each: Group 1: Cementation with GIC (Fuji) and Group 2: Cementation with a zinc phosphate cement (Mizzy). Both cements were handled according to manufacturer's instructions. Before cementing the bands, an area of 5 x 5 mm was masked with adhesive tape on the lingual surfaces of all teeth. The orthodontic bands were cemented over this adhesive tape. After band cementation, the occlusal and gingival margins of the band were delineated with a bur on the tooth surface. The teeth were thermocycled (200 cycles, 5-55°C, 30-second dwell time) and stored in distilled water for 24 hours. Then, the bands and adhesive tape were removed and the teeth again stored in distilled water for a week, changing the water daily. The teeth were then varnished with the exception of a 5 x 5 mm window (including previously exposed and covered areas) on the buccal and lingual surfaces. All teeth were then placed in an acidified gel (pH 4.5) for 5 weeks to produce artificial caries. At least three sections from the exposed and covered areas were made from the buccal and lingual challenged areas. Sections were ground to approximately 100 µm. Polarized microscopy and image analysis were used to analyze the results. Group 1 showed that 16.7 percent of the sections evaluated presented enamel lesions versus 66.7 percent for Group 2 (P=0.0001). This study supports the use of the glass ionomer tested for orthodontic band cementation based on its caries protection after band removal.

Glass ionomer cement; Zinc phosphate cement; Orthodontic bands

Kreulen, C.M.; van Amerongen, W.E.; Borgmeijer, P.J.; Akerboom, H.B.M.: Comparison of two methods for evaluating the occlusal marginal adaptation of posterior restorations. J Dent Child, 60:304-309, Special Issue, 1993.

Two methods of evaluating the occlusal marginal adaptation of posterior restorations are compared: a direct and an indirect method. The direct method uses modified Ryge criteria and assessments are performed with mirror, probe and operating lamp. With the indirect method assessments are conducted using photographs of impressions of the restorations. For the purpose of the comparison a selected group of newly placed amalgam and composite restorations is used and attention is paid to a 'section method' of observation. This routine of localization the parts of the outline to be measured, permits independent comparison of the assessments. The two methods were applied by pairs of observers and the indirect photographic method appears to be more reliable (percentual agreement between observers 97 percent versus 80-91 percent for the direct method). The agreement between the indirect and direct methods is rather low. The indirect photographic method is more valid when compared to a yardstick, especially if few deficiencies of the margin are expected. It is not clear which method is preferable if more deficiencies occur with restorations of higher age.

Occlusal marginal adaptation; Resin composite and amalgam; Direct and indirect evaluation; Comparison of method

Kreulen, C.M.; van Amerongen, W.E.; Akerboom, H.B.M.; Borgmeijer, P.J.;

Gruythuysen, R.J.M.. Evaluation of occlusal marginal adaptation of class II resin composite restorations. J Dent Child, 60:310-314, Special Issue, 1993.

This paper describes the results of an evaluation of the occlusal marginal adaptation of Class II restorations in a clinical trial. The margins of 183 resin composite and 61 amalgam restorations, made by three dentists, were assessed. An indirect evaluative method has been applied, that uses a shadowing photographic technique to produce images of impressions. The restorations were classified into excellent and non-excellent marginal adaptation categories and on this basis influencing factors were determined. Resin composite restorations appeared to show more 'excellent' margins than amalgam restorations (64.5 percent and 21.3 percent, respectively). The variable mainly influencing the marginal adaptation of the composite restorations was the dentist. In addition, the influence of an occlusal bevel is discussed, since a difference of marginal adaptation between bevelled and nonbevelled parts of the occlusal outline was observed.

Occlusal marginal adaptation; Resin composite and amalgam; Clinical trial; Indirect evaluation

Waldman, H. Barry: Your next pediatric dental patient may have been physically or sexually abused. J Dent Child, 60:325-329, Special Issue, 1993.

A virtual epidemic of physical, sexual and emotional abuse is spreading to even the youngest of our children. Pediatric practitioner awareness of potential problems must be incorporated into efforts to establish a working relationship with children—even those in the "best of families." Data are presented to provide some dimensions of the problem. **Prevalence; Sexual and emotional abuse**