ASDC
AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN
JOURNAL OF DENTISTRY FOR CHILDREN
JULY–AUGUST 1992

In the broadest sense, child development is the process of becoming fully human. A child's experiences combine with a child's biological givens, and from this mixture emerges a complete person, ready for the challenges of day-to-day life—as a student, a worker, a friend, a family member, and a citizen. To succeed in these roles, children must acquire the basic skills of modern life: social competence, a secure and positive sense of one's own identity, proficiency in thinking and speaking clearly, an understanding of the many ways in which people communicate with one another. The foundation of all these skills is the child's emergent *capacity to know*, in the broadest sense of the word, for everything else is tied to this competence.

—*James Garbarino*

EMPHASIS ON SELF-DISCIPLINE, IMPORTANCE OF DOING ONE'S BEST, AND SATISFACTION OF ACCOMPLISHMENT MAY BE TERMED "VALUE OF ACHIEVEMENT."

—*Kathryn D. Sloane*

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JULY-AUGUST 1992 VOLUME 59 NUMBER 4

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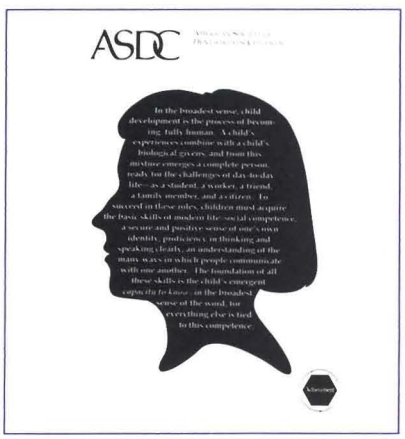

Child development is the process of becoming a complete person, fully human.

Cover art and design by Sharlene Nowak-Stellmach.

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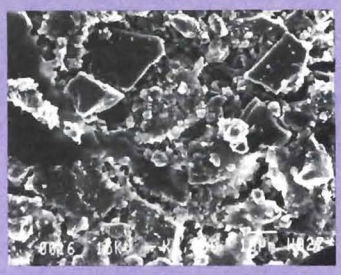

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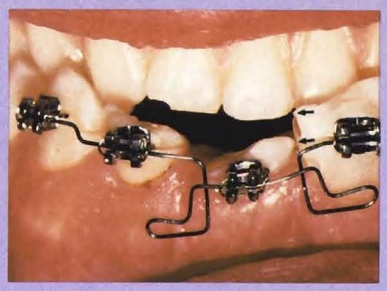

RESEARCH

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Preventive measures and caries progression: An *in vitro* study on fissures and smooth surfaces of human molars—page 257

Pit-and-fissure sealants are compared with fluoride treatments in their effectiveness to inhibit or reduce the progress of enamel lesions.

Requests for reprints should be directed to Dr. C.S.E. Van Dorp, Department of Cariology and Endontology, Academic Centre for Dentistry (ACTA), Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

Sealing of occlusal hidden caries lesions: An alternative for curative treatment—page 263

The bacterial composition of the dentine of 30 molars with sealed occlusal surfaces was examined. Undiagnosed hidden caries was present at the time of treatment.

Requests for reprints should be directed to Dr. K.L. Weerheijm, Academic Centre for Dentistry Amsterdam, Department of Pediatric Dentistry, Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

Glass ionomer/resin preventive restoration—page 269

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Requests for reprints should be directed to Dr. Theodore P. Croll, Georgetown Commons, Suite 2, 708 Shady Retreat Rd., Doylestown, PA 18901-3897.

Hereditary dentinogenesis imperfecta: A treatment program using an overdenture—page 273

Overdentures are used to treat this interesting case of dentinogenesis imperfecta.

Requests for reprints should be directed to Dr. Sabine C. Maréchaux, 20, Cours de Rive, 1207 Geneve, Switzerland.

Teenage luxation injury: report of case—page 277

This interesting case was treated using endodontic, orthodontic, and extrusion therapies.

Requests for reprints should be directed to Dr. Sabine C. Maréchaux, 20, Cours de Rive, 1207 Geneve, Switzerland.

Possible hazards of the transpalatal bar: Report of cases—page 282

Care must be exercised in the use of the transpalatal bar. Two possible hazards of this appliance are illustrated.

Requests for reprints should be directed to Dr. Margaret Rosa Grimsdottir, University of Oslo, Department of Orthodontics, Dental Faculty, Geitmyrsveien 71, 9455 Oslo 4, Norway.

Dens evaginatus: Report of case of continued root development after $Ca(OH)_2$ apexification—page 285

In this case the root developed to completion after final obduration of the canal.

Requests for reprints should be directed to Dr. Huey-Li Su, Division of Pediatric Dentistry, Department of Dentistry, Chang Gung Memorial Hospital, 199 Tung Hwa North Road, Taipei, Taiwan, Republic of China.

Effect of APF gel on a glass ionomer cement: An SEM study—page 289

Glass ionomer restorations should be protected before applying APF gel. Two coats of resin glaze offer that protection.

Requests for reprints should be directed to Dr. Franklin Garcia-Godoy, Department of Pediatric Dentistry, The Dental School, The University of Texas, Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, Texas 78284-7888.

Increasing interest in pediatric dentistry?—page 296

Increasing numbers of senior dental students are show-

ing an interest in postdoctoral programs in pediatric dentistry.

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

The relationship of the changing structure of families and the health of children—page 301

The dramatic changes in family structure in recent years have raised some important questions pertaining to children's health.

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

The assessment of two oral sedation drug regimens in pediatric dental patients—page 306

Emesis occurred in 5 percent of the cases treated, and oxygen desaturation was noted in approximately 48 percent of the cases, based on pulse oximeter recordings. No difference in prevalence of hypoxemia was noted between the use of a sedative-hypnotic and a narcotic agent.

Requests for reprints should be directed to Dr. Deirdre R. Sams, Department of Pediatric Dentistry, Medical College of Georgia, School of Dentistiry, Augusta, Georgia 30912-1210.

Caries preventive effect of high fluoride and xylitol containing dentifrices—page 313

An anticaries therapeutic role for xylitol was not substantiated at the 15mg/gm level used in this study.

Requests for reprints should be directed to Dr. T.W. Cutress, Director, Health Research Council of New Zealand, Dental Research Unit, P.O. Box 27-007, Wellington, New Zealand.

Preventive measures and caries progression: An *in vitro* study on fissures and smooth surfaces of human molars

Corien S.E. Van Dorp, DDS
Jacob M. Ten Cate, PhD

The prevalence of dental caries has shown a remarkable decline during recent decades in many western countries. Although not considered the only cause, this decrease is primarily attributed to the widespread use of fluoridated toothpastes.[1] Fluoride treatments are particularly effective in preventing caries in smooth and interproximal tooth surfaces, but are far less effective in fissures.[2] As a result, today the primary sites are in occlusal surfaces for restorative treatment. Fissure sealants have been applied for at least twenty years and many studies have proved them to be successful in significantly lowering the level of fissure caries.[3] Although sealing is less expensive than restorative treatment, the costs, nevertheless, are significant. Even though several public health organizations and insurance companies support fissure sealing, only a small proportion of the children (4 percent) is being sealed.[4] Since relatively few clinical studies deal with a direct comparison of caries preventive treatments focusing on fissures, we have completed an *in vitro* study with a number of available preventive measures. Such information could then be used in future *in vivo* testing to predict clinical efficacies.

The aim of this study was to compare pit-and-fissure sealants with fluoride treatments in their effectiveness to inhibit or reduce the progression of enamel lesions. Because of the difficulties involved in the examination and diagnosis of fissure areas, progression of a lesion on the smooth surface of the same tooth was also studied, using the same protocol.

Drs. Van Dorp and Ten Cate are in the Department of Cariology and Endodontology, Academic Centre for Dentistry (ACTA), Louwesweg 1, 1066 EA Amsterdam, The Netherlands.

MATERIAL AND METHODS

Impacted human third molars were collected. The teeth were stored at 4°C in a thymol containing solution, immediately after surgical removal.[5] The molars were carefully checked for enamel damage caused by extraction. The crowns were sectioned from the roots using a water-cooled, diamond-coated wheel, and the pulps were removed. All molars were classified by fissure pattern:

- ☐ Shallow fissures.
- ☐ Shallow fissures with some deep pits.
- ☐ Narrow and steep fissures.

After being cleansed for a minute with (fluoride free) pumice, the crowns were embedded separately in epoxy resin, leaving the fissure area and part of the smooth surface exposed. Subsequently the cusps and smooth surfaces of each specimen were sealed with nail varnish, leaving one window exposed in the fissure region and one on the smooth surface. After preparation of the specimen, the teeth were radiographed individually, under standardized conditions. X-rays were taken in the occlusal-apical direction, together with an aluminum stepwedge covering the range from 2 to 20 mm. Kodak Ultra speed D DF 58 film was used. The X-ray source was an Oralix 65 kvp, 7.5 MA, emitting polychromatic radiation. Before treating the specimens with

one of several preventive treatments, they were subjected to an *in vitro* caries-like challenge. Caries lesions were formed during a period of nine weeks in a demineralizing solution. After four and nine weeks, the specimens were radiographed to record the mineral loss. The forty-eight molars were then divided randomly into eight series of six specimens each (ensuring that the three types of fissures were distributed equally). The experimental groups can be schematized as given in the Table. Application and/or treatments were made on both the fissure and smooth surfaces of each specimen. Next, the specimens from groups 1-7, were subjected to five additional weeks of demineralization. In detail the treatments were:

- ☐ The negative control-group (1) received no caries preventive treatment.
- ☐ The sealant groups (2, 3) were acid-etched with 37 percent phosphoric acid for a minute, and subsequently rinsed with water during a minute, dried and sealed with either an unfilled, Delton (#2), or a filled, White sealant (#3), light-cured pit-and-fissure sealant.

Since we were particularly interested in the caries preventive effect of abraded sealants, the excess of sealant was carefully removed with a finishing bur in a green handpiece under magnification (wasotype 271 cos p = 0.35). Subsequently the sealed surfaces and fissures were polished with 0.3 micron alpha alumina micropolish A, under standardized conditions, to stimulate abrasion of the surfaces studied. Polishing the surplus of sealant leaves only the resin tags in the interprismatic regions of the enamel both on the smooth surface and in the upper parts of the fissure walls. An abrasion group (#4) was added as a control for the fissure sealant series, and treated likewise except for the acid-etching and sealing. In the Duraphat group (#5) the fluoride product, containing 5 percent fluoride, was applied and after seventy-two hours storage at 37°C, the excess resin was removed with 70 percent ethanol and a cotton stick. Elmex liquid containing 1.23 percent fluoride was applied to specimens of group #6, stored for seventy-two hours at 37°C and rinsed thoroughly with tap water. In the probed series (#7) the specimens were probed with a force of 0.5N at several positions. A final group (#8) was given neither a caries preventive-treatment nor an additional five-week demineralization challenge and thus served as positive control or baseline group. At the end of the total demineralization period (fourteen weeks), standardized X-ray photographs were taken for series 1-7. Thereafter the specimens of all eight series were fully embedded in epoxy resin. Cross sections were made on a Leitz 1600 sectioning machine, including both the fissure and the smooth surface regions. The cross sections were stained with 1 percent rhodamine in 79 percent ethanol, and light microscopic (LM) photographs were taken at ten-fold magnification. The X-ray pictures were analyzed longitudinally by an image-analysis system, to quantify and visualize the progress of demineralization during the demineralization period per individual tooth.

Table ☐ Schematization of experimental groups.

	9 wks dem	treatment	5 subseq. wks dem
1 no treatment control	+	none	+ (negative control)
2 Delton fissure sealant	+	seal, abrasion	+
3 white sealant , ,	+	seal, abrasion	+
4 abrasion	+	abrasion	+
5 Duraphat	+	72hF, ethanol	+
6 Elmex liquid	+	72hF, water	+
7 probing	+	probing, f=0.5N	+
8 initial demin control	+	none	none (positive control)

Progress in depth of a caries lesion is provided by the LM analysis of the cross-sections.

RESULTS

Together these data sets provide an insight in the spread of caries in the fissure region, as effected by various treatments. The X-ray pictures (Figure 2) highlight the lateral spread of the caries defect in the fissures, without providing information about progression of the lesion in depth. The latter datum is provided by the LM analysis of the cross-sections (Figure 1). To analyze the treatment effects, these two 'diagnostic tools' were combined to compose a three dimensional impression of the fissure caries-defects. These will be described below and illustrated by representative samples for the various treatment groups.

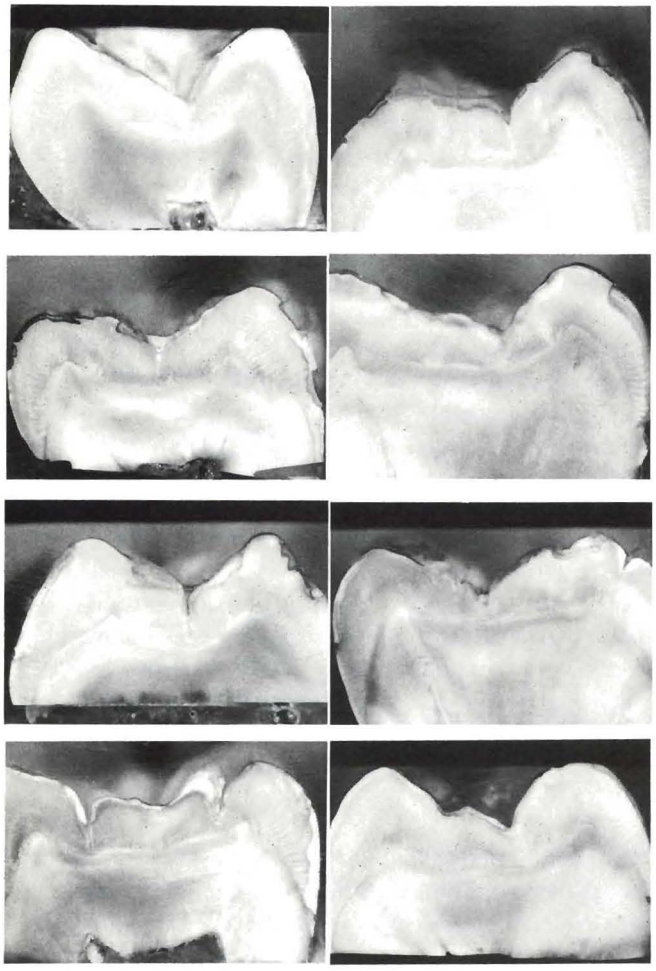

Figure 1. Light-microscopic images of the cross sections from the experimental groups after fourteen weeks demineralization (except for the initial demineralization control, which had only nine weeks demineralization: a, Negative control; b, Delton; c, White sealant; d, Abrasion; e, Duraphat; f, Elmex liquid; g, Probing; h, Positive control.

All photographs were scored both for their appearance in the fissure region and in the smooth region. The X-ray pictures (Figure 2) showed extensive lesions formed during the initial nine weeks of the demineralization period. After the five posttreatment weeks of

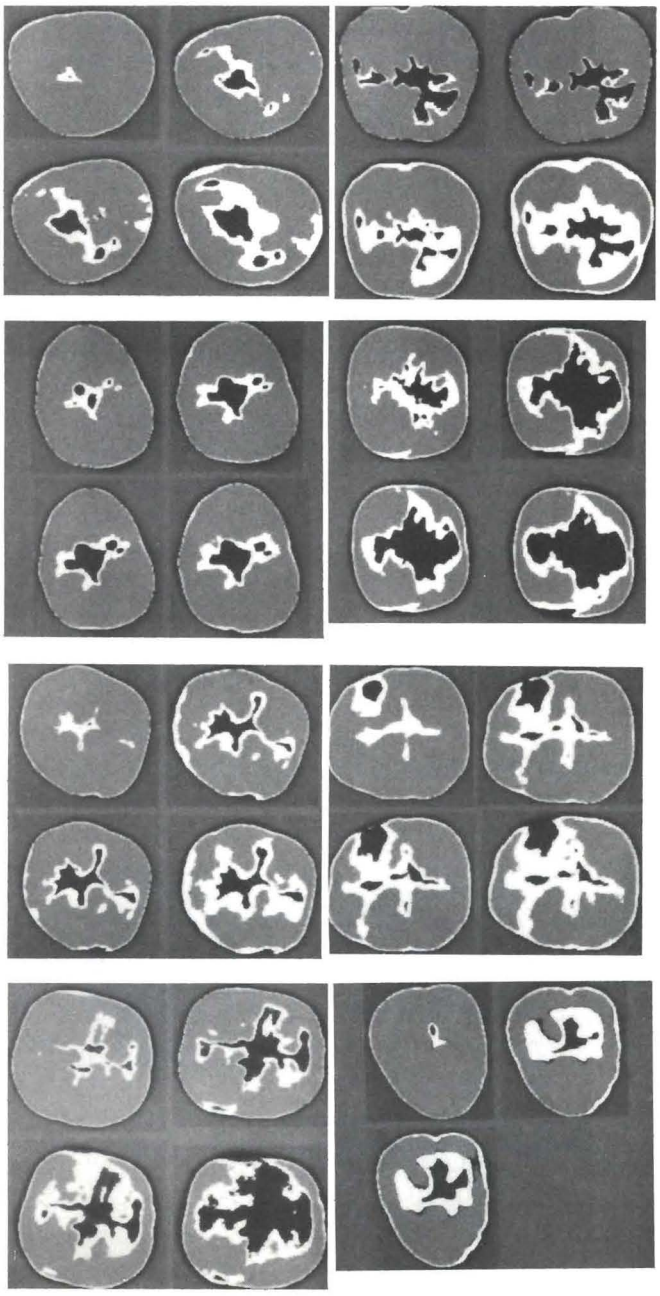

Figure 2. X-ray pictures of the experimental groups representing sequentially the computer images at 0 weeks, 4 weeks, 9 weeks and 14 weeks demineralization: a, Negative control; b, Delton; c, White sealant; d, Abrasion; e, Duraphat; f, Elmex liquid; g, Probing; h, Positive control.

demineralization, the negative control (Figure 2a) showed increased severity of the lesion, compared to the initial demineralization control (i.e. positive control, Figure 2h). The light-microscopic photographs (Figure 3) show a general resemblance in lesion development to the different types of fissures (a-c). The lesion was mainly restricted to the fissure walls. In the narrow fissures (Figure 3c), demineralization appeared to be less homogeneous as compared with the shallow types (Figures 3a and b). The smooth surfaces showed a very even, homogeneous demineralization in the positive and negative controls (Figures 1a and h).

In the sealant groups, the light microscope (Figures 1b and c) showed a sharp demarcation, in the fissure region, at the borderline where the sealant had been polished away, only leaving its resin tags. At sites where presumably tags were left, an irregular increase of lesion progression was observed; and at those locations where sealant was still present, no progression was seen. The lesion progression at the polished margin of the White sealant-treated fissures (Figure 1c) was more distinct than that of the Delton-treated fissures (Figure 1b); the same applies to the similarly treated smooth surfaces. The X-ray images showed lesion progression in the fissure region in particular for the Delton treatment groups (Figure 2b).

The abrasion group showed irregular increases of lesion progression in all directions, both in the fissure and on the smooth surface, which was observed with the light microscope and on the X-ray images (Figures 1d and 2d).

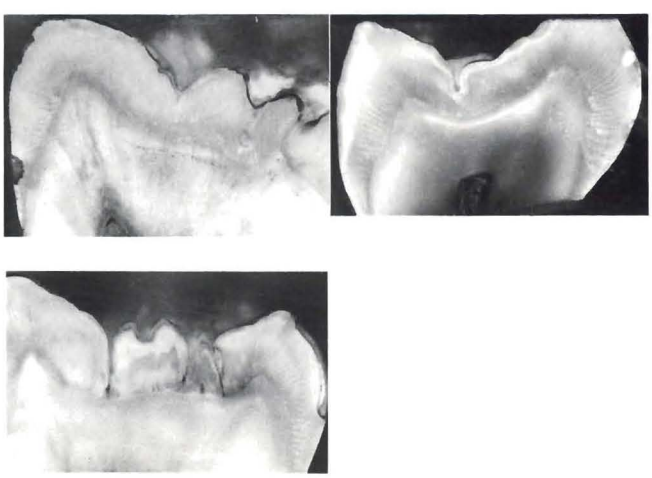

Figure 3. Light microscopic images of cross sections from the control group at 14 weeks demineralization: a, Shallow fissures; b, Shallow fissures with some deep pits; c, Narrow and steep fissures.

The Duraphat treatment group showed in general no protection against lesion progression in the fissure region when compared with the negative control. In some of the fissures, however, differences (i.e. less demineralization) were observed in the light microscopic photographs (Figure 1e). On the smooth surfaces, no differences could be measured with the negative control (Figure 1a), indicating no preventive effect of the regimen used. Likewise in the group of Elmex liquid-treated specimens, no caries preventive effect was observed in the LM analysis (Figure 1f). On the X-ray images (Figure 2f), however, a lesion progression was seen, both for the fissure region and the smooth surface, comparable to the positive control (Figure 1h) and less than the negative control (Figure 1a). Combining these findings, it appears that Elmex Fluid treatment did prevent the lateral spread of the lesions, but not the progress of the lesion in depth.

The light microscope showed in the probed specimens (Fig 1g) lesion progression to occur in the lateral direction in the walls of the fissure. This type of attack was more pronounced than in any of the other groups. No enhanced demineralization could be observed at the bottom of the fissure, which can probably be attributed to the failure of the probe to reach this region. Similarly in narrow fissures no progression of demineralization toward the dentine border could be observed. Both on the smooth surface and in the fissure region the demineralization was observed to spread out from the site where the probing had been done. The effects of local probing could not be discerned as enlarged caries defects on X-ray pictures (Figure 2g), indicating that increased caries at the fissure walls does not lend itself to X-ray diagnosis. In the fissures, the appearance of the probed specimens was comparable to the negative control (Figure 2a). In the probed smooth surfaces, however, lesion progression was quite clear (Figure 2g).

DISCUSSION

The light microscopic pictures showed a significant progression in lesion depth, during the five week treatment-phase of the experiment. Analysis of negative controls showed lesion depths had progressed to 150 percent of the baseline values (positive controls). The sealant groups with fully covered lesions appeared similar to the positive control. The sealants proved best in stopping further lesion progression; both LM and X-ray analysis did show lesion progression, however, in the fissure region at sites subjected to abrasive forces.

The light microscopic evaluation provide no evidence of protection by either fluoride treatment. The computer images of the X-ray pictures, however, showed that in the groups receiving fluoride treatments, the extension of the caries remained limited to the fissure region, in contrast to occurrences in the negative control. The effect of fissure probing was distinguishable in the light microscopic pictures, but invisible in the computer images.

Several investigations have been reported comparing the effects of different caries preventive schemes, such as fluoride-containing solutions, gels, and lacquers. Arends and Schuthof concluded from an *in vitro* investigation that a fluoride containing polyurethane varnish was more effective than several applications of a fluoride-containing solution or gel.[5] Kirkegaard reported a clinical trial, comparing the effect of several caries preventive methods.[6] No significant differences in overall DMF-S were demonstrated between Duraphat varnish and repeated use of fluoride rinses. The levels of protection by Duraphat in the referred trials varied from 6 percent to 8 percent.[2,7] Riethe carried out a clinical trial comparing a fissure sealant and a fluoride containing polyurethane varnish: the fissure sealant gave optimal caries prevention while the fluoride varnish provided only limited protection.[8] Our study differed in design from the trials just described, as we started with incipient enamel lesions and monitored their progression under *in vitro* conditions. The current study was mainly directed toward differences in effectiveness against fissure caries. The findings concerning the various fluoride-containing agents are in agreement with the literature cited; no significant differences were found favoring either Elmex or Duraphat. With respect to sealants, the present results confirm the results of Goepferd reporting no lesion progression underneath a resin sealant.[9] In our study small differences in effects between a UV-cured filled or nonfilled,pit-and-fissure sealant could be revealed. Hicks and Silverstone reported in an *in vitro* investigation, that both the filled and unfilled (light cured) pit-and-fissure sealants produced an absolute barrier to further progression of a lesion.[10] They describe a better effect from UV-cured sealants, compared to chemically polymerized sealants; in this study only UV-cured sealants were used.

In the fissure region, decay is difficult to measure longitudinally with nondestructive methods.[11,12] This study was performed *in vitro*, therefore, on whole tooth crowns. Although this approach has shortcomings, compared with the intraoral methods, caries progression can be followed and recorded more accurately with noninvasive X-ray techniques. The computer-aided X-ray visualization was helpful in analyzing objectively the changes (in particular the lateral spread of caries) that had occurred. Furthermore, the extent of caries could be assessed upon termination using a histologic analysis. Moreover, an *in-vitro* set-up was chosen to standardize the degree of initial demineralization, thus excluding differences due to the oral physiological variation. Regarding the X-ray method of assessment of caries, Pitts concluded that computer-aided image-analysis had a high level of reproducibility.[13] Still, X-ray pictures have limitations: Gray levels do not correlate linearly with the amounts of mineral present and become readily saturated, at both ends of the gray scale. Small differences, therefore, are not necessarily revealed. Consequently the effect of treatment may not show up in a thick specimen. Furthermore, because the X-ray picture is a two-dimensional replica of a three-dimensional tooth crown, lesion progression is only revealed in the plane in which it was taken. Light-microscopic pictures provide accurate information of the results of treatment on demineralization, therefore, but a longitudinal monitoring of the effect of treatment is lacking. The X-ray photographs mainly reveal lesion extension in the lateral dimensions, while the light-microscopic photographs show lesion extension in depth.

The different results obtained with the filled and unfilled pit-and-fissure sealants, respectively, might be partially attributed to the differences in their penetrating qualities, as illustrated by the light-microscope data. When the surface was polished away, the White Sealant group (Figure 1c) showed more progress of demineralization at the polishing border than did the Delton group (Figure 1b). The X-ray picture illustrated the lateral spread: the Delton group (Figure 2b) showed more lateral progress of demineralization than did the White Sealant group (Figure 2c). The differences between the observations on the light microscope in the Duraphat treatment-group might be attributed to the effect of fluoride, either being totally washed out or partly retained, and thus functioning locally as a sealant. The findings of the Elmex treatment group illustrate another probable mode of action of fluoride: where fluoride restricts lesion progression laterally, it did not affect lesion progression in depth. The observed lesion progression after abrasive treatment might well emphasize the important role of the surface layer in inhibiting lesion progression.

No information was obtained from the X-ray photographs concerning morphologic variation of fissures. The

light-microscopic pictures, however, showed that lesion progression was reduced in the deeper recesses of narrow fissures. This phenomenon might be caused, however, by the demineralizing gel, possibly causing a saturation in the depth of the fissure by a lack of fluid movement. The light-microscopic pictures showed greater homogeneity and penetration of lesions on smooth surfaces than lesions in fissured enamel. The light-microscopic pictures showed a consistent arrest of lesion progression in the fissure region, where the fissure sealant was *in situ.*

The findings of the present study can be summarized as follows: Sealants were found to be the best preventive measure for fissures, as long as the walls of the fissures were well covered. Mechanical loads damaged demineralized regions and contributed to lesion progression. On smooth surfaces fissure sealants did not give adequate protection when subjected to wear. No significant protection was found in this model for Elmex liquid or Duraphat treatments, neither in fissure nor in smooth surface regions. Expanding the present findings to clinical practice, it can be concluded that the use of a probe in examining for dental caries should be abandoned: As long as caries prediction will not be possible on a population scale, the use of pit-and-fissure sealants should be encouraged as a standard measure in combination with a fluoride regimen. As differences in clinical efficacy between different fluoride applications have not been reported or revealed by this laboratory study, fluoridation should continue to be administered in a low-cost form.

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ON-LAP TRAVEL: STILL A PROBLEM

Reasons cited for holding the infant on the lap include the myth that this is the most protective position and that it may impart a sense of security to the parent or caretaker. Parents also have indicated that rather than have the driver pull over to the side of the road when the infant is crying or otherwise needs attention, the nondriving occupant will simply remove the child from the CSSs to care for the child. An inadvertent lapse such as this results in tragedy to many families—the loss of a child, in fact, a preventable loss of a child.

On-lap travel must be eliminated. Parents, through physicians and other health professionals, must learn that this is an unsafe practice and poses a significant risk for injury, and even death. Informational materials on child transportation in motor vehicles must continue to address this issue.

Current laws which prohibit on-lap travel of young children must be strictly enforced. State laws that allow exemption of restraint use when tending to the needs of the child, or for nonparent drivers, must be amended to eliminate this potentially life-threatening custom. We suggest that physicians, especially pediatricians, use the information presented here to advocate for changes in state statutes and to appropriately counsel parents.

Agran, P.F. **et al**: On-Lap travel: Still a problem.
Pediatrics, 90:30-32, July 1992.

Sealing of occlusal hidden caries lesions: An alternative for curative treatment?

K.L. Weerheijm, DDS
J.J. de Soet, DDS, PhD
W.E. van Amerongen, DDS, PhD
J. de Graaff, DDS, PhD

In a previous study we showed the presence of a high percentage of mutans streptococci and lactobacilli, in combination with soft, lightly colored dentine, in teeth with an occlusal dentine lesion under an apparently sound enamel surface (hidden caries).[1] On the basis of these results, such lesions were considered to be active lesions that had to be treated curatively.

Research on clinically visible occlusal lesions has shown that when carious dentine has been partially removed and the lesions subsequently restored, the number of microorganisms decreased.[2,3] In a recent study by Mertz-Fairhurst *et al*, it was shown that the caries process is also arrested under ultraconservatively sealed composite restorations.[4] Other studies on carious lesions covered with a sealant also report a decrease in the number of microorganisms.[5-11] The decrease in the number of microorganisms varies among the studies in factors from 25 to 2000 times. The reduction in the number of microorganisms increased with the length of time that the occlusal surface was sealed. Application of a sealant is also known to arrest the growth of the lesion.[5,7,10-13] In addition to a slowing of the caries progression and a decrease in the number of microorganisms, good sealant retention is considered essential.[13,14]

It is not known whether the effect of a sealant on a hidden caries lesion is the same as the effect on a clinically observable caries lesion. It is possible that due to the limited accessibility of the hidden caries lesion, the supply of substrate from the oral cavity may already be less than in the lesions previously cited.[5,14] Consequently, total closure of the fissures by means of a sealant could then possibly have less effect in the arrest of the caries process.

The aim of this study is to ascertain the number and type of microorganisms that are found in sealed teeth with hidden caries.

MATERIALS AND METHODS

Thirty teeth of twenty-one patients (ages nine to nineteen years) of the Department of Pediatric Dentistry of the Academic Centre for Dentistry Amsterdam were selected on the basis of the following criteria:

- ☐ The tooth was clinically well-sealed, as far as could be judged with mirror and probe, and all occlusal pits and fissures were covered with the sealant material (Delton tinted™, Johnson and Johnson).
- ☐ The tooth was judged to be clinically sound at the time of sealing.
- ☐ A distinct occlusal radiolucency was visible on the

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recent bitewing radiograph and the bitewing that was taken before the sealant treatment.

The teeth were cleaned with pumice before treatment, after which an impression was made with a silicone material (Extrude™, Kerr). After twenty-four hours, the impressions were poured in epoxy resin die material (Araldite™, Ciba-Geigy). The replicas were then given a gold layer of 300 Å, and the sealant marginal adaptation was judged under a Scanning Electron Microscope (Philips PSEM 500) at a magnification of up to 1250 times actual size. The sealant marginal adaptation was judged as +, if no defects were observed in the margin; as ±, if a defect was found at one place in the margin; and as −, if defects were found in several places in the margin.

The teeth were isolated by rubber dam. From this moment onward, the operator was allowed to use only sterilized instruments and sterilized water for cooling. The teeth were opened to the dentinoenamel junction, using a small, sterile diamond-bur. A sample of the carious dentine was taken with a new round bur and put into 1 ml RTF.[15] Another dentine sample was then taken with an excavator and put into MC Dovell's fixative. The results of this latter sample, which was observed by TEM microscopy, will be discussed elsewhere. The dentine and water samples were taken immediately to the Department of Oral Microbiology for culturing.

Meanwhile, the remaining caries was removed and the preparation finished and restored. At this stage, aseptic conditions were no longer necessary.

BACTERIOLOGICAL DETERMINATION

After sonication (10 times per second), a hundred-fold diluted and undiluted sample was used to inoculate Rogosa-plates, bloodagar plates and nitrocellulose-membrane plates.[16] All plates were incubated anaerobically at 37°C for two days. Subsequently, lactobacilli were counted on Rogosa, mutans streptococci were determined by using species specific monoclonal antibodies and other bacteria were counted and isolated from bloodagar.[16] To identify the bacteria from bloodagar, API-Strep 20 (Bio-Merieu, France) and Minitek (BBL) were used. The identification of non-mutans streptococci was performed according to the scheme of Killian *et al.*[17]

Statistical analyses were conducted, using SPSS/PC + V2.0.[18]

RESULTS

The results are shown in Table 1. The thirty sealants were in place for an average of 3.4 years (s.d. 2.1). The median of the number of microorganisms was 400 (range 0-3 10^5) cfu per sample. No microorganisms were found in three samples, while 10 cfu's of *S. mutans* were found in one sample. Cariogenic microorganisms were found in 58 percent of the other samples. In one sample, 3.5 10^5 cfu per sample were found, while the sealant with a marginal adaptation judged as good, using SEM, was in place for three years, five months. Fur-

Table 1 □ Data of treated sealed teeth.

PATIENT		SEALANT			BACTERIOLOGICAL DATA OF DENTINE			
Number	Tooth	Yr	Mth	SEM	Tot. cfu[1]	Lact.[2]	Mut.[3]	Others[4]
01	47	3	5	+	3.10^5	100		
02	16	1	6	−	5.10^4	20	1	
03	46	6	0	−	3.10^4		10	
04	47	2	8	+	2.10^4			100^5
05	36	2	8	+	1.410^4	3	50	
06	46	2	1	+	8.10^3	1	15	
07	37	0	10	+	7.10^3	0.5	3	
08	16	4	0	+	5.10^3	1	82	
09	36	0	7	+	5.10^3		99	
10	36	1	6	+	10^3		90	
11	16	7	8	−	9.10^2			100^6
12	16	8	7	±	7.10^2			100^7
13	27	2	6	+	5.10^2	100		
14	37	3	5	−	5.10^2	10	90	
15	37	4	2	+	5.10^2			$100^{6,8,9}$
16	17	4	7	−	3.10^2		100	
17	17	2	8	±	3.10^2			100^7
18	17	3	4	±	2.810^2			100^8
19	16	3	4	+	2.610^2			100^9
20	36	4	9	±	2.10^2	10	90	
21	26	1	6	+	2.10^2	100		
22	36	3	0	+	1.510^2			100^5
23	17	2	8	+	10^2			100^7
24	26	1	5	−	10^2	100		
25	27	1	1	±	10^2			100^7
26	26	2	2	±	10^2			100^7
27	37	2	6	+	10		100	
28	16	6	1	+	0			
29	16	8	0	−	0			
30	17	2	6	−	0			

LEGEND

1 Total number cfu on blood agar
2 Percentage lactobacilli
3 Percentage mutans streptococci
4 Percentage other micro-organisms with exception of gram pos. rods
(3 and 4: of the total cfu on blood agar)
5 Unidentified gram neg. rods
6 Veilonella
7 Staphylococci
8 Actiomyces
9 S. gordonii

Yr = year
Mth = month
SEM = Scanning Electron Microscope

SEM: + = no marginal adaptation defect
± = one marginal adaptation defect
− = several marginal adaptation defects

Cariogenic microorganisms were found in 58 percent of the samples.

thermore, after opening, the dentine was of a soft consistency in all cases, and varied in color from white (n = 5) to dark brown (n = 6). Brown was the most common color (n = 19).

The percentage of mutans streptococci and lactobacilli in the samples with cariogenic microorganisms was relatively high. *Streptococcus gordonii, Streptococcus sanguis, Streptococcus salivarius, Streptococcus mitis, Veillonella* species, *Actinomyces* species and *Staphylococcus* species were found, in addition to the mutans streptococci and lactobacilli. The other microorganisms detected were unidentified Gram positive rods.

No microorganism was detected in the water samples (with the exception of sample 12, which contained *Staphylococcus* species).

Sixteen sealants displayed an intact seal in the SEM assessment (Figure 1). Six sealants had one defect and eight sealants displayed several defects in the margin (Figure 2). The defects varied from 9 to 23 μu, as measured from the surface of the sealant to the enamel surface. It was not possible to measure the depth of the defect with the method employed.

No relationship was found between the number of microorganisms and the marginal adaptation of the sealant, under the SEM (Kendall's Tau-C = 0.17, n.s. also see Table 2); neither was a relationship found between the age of the sealant and the number of microorganisms (Kendall's Tau-C = − 0.01, n.s.).

DISCUSSION

In comparison with the study on untreated hidden caries lesions, the number of microorganisms under sealants found in this study is 100 times smaller.[1] Nevertheless, ten samples still contained ≥ 10^3 microorganisms, and nine of these contained cariogenic microorganisms. These results do not agree with those of Mertz-Fairhurst, who did not find any microorganisms in their study after a year.[11]

At ACTA, a few years ago clinically sound teeth with a radiolucency showing on the bite-wing were treated

Table 2 □ SEM marginal adaptation and the number of micro-organisms (n = 30).

SEM	n	median*	range*
−	8	400	0-5.10^4
±	6	250	10^2-7.10^2
+	16	750	0-3.10^5

*cfu per sample

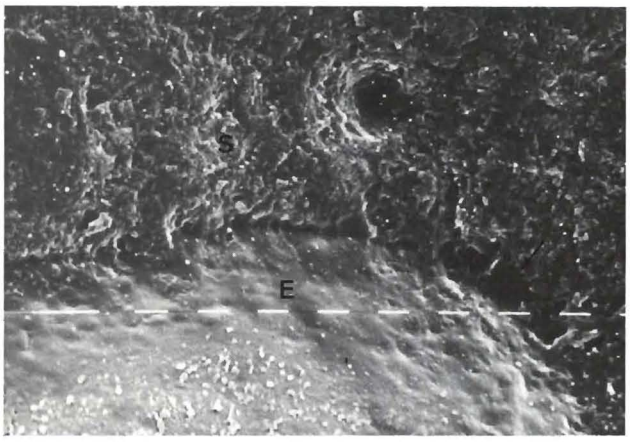

Figure 1. Correct SEM marginal adaptation (640x). E = enamel, S = sealant.

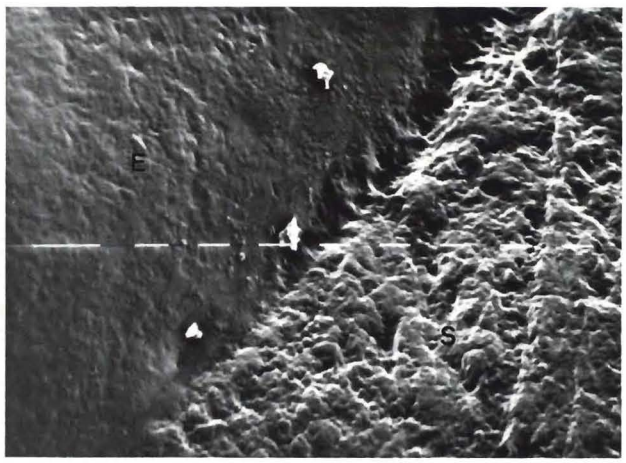

Figure 2. Incorrect SEM marginal adaptation (640x). E = enamel, S = sealant, lmm = 1.4μm. Arrow points at the defect.

with a sealant, because at that time, the bitewing was considered unsuitable for the diagnosis of occlusal caries and not used, therefore, to asses the presence of occlusal caries. In the pediatric department, occlusal caries, if diagnosed, was treated curatively. In cases where some doubt existed, the tooth was not treated with a sealant. The teeth treated in this study were diagnosed, therefore, as sound at the time of sealing. Comparing the bitewing retrospectively, however, we found on all bitewings a radiolucency indicating hidden caries (data not shown). Thus, at the time of treatment, these teeth had hidden caries lesions.

Leathery, dry dentine as described in the literature was not found in this study.[5,10,11,14] The dentine was of a soft, moist consistency (Figure 3) and was usually darker in color (Figure 4) than that observed in the untreated teeth.[1] A dark color indicates the presence of colorant in the lesion. From the SEM results it appeared unlikely that transport of these particles took place via defects in the sealant margin. Transport of the colorant particles via the enamel, however, cannot be ruled out. If transport through the enamel occurs in these teeth, substrate flow through the enamel may also be a possibility. If this is the case with hidden caries lesions, sealing of the occlusal surface with a sealant will not block substrate supply to the lesion sufficiently to stop the caries process completely.

Leakage along the margin of the sealant is cited as one of the most important reasons for the persistence of microorganisms.[8] Clinical assessment of the quality

Total retention of the sealant in 80 percent of cases after eight years was reported.

of the sealant will generally take place using a mirror and probe. Of the type of sealant used in this study (Delton tinted™), total retention in 80 percent of the cases after eight years was reported.[19] Marginal leakage cannot be determined clinically, however, to a sufficient extent. In order to obtain a more accurate picture of marginal adaptation, the sealants in this study were reassessed, using the SEM. Forty-seven percent of the sealants clinically assessed as good showed one or more defects when reassessed with the SEM. The fact that lactobacilli and mutans streptococci were found in ten teeth with intact (SEM-)margins, indicates that factors

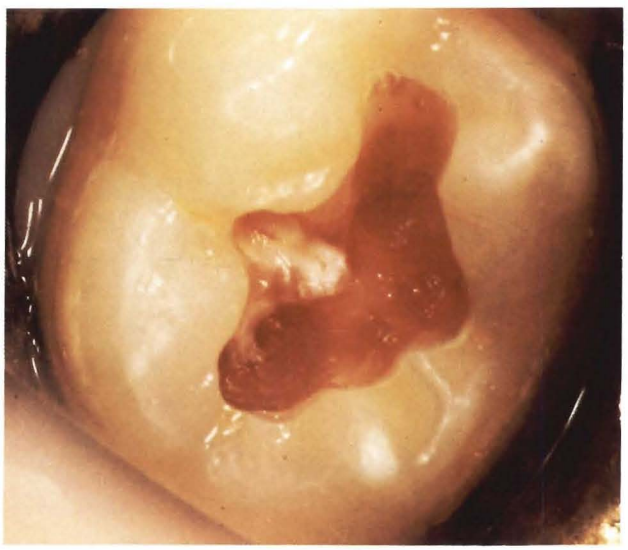

Figure 3. Soft, moist dentine of tooth 07 after opening and sampling.

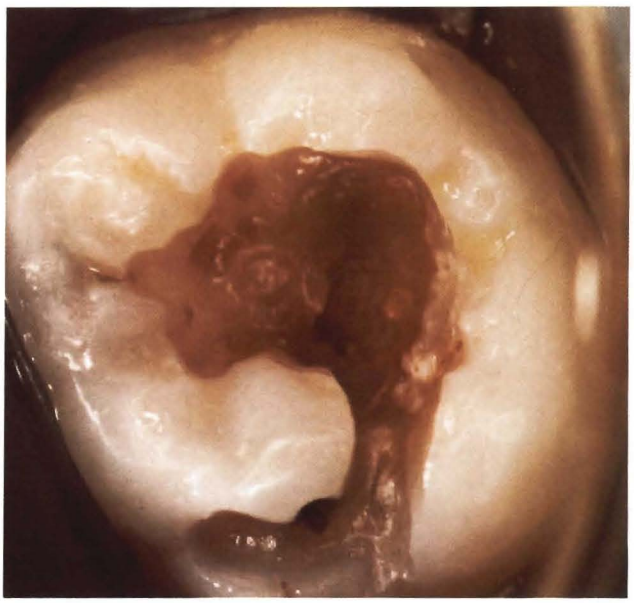

Figure 4. Dark colored dentine of tooth 21 after opening and sampling.

other than insufficient marginal adaptation play roles in the persistence of microorganisms. We were not able to show a relationship between the number of microorganisms and the time passed since the sealant was placed, as reported by earlier studies.[6,7,10,11,14]

It is suggested in the literature that microorganisms can survive by obtaining nutrients from the pulp via the dentinal tubuli.[14,20] This should allow microorganisms to persist in deep lesions, thus enabling the caries process to continue. Going, however, states that the results of his research and those of Besic actually refute this hypothesis.[2,8] In the present study, deep dentine lesions were found in nine teeth (numbers 02, 03, 06, 07, 08, 10, 21, 23, 30). In two teeth, no cariogenic microorganisms, nor microorganisms at all, were found. Cariogenic microorganisms were found in the remaining seven deep lesions (median 7.10^3, range 2.10^2 – 5.10^4 cfu per sample). The marginal adaptation of the sealant was assessed as good under the SEM in five of the seven teeth. On the basis of these results, a continuation of the carious process might be quite possible. Swift's conclusion that dentine caries that has been accidentally sealed does not necessarily constitute a problem, as long as the sealant remains intact, is possibly too optimistic, therefore, in the case of hidden caries.[21]

The high percentage of *S. mutans* and lactobacilli in the dentine of the samples in which microorganisms were found are in agreement with the selection of these microorganisms under sealants reported by Going.[8] A displacement of the flora in the direction of the lactobacilli was observed in 19 percent of the teeth with a good SEM assessment. In those cases, the percentage of lactobacilli had increased to more than 44.5. In the study by Going, this was found in sealed teeth clinically classified with active caries.[8]

As well as the presence of cariogenic microorganisms in more than 50 percent of the teeth studied, all teeth were clinically diagnosed as having soft carious tissue. No pain was reported, however, in any of these cases. Application of a sealant appeared to slow down the caries process. Sealing carious dentine does not necessarily have negative consequences, therefore, within the short term. Continuation of the process in the long term cannot be ruled out. Furthermore, from the clinical point of view, in the case of large dentinal lesions where considerable tissue alteration has occurred, the desirability of simply covering the caries with a sealant is doubtful. Clinical experiences have led Mitchell to have reservations about the theoretical option of sealing dentinal caries.[22] It was reasoned clinically that sealant retention cannot always be sufficiently monitored, since patients do not always keep their appointments. According to Mitchell, preventive resin restoration of teeth with occlusal caries on the radiograph is to be preferred to the application of a sealant.[22] In the light of this genuine clinical problem and the problems associated with the clinical assessment of the marginal adaptation of sealants, it does not seem desirable to treat these lesions solely with a resin sealant as long as the factors determining the persistence of microorganisms in hidden caries are unknown.

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EFFECT OF CONVENTIONAL DENTAL RESTORATIVE TREATMENT ON BACTERIA IN SALIVA

Dental caries results from the dissolution of mineralized dental tissues by the metabolic by-products of oral bacteria colonizing the surface of teeth. The principal modality for dealing with this infectious process is through restorative treatment which removes the pathologic tissue and replaces it with a variety of inert materials. The purpose of this study was to evaluate the effect of traditional restorative treatment on select oral bacterial populations. Fifty-two females demonstrating high levels of mutans streptococci ($\geq 2.5 \times 10^4$ colony forming units (cfu) per ml saliva) with no more than four missing posterior teeth were recruited for this study. Salivary levels of mutans streptococci, lactobacilli, total streptococci, and total cultivable bacteria were evaluated before, during, and after restorative treatment. Initial DMFS scores were established by two standardized examiners using bitewing radiographs and clinical examination, which was conducted under optimal conditions. All restorative treatment was completed by faculty members of the University of Alabama School of Dentistry using treatment plans developed by the DMFS examiners. The participants received a mean of 16.4 restored surfaces, which resulted in significant reductions of all the bacterial populations tested. All microbial populations monitored were predicted to return to their baseline levels within 151 days after restorative treatment in 50 percent of the participants. This study shows that conventional restorative treatment results in a significant reduction of bacterial populations including those associated with the dental caries process, i.e., mutans streptococci and lactobacilli. Although restorative treatment is essential for replacing form and function to the dentition, it does not appear to have a prolonged effect on any of the salivary bacterial populations monitored, including those thought responsible for dental caries. Ideally, comprehensive treatment of dental caries should address the infectious nature of this disease through modalities directed at controlling bacterial colonization as well as restoring the afflicted dentition.

Wright, J.T. *et al*: Effect of conventional dental restorative treatment on bacteria in saliva.
Community Dent Oral Epidemiol, 20:138–143, 1992.

Glass ionomer/resin preventive restoration

Theodore P. Croll, DDS

Garcia-Godoy described a variation of the preventive resin restoration, called the "preventive glass ionomer restoration".[1,2] Since the preventive resin restoration concept was first developed by Simonsen, such restorations have become the mainstay of conservative direct application restorative dentistry using adhesive dental materials.[3-9] Rather than traditional bur cutting and "extension for prevention", which is important in Class I silver amalgam restorations, preventive resin restorations offer important advantages including:

- ☐ Conservation of tooth structure.
- ☐ Adhesive bonding to tooth structure.
- ☐ Sealing of noncarious associated enamel pits and fissures.
- ☐ Restorations of normal tooth color.
- ☐ Mercury-free restorations, a desirable feature to certain patients and parents.
- ☐ Restorations that can be easily repaired or replaced.

Garcia-Godoy's variation substitutes self-hardening glass ionomer restorative cement for composite resin.[1,2] Glass ionomer restorative materials provide the following advantages:

- ☐ Fluoride ion leaching.
- ☐ Coefficient of thermal expansion similar to that of tooth structure.
- ☐ Chemical bonding to dentin and enamel.
- ☐ Dimensional stability.
- ☐ Insolubility in oral fluids at intraoral temperatures.
- ☐ Excellent biocompatibility.

The chief disadvantages of the self-hardening glass ionomer in a preventive-type restoration are:

- ☐ The 4-6 minutes required for sufficient hardening of the material before application of sealant.
- ☐ Much lower fracture toughness.
- ☐ Less resistance to wear.

In preventive restorations that require minimal preparation and are not subject to high occlusal stresses, the latter two factors may not be important.

A new type of glass ionomer material consists of approximately 80 percent glass ionomer cement and a visible light-hardened resin component of approximately 20 percent.[10,11] After the new glass ionomer/resin material is injected into a cavity preparation, significant hardening of the cement takes place within thirty seconds of light beam exposure. *In vitro* experimentation in my office has shown curing depth of over 5 mm with thirty seconds exposure. As the glass ionomer reaction continues to mature after the initial hardening, the material attains greater hardness and better physical properties. Another desirable feature of the new glass ionomer/resin systems is that they are supplied in various shades of tooth color.

This paper describes placement of a preventive glass

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ionomer/resin restoration in a first permanent molar, using Fuji II LC (GC America, Chicago, IL) light-hardened restorative cement. The chief advantages of this variation of preventive type restorations are:

- ☐ They can be trimmed and sealed in less than sixty seconds after placement.
- ☐ The material serves as both a dentin and enamel replacement, eliminating the need for resin/glass ionomer layering.[12,13]

TECHNIQUE

Placement of a light-hardened preventive glass ionomer/resin restoration for small Class I carious lesions is demonstrated in Figures 1-12:

Figure 1. This maxillary first permanent molar has beginning caries and decalcification in the mesial fossa and occlusolingual groove.

Figure 2. A small inverted cone bur is used to remove the caries and create mechanical interlocking retention form. Dentinal penetration was minimal.

Figure 3. Twenty-five percent polyacrylic acid is placed for five to ten seconds to remove the smear layer.

Figure 4. Fuji II LC cement is mixed according to manufacturer's instructions and placed in an Accudose syringe tip (Centrix, Inc., Millford, CT). The cement is slowly and carefully injected into the cavity preparations, to avoid entrapment of air.

Figure 5. A ball burnisher is used to spread the cement over all cavosurface margins.

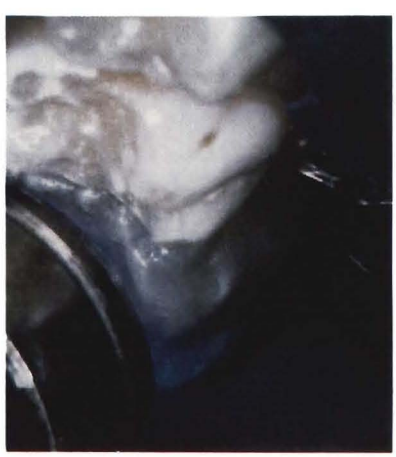

Figure 6. The visible light beam is applied for thirty seconds.

Figure 7. A slow-speed, round bur is used to shape the surface configuration of the hardened glass ionomer cement.

Figure 8. The glass ionomer/resin material is shown before application of bonded resin sealant.

Figure 9. Forty percent phosphoric acid is applied for twenty to thirty seconds on the hardened cement and surrounding enamel. It is then rinsed for at least twenty seconds and the tooth surface dried.

Figure 10. Clear resin sealant is applied to surface and peripheral enamel.

Figure 11. After the rubber dam is removed, occlusal evaluation and adjustments assure that the glass ionomer/resin cement is not supporting any high stress functional contacts.

Figure 12. Four and a half months after placement of the light-hardened glass ionomer/resin preventive restoration, the tooth is shown.

DISCUSSION

After six months of using Fuji II LC restorative material, it is apparent that this new type of cement has greater wear resistance, improved fracture toughness, and more durability than the self-hardening glass ionomers. It is my impression that inclusion of a 20 percent resin component not only provides for rapid hardening by the light beam, but gives the hardened material a modulus of elasticity, so that the surface will absorb stress, rather than to fracture. All physical properties of these cement systems need to be investigated *in vivo* so that durability, reliability, and longevity of restorations will be known. Vitrebond (3M Dental Product Div, St. Paul, MN) light-hardened, glass ionomer base/liner dentin and enamel restorations, how-

A new type of glass ionomer material consists of approximately 80 percent glass ionomer cement and a visible light-hardened resin component of approximately twenty percent.

ever, have given four years of outstanding service, when used in low stress regions.[14] Furthermore, glass ionomer-silver cermet cement has proven itself reliable as an occlusal Class I restorative for over six years.[15] These observations make the potential use of the glass ionomer/resin concept exciting

Manufacturers of dental restorative materials should now be concentrating on creating a bonded material that has the favorable properties of both glass ionomers and composite resins, combined with the wear resistance and fracture toughness of metallic restorations. Perhaps the light-hardened glass ionomer/resin materials are a big step in that direction. If indeed these new systems do prove to hold up in the mouth, the "amalgam wars" will truly be over.

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ENAMEL DYSMINERALIZATION

Enamel "dysmineralization" is defined as a disturbance in formation of the inorganic component of enamel during amelogenesis. Such disturbances in the normal mineralization process can result in brown enamel discoloration, white opacities in the enamel surfaces, or enamel coloration defects of various hues. Enamel dysmineralization defects can be localized to one section of an enamel surface, or an entire surface of a tooth can be marred by colored streaks, multiple spots, or various other patterns of discoloration.

Croll, T.P.: *Enamel microabrasion*, Chicago: Quintessence Publishing Co. 1991, p 22.

Hereditary dentinogenesis imperfecta: A treatment program using an overdenture

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Dentinogenesis imperfecta (D.I.) or hereditary opalescent dentin, was described in the late 19th century and is characterized by abnormalities of the enamel and dentin respectively.[1-3] In general, both the primary and permanent dentitions are affected. The disease is inherited in a simple autosomal dominant mode with high penetrance and a low mutation rate.[4] It has been reported to occur at a rate of l in 6000-8000 births.[5,6]

Shields, Bixler and El-Kafrawy (1973) proposed three types of D.I.: Type I is the defect associated with osteogenesis imperfecta. Type II is the so-called classical heredity opalescent dentin; and Type III is the type found in the Brandywine isolate of Maryland.[7] Later studies have shown that D.I. Type II and Type III are in fact different expressions of the same gene.[8,9]

Clinically, the color of the teeth, because of the lack of a normal pigmentation of the enamel layer, varies from a brown to a translucent gray with an opalescent sheen.[10] Soon after the primary dentition is complete, enamel, which might appear to be clinically normal or slightly hypoplastic, often breaks away from the underlying dentin. This occurs at the incisal edges of the anterior teeth and the occlusal surfaces of the posterior teeth, because of lack of scalloping of the dentino-enamel junction, the poorly calcified nature of the dentin base, or a basic fault in the enamel.[11] Attrition is frequently rapid and severe, and affected teeth may become abscessed. The permanent teeth often seem to be of better quality and suffer less destruction. There is a marked reduction in caries and no sensitivity.[1]

Radiographically, the teeth have bulbous crowns and short roots with pulpal obliteration, which at an early stage is most pronounced in the coronal segment.[12]

LITERATURE REVIEW

Various types of treatment for dentinogenesis imperfecta have been suggested in the literature. Previously, the majority of these cases remained untreated until adolescence or adulthood when all the teeth were extracted and full dentures made. The earliest mention of the use of multiple crowns is by Talbot (1893) for an adult case of D.I.[1] Gold crowns and gold inlays are also mentioned.[13,14] Schimmelpfennig and McDonald (1953) reported a child with D.I. (which they described as "dentine aplasia") in which gold overlays were constructed over primary teeth and the permanent teeth were covered with Tru-Chrome crowns to protect them from further attrition.[15] This was the first recorded active treatment for children described in the literature. The use of a mixture of pin-retained cast gold thimbles under acrylic crowns, jacket crowns and simple removable appliances, and stainless steel crowns with acrylic facings for anterior teeth have been described.[11,16-18] Gibbard (1974) suggested a combination

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of stainless steel crowns, overlay dentures, full veneer gold crowns, and very briefly mentioned an acid-etch technique. A case report using composite resins with the acid-etch technique was published by Koenig and Taylor and used widely thereafter.[20-25] The use of an activator in order to obtain a higher vertical dimension was also recently published.[26]

The use of overdentures, or overlay dentures, is an old concept, but has become more accepted in recent years for the treatment of many D.I. patients.[27-31] The indications for their use include congenital disorders (cleft palate, oligodontia, cleidocranial dysostosis); acquired defects; and also the need to prolong the life of the remaining teeth, when retention would otherwise be doubtful.[32,33] Before fabrication, all carious teeth should be restored, and the patient given instructions on the proper care and cleaning of the teeth and oral tissues.[31,34]

The treatment of young children may present problems of cooperation, but early treatment will often lead to a better final result. To improve esthetics, to maintain the vertical dimension, and to provide an efficient masticatory system, it is very important for these patients, to maintain good oral health. Possibly the most important advantage is the positive psychological support for the child.

CASE REPORT

A nine-year-old female child was referred to the Pedodontic Clinic at the University of Geneva Dental School to improve her functional problems and the esthetic appearance of her teeth. Physical and dental development was normal for her age. Her hygiene was not perfect. The enamel showed generalized pitting, was hard but grayish in color, and transparent. All her primary teeth and first permanent molars showed extreme attrition to the gingival margin (Figure 1). A

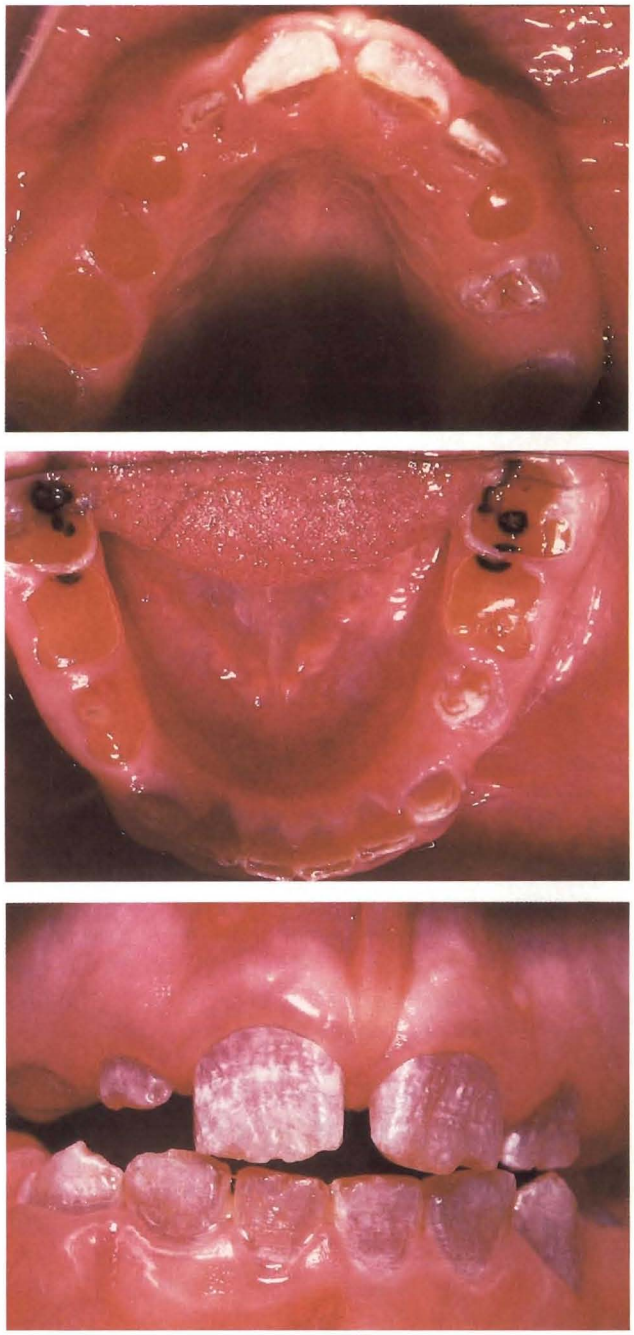

Figure 1. Occlusal and frontal views of a nine-year-old female with dentinogenesis imperfecta.

The use of overdentures is an old concept, but their popularity has grown in recent years.

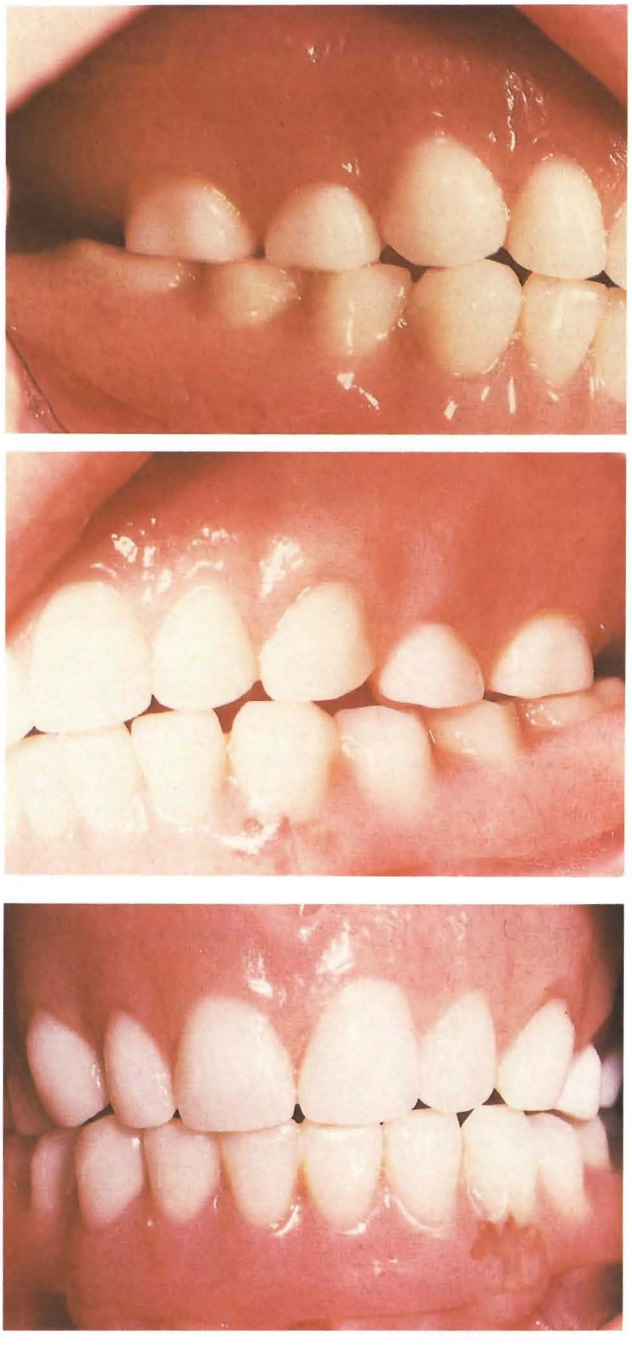

Figure 2. Lateral and frontal views of the overdentures 2.5 years after the initial treatment.

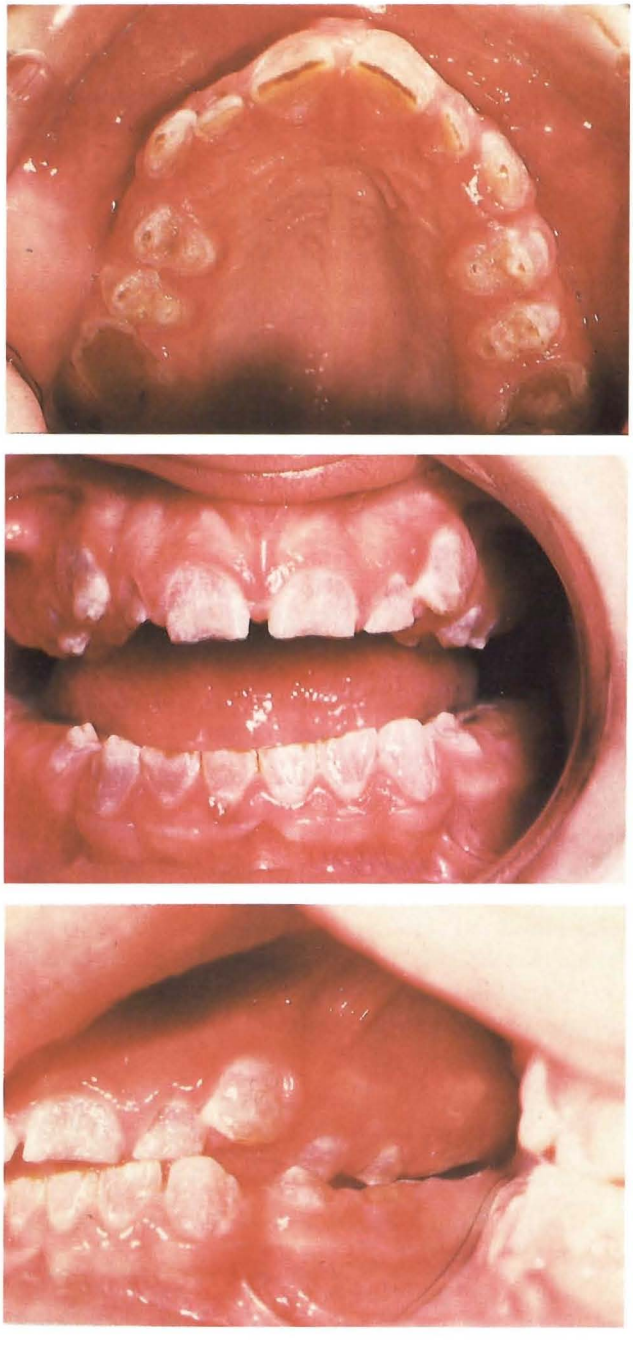

Figure 3. Maxillary occlusal, frontal and left lateral views of the eleven-year-old patient with dentinogenesis imperfecta.

Class I dental relationship and a posterior crossbite due to the slightly narrow maxilla were noted. Perusal of the family history was attempted, to determine whether other members of the family had been similarly affected; but the mother was not very cooperative. She did admit, however, that all her teeth had been extracted and that she now wore complete upper and lower dentures.

At the first appointment (December 1985), teeth 53,54,55,84 had to be extracted. Impressions were made

for the treatment plan. An oral home-care program of daily rinses with Plack-Out* and weekly applications of fluoride were recommended. The case was reported to the Swiss Invalidity Insurance which agreed to pay for the dental treatment of this case.

It was decided to make overdentures. It was imperative to increase the vertical dimension, however, in order to make satisfactory overdentures. So, after the usual impressions and occlusal registrations with a face bow, an upper overdenture was constructed and placed in October 1986. Subsequently, since the patient accepted the denture very well, resin was added in the posterior region at regular intervals to determine whether the patient would tolerate the increased vertical dimension. In June 1987, the lower overdenture was placed and the occlusal plane of the upper denture was readjusted to occlude with the lower. The patient tolerated both dentures very well. They required refabrication in March 1988, due to alveolar growth (Figure 2). The patient continued with hygiene procedures, especially with Plack Out*, and until now, all of the permanent teeth have erupted into the dental arch without loss of alveolar bone (Figure 3).

SUMMARY

The aim of treatment in cases of dentinogenesis imperfecta is to improve the esthetic appearance and maintain the oral masticatory apparatus in a healthy and functional state. In the growing child, it was decided to maintain the teeth for as long as possible under an overdenture, until such time when a permanent prosthetic solution can be decided upon.

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* Plack-Out, Hawe-Neos Dental, Dr. H. von Weissenfluh SA. Switzerland.

Teenage luxation injury: Report of case

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In the teen and young adult years, dental injuries are often a result of athletic injuries, automobile accidents, and falls. Several studies have reported that between 13 percent and 39 percent of dental injuries are related to sports and are commonly seen in eight- to fifteen-year-old boys.[1,2] Either direct or indirect trauma can cause them. The most vulnerable tooth is the maxillary permanent central incisor, which sustains approximately 80 percent of the dental injuries, followed by the maxillary permanent lateral and the mandibular permanent central and lateral incisors.[3]

LITERATURE REVIEW

The usual emergency treatment of the uncomplicated crown fracture with exposure of dentin and/or the pulp, is the protection of the exposed area with a $Ca(OH)_2$ product and an intermediate restorative material held in place with a band before reconstruction with a composite resin.[4]

In crown-root fractures, in which direct trauma is often the major factor in the incisal region, emergency treatment can include stabilization of the coronal fragment. Forced eruption has been suggested in the periodontal and endodontic literature as an alternative method to manage root fractures in the region of the alveolar crest.[5,6] Endodontic treatment of the root portion is usually performed before orthodontic treatment. Once the root attains the desired position, it must be stabilized for approximately six months to allow the periodontal ligament to reestablish itself and initiate alveolar healing.[7]

In luxation cases, the teeth are repositioned either by digital pressure, to allow the teeth to realign themselves; or accomplished orthodontically. Splinting is recommended for a short period of time during the healing of the periodontal structures.[8] For teeth requiring endodontic treatment, a 64 percent to 94 percent success-rate has been reported.[8,9]

In total luxation cases, it is important to know exactly the amount of time between the injury and the start of treatment; the conditions under which the tooth has been preserved; the width of the apical foramen; and the stage of root development.[10] Periods exceeding thirty

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Sabine C. Maréchaux was head of the Pedodontic Clinic at the University of Geneva Dental School, Switzerland until October 1988 and is now exclusively in private practice.

minutes of drying time present an increased risk of ankylosis.[11-13] Recently, Cvek *et al* suggested topical antibiotic application before reimplantation (in monkeys) so as to increase the frequency of complete revascularization.[14]

CASE REPORT

A sixteen-year-old Caucasian boy came to the Orthodontic Emergency Service two hours after an accident at school. His mouth had been traumatized with a tennis racket. The maxillary right permanent central incisor (11) was totally luxated. The maxillary left permanent central incisor (21) had a crown-root fracture, which extended lingually under the gingiva. The maxillary left permanent lateral incisor (22) had an enamel-dentin fracture with a pulp exposure (Figure 1), while the lower left permanent lateral incisor (32) had an enamel fracture of the incisal edge. There were also gingival lacerations in the maxillary incisal area. After the initial radiographs, vitality tests (of 11,21,22,32) and photographic documentation, the emergency treatment consisted of the following:

- ☐ In spite of the two-hour extraoral period of the maxillary right permanent central incisor (11), it was decided to reimplant it and use a 017 x 025" stainless steel wire for stabilization (Figure 2).
- ☐ The upper left permanent central incisor (21) and lateral incisor (22) received a direct pulp capping in an attempt to maintain pulp vitality. The fractured surface was washed with a sterile physiological saline solution and the exposed pulp was covered with calcium hydroxide*, and protected with a zinc-oxide-eugenol cement**.
- ☐ The patient was advised to receive tetanus vaccination, antibiotic protection, analgesics and a mouth wash*** (rinse) to promote the healing of the gingival tissues. The patient came a few days after the accident for a recall check-up (Figure 3).

Figure 1. Clinical condition at the time of injury.

Figure 2. Radiographic condition after the reimplantation and splinting.

THE TREATMENT PROCEDURE

Three months after the initial emergency treatment, during which time the patient did not keep his follow-up appointments, he was referred to the Pedodontic Department. Root canal extirpation was performed on the maxillary left permanent central (21) and lateral (22) incisors, due to the loss of vitality. The root canals were

* Pulpdent LD Caulk Co, Milford, DE, USA.

** IRM Caulk Intermediate Restorative Material; Milford, DE, USA.

*** Plack-Out Hawe-Neos Dental, Dr. H. von Weissenfluh SA, Switzerland.

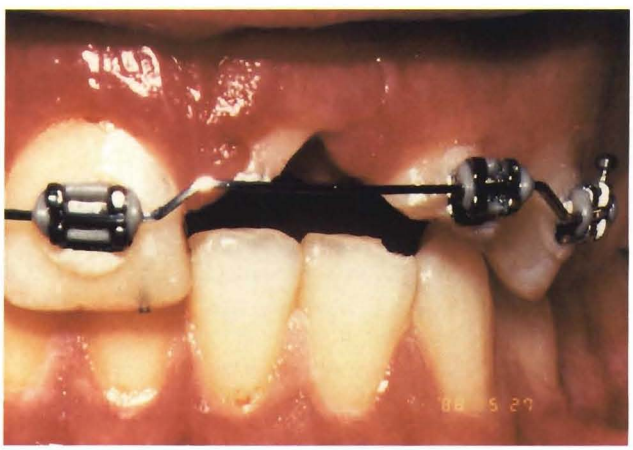

Figure 3. Two days after the injury. Note the healing of the gingival tissues. The arrow indicates the incisal fracture of tooth 32.

cleaned and calcium hydroxide was used as an interim dressing. Figure 4 shows the lateral root resorption of the maxillary right permanent central incisor (11), which was subsequently also treated endodontically with a calcium hydroxide dressing.

At two-month intervals, the teeth were controlled and the calcium hydroxide dressings, which had resorbed from the apical half of the root canal, were replaced.

Ten months after the accident, the maxillary left permanent central incisor (21) was filled with gutta percha and Kerr cement, because an apical hard tissue barrier was present clinically and visible radiographically. In order to obtain a more aesthetic result for the crown restoration of the upper left permanent central incisor (21), it was decided to extrude the remaining part. A gingivectomy of teeth 21 and 22 was performed in order to increase the crown length sufficiently to place brackets. One month later, an anterior sectional, or-

Figure 4. A radiograph, three months after the injury. The root canals were filled with calcium hydroxide dressings.

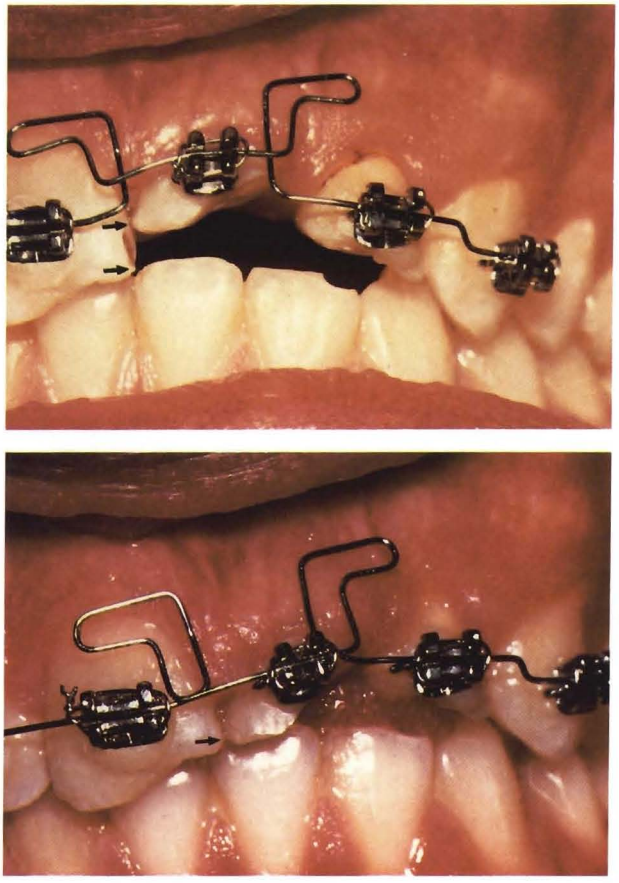

Figure 5. The situation before (5a) and after (5b) orthodontic extrusion of the maxillary left permanent central incisor (21).

In total luxation cases, it is important to know exactly the amount of time between injury and start of treatment.

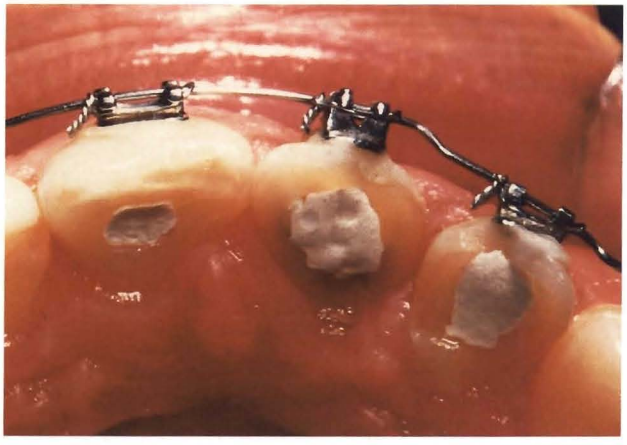

Figure 6. An occlusal view after the extrusion of tooth 21.

Figure 7. The apical radiographs of teeth 11, 21, and 22 after endodontic obturation and before reconstruction. The progressive external resorption of the maxillary right permanent central incisor (11) can be seen.

thodontic, fixed appliance was used utilizing 0.022″ x 0.028″ slot direct-bonded, straight-wire brackets. A 014″ stainless steel round wire with a double extrusion loop was placed. The loops were activated after thirty days (Figure 5a). The active orthodontic treatment lasted for three months and a 016″ stainless steel arch-wire was used for the retention period of six months (Figure 5b).

With completion of the orthodontic treatment (Figure 6), the maxillary left permanent lateral incisor (22) was filled with gutta percha and Kerr cement. Although the canal of the maxillary right permanent central incisor (11) had been filled several times with calcium hydroxide, progressive replacement resorption was evident (Figure 7). Composite restorations were placed after a gingivectomy was performed for the maxillary left permanent central incisor (21) and the maxillary left permanent lateral incisor (22). The palatal access for endodontic treatment of the maxillary right permanent central incisor (11) was left accessible with IRM; this tooth was also restored with a composite restoration for esthetic reasons. Despite its ankylosis, the tooth is functioning normally (Figure 8) for the time being.

Figure 8. Frontal view, after the composite restorations of teeth 11, 21 and 22 were completed.

SUMMARY

The endodontic, restorative, and orthodontic treatment sequence of the accidental injury of three maxillary incisors has been presented. The treatment objective was to achieve an esthetically acceptable result for a young adult, until a definitive fixed prosthetic restoration can be planned. The ankylosed maxillary right permanent central incisor (11) is being maintained for reasons of arch-length space and alveolar bone height.

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BONDING TO DENTAL PORCELAIN

The results showed that surface treatment of dental porcelain significantly improved the bond between composite resin cement and the porcelain.

The improvement in bond strength after hydrofluoric acid etching of the porcelain surface may be explained by the micro-mechanical interlocking between the resin cement and the etched porcelain. According to Stangel, Nathanson and Hsu, hydrofluoric acid dissolved the glassy components of porcelain and created micro-pores and porosities. This increased the surface area of porcelain and created micro-undercuts which encouraged composite resin to bond to the porcelain surface.

With silane pre-treatment of an unetched porcelain surface, the high proportion of silica in dental porcelain allowed silane coupling agents to chemically link the composite resin to the porcelain surface. This was said to be achieved through the hydrolysis and adsorption of a silane on a ceramic surface and the covalent bonding between the silane and the resin matrix. Many laboratory studies have found that silane coupling agents are effective in improving the composite resin/porcelain bond.

Lu, R.: An investigation of the composite resin/porcelain interface. Australian Dent J, 37:12–19, February 1992.

Possible hazards of the transpalatal bar: Report of cases

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The transpalatal bar is frequently used in both extraction and nonextraction orthodontic treatment. It is useful for improving the anchorage qualities, rotation, and distal movement of molars; the expansion and contraction of the dental arch; the intrusion and torquing of individual teeth. In order to produce the desired results, however, the appliance demands expertise, attention to detail, and close monitoring by the operator. In spite of extreme care, however, clinical observation shows that some undesirable side-effects may still be encountered.

Experimental and mathematical analyses have shown that the application of torque to the buccal roots of upper molars by means of the transpalatal bar without appropriate adjustments of the arch-width can produce, initially, an adverse tipping of the crown buccally.[1,2] A search of the literature, however, revealed no previous reports regarding adverse effects.

This report presents two cases in which the transpalatal bar was partially embedded in the palatal mucosa during orthodontic treatment. Discussed also are the possible reasons for the occurrence.

CASE REPORT 1

R.Q., female, was ten years of age. Diagnosis: Angle Class II div 1; overjet, 3 mm; overbite, 2 mm. Severe crowding was present in the maxilla and moderate crowding in the mandible.

Treatment

The treatment plan was to extract the maxillary first and the mandibular second premolars, apply high-tension headgear and, in addition, use a transpalatal bar to reinforce the anchorage and correct the rotation of the first molars. It was planned to use the straight wire-technique to reduce the overjet.

A transpalatal bar with mesial loop (GAG International, Inc., N.Y., USA) was fitted, followed two months later by high-tension headgear. The patient was seen on scheduled appointments every four to six weeks. During the ninth month of treatment, the patient presented with the loop of the transpalatal bar embedded in the palatal mucosa (Figure 1). It was learned that the patient had not used the headgear for the past two months. The removal of the bar did not require incision.

CASE REPORT 2

K.J., female, was thirteen years of age. Diagnosis: Angle Class II div 1; overjet, 7 mm; overbite, 2 mm; mild crowding was present in the maxillary anterior segment.

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Figure 1. The mesial loop of the transpalatal bar partially embedded in the palatal mucosa.

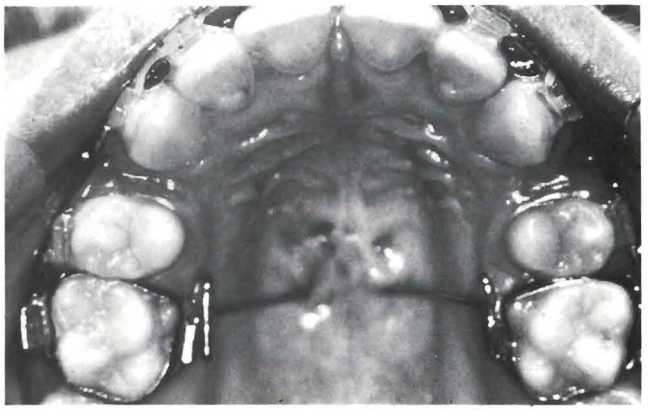

Figure 2: One arm of the transpalatal bar out of the sheath and mesial loop partially embedded in the palatal mucosa.

Treatment

The treatment plan was to extract both maxillary first premolars and reduce the overjet with the straight wire technique. Consideration was given to the use of a transpalatal bar for anchorage and for correction of the rotation of the maxillary first molars, and high-tension headgear for additional anchorage. There was to be no treatment in the mandible.

After extraction of the premolars, a high-tension headgear was fitted, followed by the placing of a transpalatal bar (GAC) a month later. The patient was seen every four to six weeks and the bar checked. Ten months into treatment she presented (after an interval of six weeks) with one arm of the appliance out of the band sheath. The loop was lodged in the palatal mucosa (Figure 2) to an extent that an incision to free it was required.

DISCUSSION

The transpalatal bar is very sensitive to small differences in shape; variation in over-all shape and dimension could significantly alter the activations required.[2]

Ideally, the appliance should be formed so that it lies passive in the molar sheaths and contoured to the palatal tissues to maintain a distance of about 2 mm from the mucosa (except when intrusion of molars is desired, in which case the distance should be slightly greater). This will allow optimal comfort without impingement and is the shape that the bar should return to, following activation.[2]

The correction of crossbites and severe rotations of the maxillary first molars is recommended as a first procedure before beginning therapy with a fixed or removable appliance, or headgear. The transpalatal bar is extremely effective, not only in this early phase, but

The transpalatal bar is very effective as an adjunct to the distal movement of the first and second maxillary molars.

also as an adjunct to distal movement of first and second maxillary molars.[3]

When first molars have been moved distally with headgear or other devices and subsequently the bar is applied to maintain the teeth in the new position, there may still occur a certain degree of relapse, with mesial movement and/or forward tipping of these teeth. The tendency for maxillary molars to rotate and tip mesially may also overwhelm the counteractive force offered by the bar, when used alone for anchorage. These phenomena may result in the impingement of a previously well-contoured mesial loop on the palatal mucosa and may explain the occurrence in Case 1. It may occur insidiously. The patient either remains unaware of it or tolerates the discomfort until the next scheduled appointment. Further impingement leads to a break in the mucosa and formation of epithelium around the loop, which may necessitate an incision to free the bar. Obviously, this should be guarded against.

In situations where forward tipping of molars is anticipated, it would seem appropriate to design the transpalatal bar to clear the palatal mucosa or to use one with a distal loop.

The arms of the bar are usually ligated in the band sheaths with elastic chains. With time, however, these chains tend to deteriorate and to lose much of their force.[4] This may result in loosening of the appliance during mastication or use of headgear and, consequently, the arms may slip from the sheaths. This is what appears to have occurred in Case 2 in the present report.

Frequent review of the bar is necessary, therefore, to check for adverse effects, looseness, palatal clearance, and to change the elastics. In some cases steel ligatures may be a better alternative of securing the transpalatal bar.

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INTERCEPTIVE ORTHODONTIC PROCEDURE

Whilst the merits of preventive/interceptive procedures in orthodontics have been debated for many years the judicious extraction of deciduous canines in non-crowded arches where the permanent canine is erupting palatally and the patient is aged 10-13 years may obviate the need for surgical intervention and orthodontic appliances. This may spare the patient discomfort, expense, time and iatrogenic lesions that occasionally result from surgical and orthodontic treatment.

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Dens evaginatus: Report of case of continued root development after $Ca(OH)_2$ apexification

Huey-Li Su, DDS

Dens evaginatus is a developmental anomaly, in which an enamel-covered tubercle projects from the occlusal surface. As reported by different studies, this anomaly occurs almost exclusively in people of Mongoloid stock: Chinese, Thai, Malays, Japanese, Indians and Eskimos.[1-9] This anomaly is also found in Negroes and Caucasians, but only rarely.[10-12]

The prevalence of dens evaginatus has been reported to be 1.0-4.3 percent of the child population.[2,5-8] Yip made a survey in Singapore in 1974 and reported that the prevalence among the Chinese children was 3.62 percent.[7] In 1980, Lin and Roan examined 8651 school children in the city of Kaohsiung in Taiwan, where residents were all ethnic Chinese.[9] They found an overall prevalence of 3.52 percent. The anomaly occurred predominantly in mandibular premolars rather than in maxillary premolars.[1,3,9]

Clinically, due to its slender form, attrition or trauma to the tubercle may lead to exposure of the pulpal extension with subsequent pulpal infection. Mellier reported 14.1 percent of teeth with dens evaginatus were nonvital, but Oehlers found 40.2 percent were nonvital and affected by periapical abscesses.[3,5] In Yip's survey of 2373 school children, the tubercles were worn or fractured in 82.5 percent evaginated teeth, and 26.3 percent of these abnormal teeth were nonvital. Lin and Roan reported that 89.3 percent of the dens evaginatus were worn at the time of examination.[7,9]

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If pulpal death occurs before the root is completely developed, cessation of the root formation may be found, especially if the young pulpless tooth has thin, fragile walls and a fan-shape open apex. The necessary periapical seal is difficult to accomplish in these cases.

This paper describes an unusual apexification case with a dens evaginatus in which the root continued to develop completely after final obturation of the canal with gutta percha.

CASE REPORT

A nine-year-old boy came to the Dental Department of Chang Gung Memorial Hospital on December 12, 1985 with a chief complaint of a painful mandibular tooth. He had experienced moderate spontaneous pain and slight buccal vestibular swelling for two days.

Initial evaluation disclosed the left mandibular second premolar, noncarious and normal in appearance, except for a remnant of a worn, flat dens evaginatus on the occlusal surface. The tooth was painful when finger pressure was applied. There was a grade II mobility, and a slight buccal swelling below the level of the gingival margin was evident. The contralateral second premolar also had a worn flat dens evaginatus on the occlusal surface and was asymptomatic. Radiographic examination revealed a thickened periodontal ligament, incomplete root formation with a wide-open apex, and a radiolucent lesion around the periapical area (Figure 1). The initial diagnosis was pulpal necrosis with acute apical periodontitis caused by microbial infection of the pulp via the evagination defect.

Figure 1. The second premolar showed a remnant of dens evaginatus on the occlusal surface, a thickened PDL, incomplete root formation with a wide open apex, and a periapical radiolucent lesion.

Treatment

On the same day, the tooth was isolated with a rubber dam. The pulp chamber was opened without anesthesia and an empty canal was found. After thorough debridement and irrigation of the root canal, a small piece of CMCP cotton dressing was placed in the chamber and tightly sealed with IRM*.

Two weeks later symptoms had disappeared. Upon opening the canal a working length measurement was taken using a radiograph (Figure 2). After thoroughly cleaning and filing the canal walls, the canal was filled with a thick paste of calcium hydroxide mixed with saline and sealed with IRM.†

*(L.D. Caulk Division, Milford, DE).

†(W.P. Chemical Industries Ltd).

Figure 2. Determination of working length.

On February 5, 1986, the patient was recalled to change the calcium hydroxide dressing. After three and a half months, the patient was recalled again. The apical calcification was quite evident (Figure 3) on the radiograph, but the apical constriction did not exist; thus, the canal was refilled with calcium hydroxide and sealed with IRM.

On May 20, 1986, the patient was recalled again. The apical stop was detected with a paper point at this time, so the canal was filled with gutta percha and tubuli-seal cement using the conventional obturation method.‡ The cavity was restored with amalgam. The apical healing was progressing and the apical development was noted (Figure 4).

On June 9, 1987, the periapical radiograph showed that the root continued to develop with a well-defined

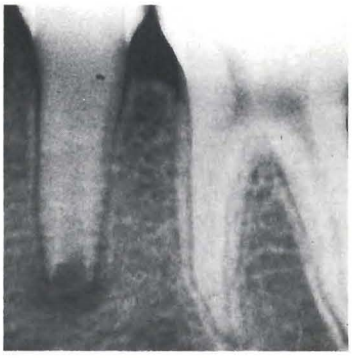


Figure 3. The canal was refilled with $Ca(OH)_2$ paste, and the apical calcification was shown at 3.5 months after the first examination.

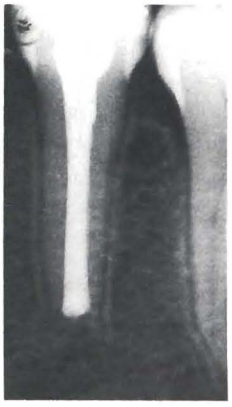


Figure 4. Nearly five months after the first examination, the canal was filled with gutta percha. The apical healing and root development was progressing.

$Ca(OH)_2$ induces root formation.

lamina dura. A slightly open apex was evident (Figure 5).

On June 15, 1988, the apical constriction was evident and the root continued to develop completely, as shown in the periapical radiograph (Figure 6), almost twenty-five months after final obturation with gutta percha.

In the past three to four annual recall examinations, the periapical radiographs all showed a well-defined lamina dura and no apical lesion (Figures 7,8).

DISCUSSION

Teeth with dens evaginatus are potentially subjected to occlusal trauma. The most common complication is exposure and infection of the pulp, due to attrition or fracture of the tubercle. Usually these are found in adolescents, thus explaining the fact that most of the cases have incomplete root formation with wide open apexes. Earlier investigators suggested that root-canal therapy was often contraindicated and that the teeth must be extracted.[3,13,14] In recent reports, however, calcium-hydroxide-induced apical closure is widely practiced for the treatment of these teeth.[15-19] The result of this case shows that calcium hydroxide not only induces hard tissue formation at the apex, but root growth continues completely.

Therapeutic grinding of the tubercle to promote secondary dentine formation in the pulpal horns, as recommended by Oehlers *et al* may be successful, if the grinding is carefully done.[20] In a recent scanning electron microscopic study, however, spontaneous closure of the pulpal extension by secondary dentine was found.[21]

Yong reported successfully treating a case by prophylactic removal of the tubercle and preparing an occlusal cavity and placing a direct or indirect pulp capping of calcium hydroxide; then restoring the tooth with amalgam or composite resin.[22] This procedure weakens the buccal cusp, so a more conservative treatment with pit and fissure sealant or a composite resin for protec-

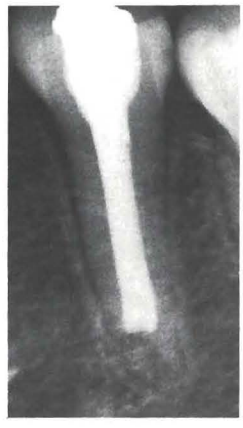


Figure 5. A year after obturation of the canal, the root continued to develop with a well-defined lamina dura.

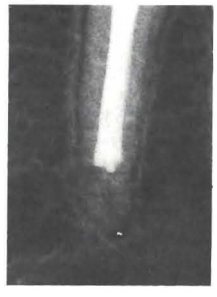
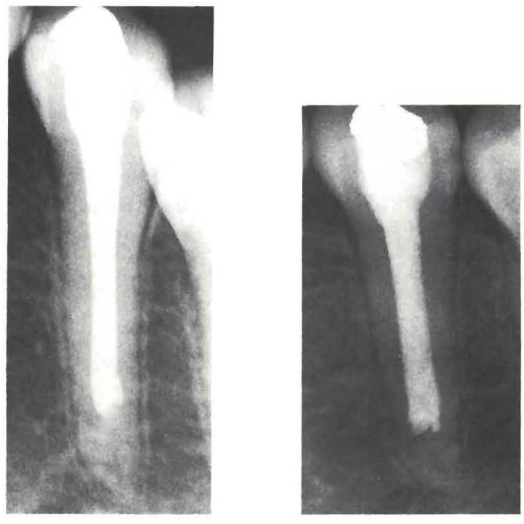


Figure 6. Nearly twenty-five months after obturation of the canal, the apical constriction was evident and the root continued to develop.



Figures 7, 8. Three to four years after obturation of the canal, both radiographs showed a well defined lamina dura and no apical lesion.

Hertwig's sheath plays an important role.

tion of the dens evaginatus is considered.[2,3,24] Obviously, these are treatments of a sound and healthy pulp.

The case described presents an interesting phenomenon: The apical development continues to it's potential, and a distinct canal was seen on radiographic examination (Figure 6). In the root formation process, the epithelial sheath of Hertwig plays an important role. The epithelium rest may remain intact, and resume its function, once the source of infection has been removed.

Two studies reported that dens evaginatus occurs in a high percentage of Chinese people.[7,9] Before deciding the treatment, the long-term prognosis of the tooth should be assessed. In the young permanent dentition stage, especially, the amount of root length remaining, the alignment of the tooth, and the amount of crowding in the arch should be noted. Extraction should be the last resort.

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Effect of APF gel on a glass ionomer cement: An SEM study

Esther Neuman, DDS
Franklin Garcia-Godoy, DDS, MS

Glass ionomers have been suggested as restorative materials and as bases for composite and amalgam restorations.[1-6] These materials adhere to dentin and enamel; have stable matrix structure; release fluoride; reduce microleakage and the occurrence of secondary caries.[3-17]

In pediatric dentistry, glass ionomer cements have been recommended as restorative materials for a variety of procedures including occlusal, proximal, labial, and lingual restorations; preventive glass ionomer restorations; tunnel restorations; and cementation of stainless steel crowns and orthodontic bands.[18-31]

The glass ionomer cement surface can be significantly altered when etched with phosphoric acid.[32,33] This is of clinical significance because acidulated phosphate fluoride gels (APF) are recommended as a preventive strategy in dentistry. The APF gels contain phosphoric acid, which etches the enamel thus enhancing fluoride uptake. Patients with glass ionomer restorations, and receiving APF treatments, could be at risk of increasing the surface roughness of the material, producing erosion and eventually degradation of the material.

The purpose of this SEM study was to evaluate the micromorphology of a glass ionomer cement treated with 1.23 percent APF gel.

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MATERIALS AND METHODS

The glass ionomer used in this study was Ketac-Fil (Espe-Premier, Norristown, PA), the glaze was Ketac-Glaze (Espe-Premier, Norristown, PA) and the 1.23 percent APF gel Oral-B (Oral-B, Redwood City, CA).

Glass ionomer cylinders (surface area 6.69 mm^2) were prepared in teflon molds, stored in distilled water for forty-eight hours before polishing and/or APF treatment and divided into seven groups of ten specimens each:

Group 1: Glaze application, no polishing.

Group 2: Glaze application, polishing with medium Sof-Lex discs (3M Co., St. Paul, MN) under slow speed and water and glaze application.

Group 3: Glaze application, no polishing, APF treatment for four minutes.

Group 4: Glaze application, polishing with Sof-Lex discs, glaze application, APF treatment for four minutes.

Group 5: No glaze, no polish, APF treatment for four minutes.

Group 6: No glaze, polish, APF treatment for four minutes.

Group 7: Glaze, polish, two coats of glaze, APF treatment for four minutes.

The glass ionomer was encapsulated and handled according to the manufacturer's instructions, except for groups 5 and 6, where no glaze was used. The glaze resin was painted with a brush over the glass ionomer. surface and cured with an Optilux 400 visible light unit

(Demetron, Danbury, CT) for 30 seconds. In group 7, the first glaze coat was cured and then the second coat was applied and cured.

The APF gel was applied with cotton applicators for four minutes, rinsed with tap water for twenty seconds and dried with oil-free compressed air.

All specimens were then mounted on aluminum stubs, coated with gold palladium and evaluated with a JEOL 840A (JEOL, Tokyo, Japan) scanning electron microscope.

RESULTS

The results are depicted in Figures 1-14. Figures 1 and 2 represent a specimen in Group 1 (glaze, no polishing) revealing the glass ionomer surface and the glaze coating contracted or incorporated into the glass ionomer matrix.

Figure 3 displays a specimen in Group 2 (glaze, polishing, glaze) with similar micromorphological characteristics as Group 1. The glass ionomer surface is readily seen with some glaze resin present.

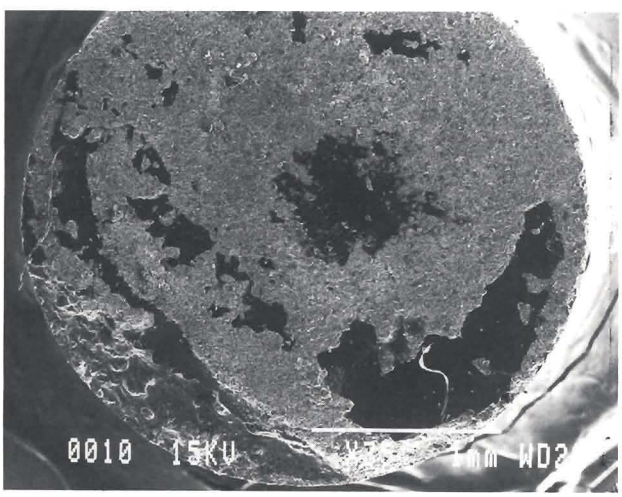

Figure 1. Specimen in Group 1 (glaze, no polishing) revealing the glass ionomer surface and the glaze coating contracted or incorporated into the glass ionomer matrix.

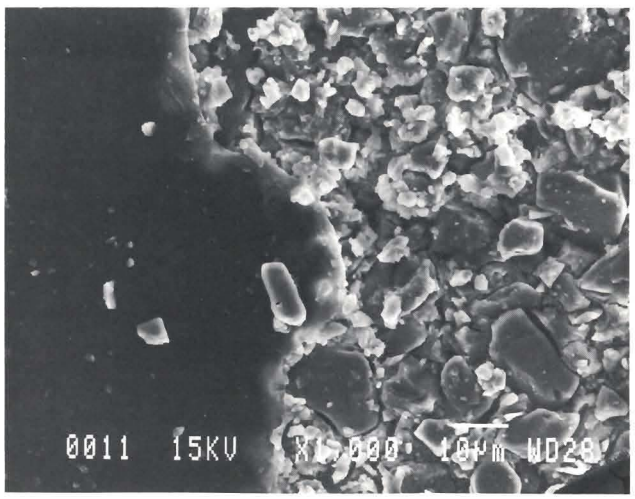

Figure 2. Specimen in Group 1 (glaze, no polishing) revealing the glass ionomer surface and the glaze coating contracted or incorporated into the glass ionomer matrix.

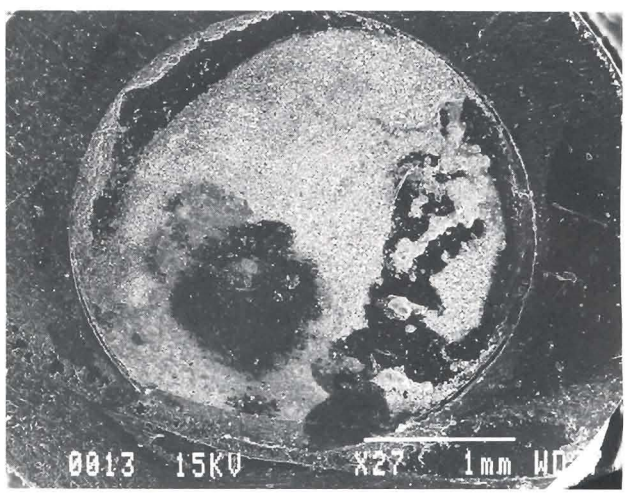

Figure 3. Specimen in Group 2 (glaze, polishing, glaze) with similar micromorphological characteristics as Group 1. The glass ionomer surface is readily seen with some glaze resin present.

Figures 4 and 5 are of a specimen from Group 3 (glaze, no polish, APF gel). Again, similar micromorphological characteristics to Groups 1 and 2 are evident. In Figure 5, glass particles are evident protruding from the matrix.

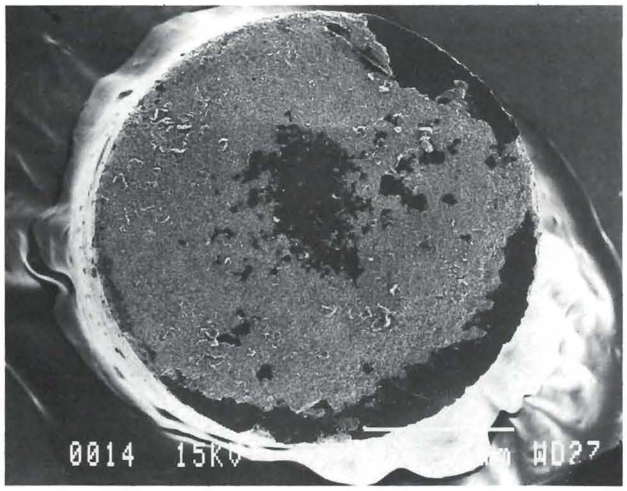

Figure 4. Specimen from Group 3 (glaze, no polish, APF gel). Again, similar micromorphological characteristics to Groups 1 and 2 are evident.

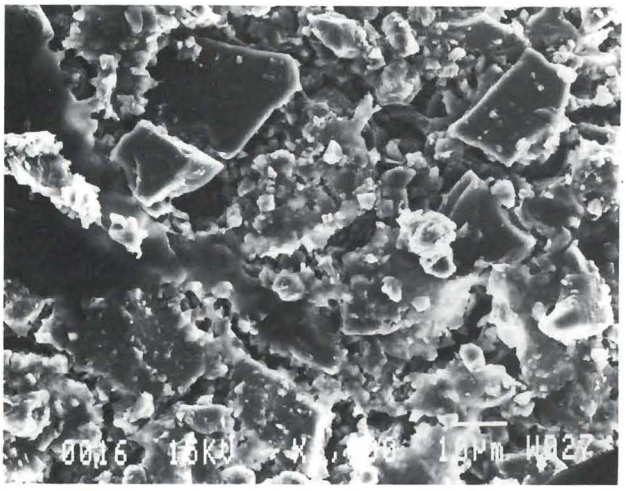

Figure 5. Specimen from Group 3 (glaze, no polish, APF gel). Again, similar micromorphological characteristics to Groups 1 and 2 are evident. The glass particles are evident protruding from the matrix.

Figures 6 and 7 are of a specimen in Group 4 (glaze, polishing, glaze, APF gel). The glaze application after the polishing procedure permitted more glass ionomer surface to be protected from the environment. A higher magnification (Figure 7) reveals a void produced by contraction of the glaze resin, air entrapment or disintegration by the APF gel.

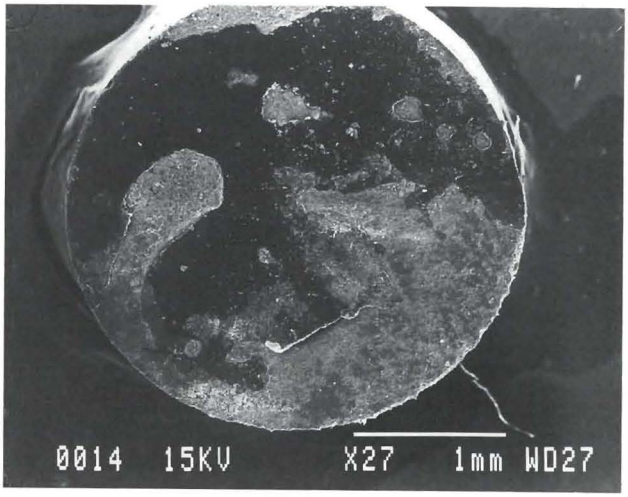

Figure 6. Specimen in Group 4 (glaze, polishing, glaze, APF gel). The glaze application after the polishing procedure permitted more glass ionomer surface to be protected from the environment.

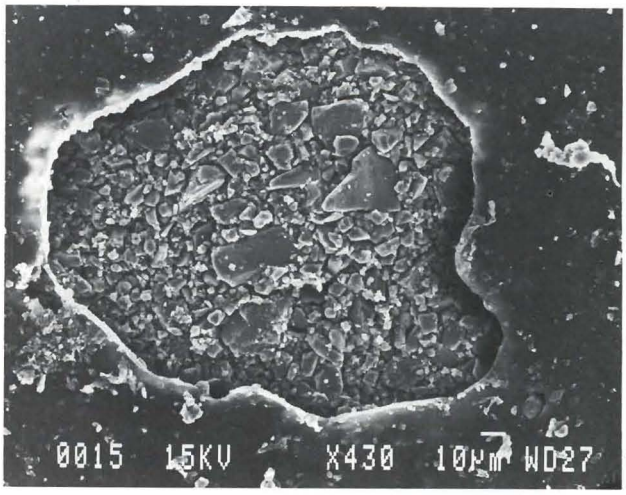

Figure 7. Higher magnification of Figure 6 revealing a void produced by contraction of the glaze resin, air entrapment or disintegration by the APF gel.

Figures 8 and 9 represent a specimen in Group 5 (no glaze, no polish, APF gel). This group reveals the effect of the APF gel on the micromorphology of the glass ionomer cement. Characteristic of an etched glass ionomer cement, glass particles protruding from the surface, are evident in these illustrations.

Figures 10 and 11 are of a specimen in Group 6 (no glaze, polishing, APF four minutes). Polishing just revealed a smoother surface, but the APF effect on the micromorphology was similar to that observed in Group

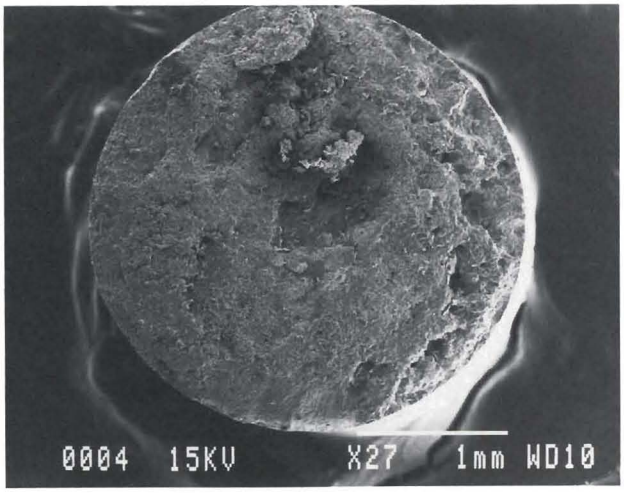

Figure 8. Specimen in Group 5 (no glaze, no polish, APF gel). This group reveals the effect of the APF gel on the micromorphology of the glass ionomer cement. Characteristics of an etched glass ionomer cement, with glass particles protruding from the surface, are evident in these illustrations.

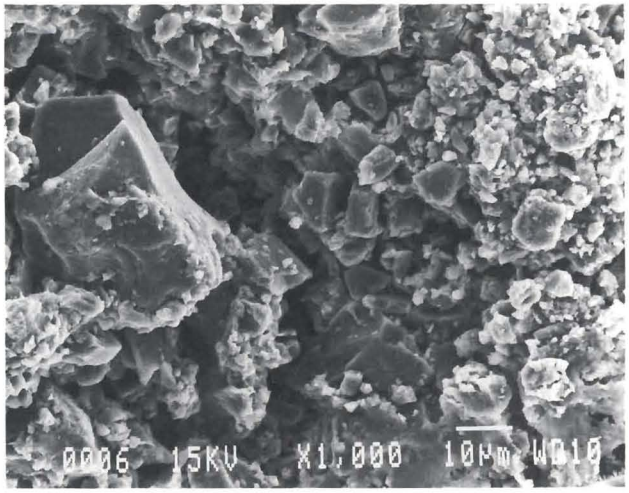

Figure 9. Specimen in Group 5 (no glaze, no polish, APF gel). This group reveals the effect of the APF gel on the micromorphology of the glass ionomer cement. Characteristics of an etched glass ionomer cement, with glass particles protruding from the surface, are evident in these illustrations.

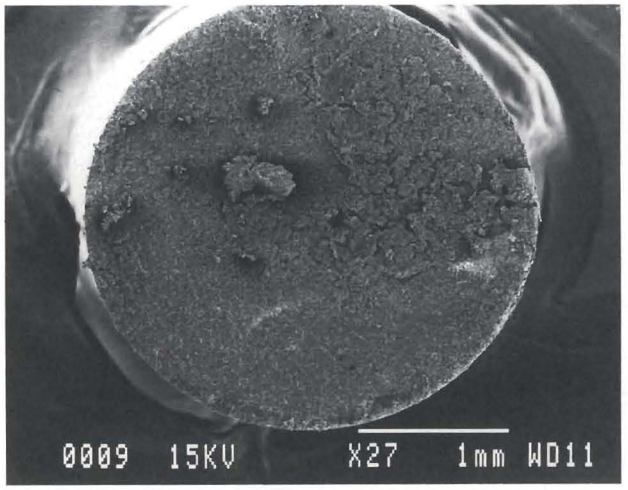

Figure 10. Specimen in Group 6 (no glaze, polishing, APF 4 minutes). Polishing just revealed a smoother surface, but the APF effect on the micromorphology was similar to that observed in Group 5.

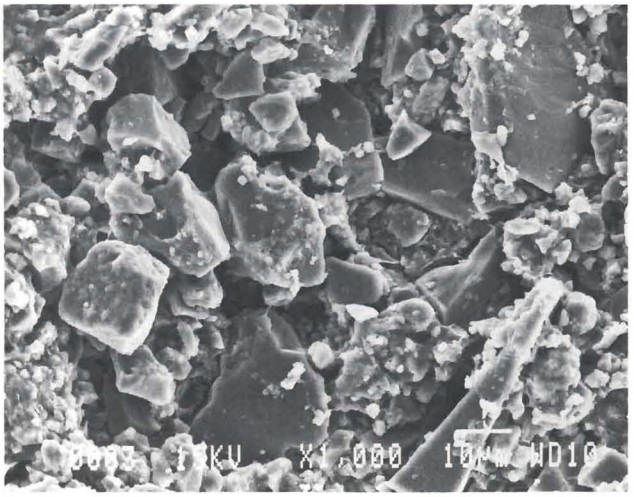

Figure 11. Specimen in Group 6 (no glaze, polishing, APF 4 minutes). Polishing just revealed a smoother surface, but the APF effect on the micromorphology was similar to that observed in Group 5.

5. Figures 12-14 depict a specimen in Group 7 (glaze, polishing, two coats of glaze, APF gel). Figure 12 reveals that most of the glaze resin has remained on the glass ionomer surface. Only the center has been exposed possibly due to the effects of glaze resin contraction, air entrapment or reaction to the APF gel. Figure 13 is a higher magnification of Figure 12, revealing the glass particles exposed to the environment.

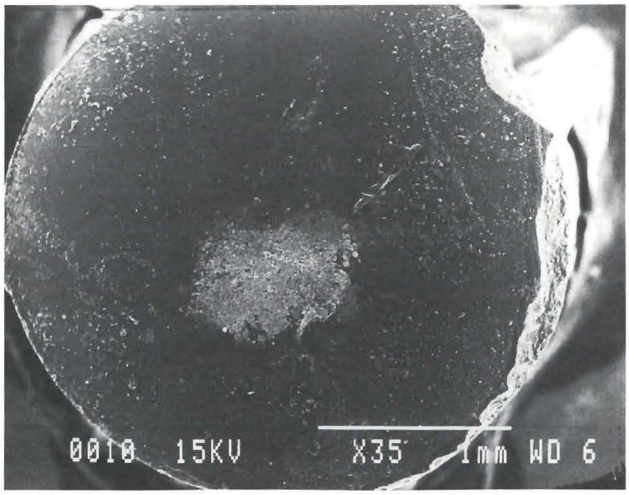

Figure 12. Specimen in Group 7 (glaze, polishing, two coats of glaze, APF gel). Most of the glaze resin has remained on the glass ionomer surface. Only the center has been exposed possibly due to the effects of glaze resin contraction, air entrapment or reaction to the APF gel.

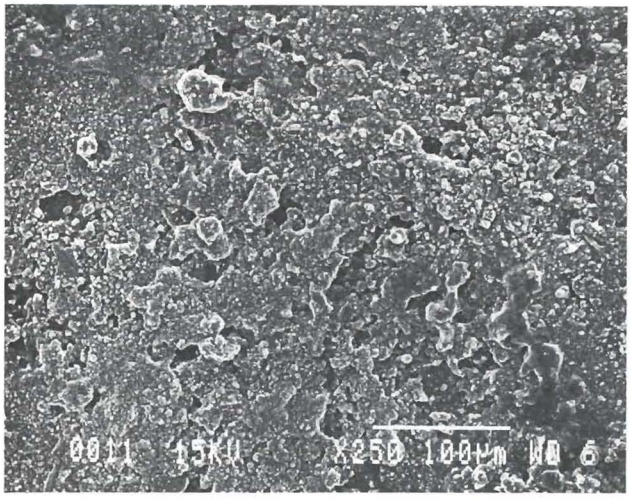

Figure 13. Higher magnification of Figure 12, revealing the glass particles exposed to the environment.

Figure 14 is a higher magnification of the resin glaze surface adjacent to the central area. A smooth protective surface is evident.

DISCUSSION

Fluoride-releasing dental materials are effective in preventing secondary caries or caries on adjacent teeth.[4,5,17] Some fluoride-releasing materials can reduce enamel solubility and acid production by bacteria that initiate caries, and prevent enamel demineralization.[34-38]

Etching the glass ionomer cement with phosphoric acid increases the surface roughness.[32,33] The present study shows that APF treatment also increases the surface roughness of the cements, which could become an area to harbor the colonization of *S. mutans*. The APF gel treatment will increase the chemical erosion of the cement by acid-etching the surface and will also increase its fluoride release.[39,40] Although the glass ionomer cements contain fluoride, after some time in the oral environment, the amount contained is not sufficient to inhibit the growth of *S. mutans* on its surface.[41] This does not mean, however, that the glass ionomer cements would not have anticariogenic effects on the cavity walls or surrounding enamel as already demonstrated; but it would contribute to the disintegration of the cement and to the recolonization of bacteria in the oral cavity.[4,5,42]

Another consideration is that glass ionomer cements can clinically incorporate fluoride into their matrices

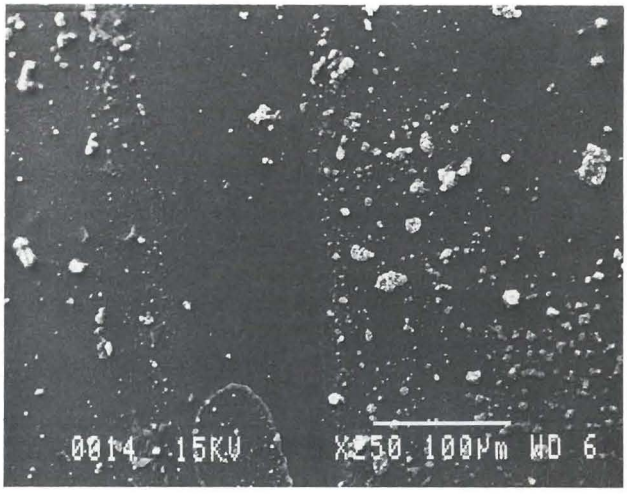

Figure 14. Higher magnification of Figure 12 at the resin glaze surface adjacent to the central area. A smooth protective surface is evident.

from external sources. This fluoride "recharging" property could be beneficial for the long-term anticariogenic potential of glass ionomer cements by activating the remineralization of softened enamel and dentin.[43]

In *in vitro* studies using distilled water or artificial saliva, glass ionomer cements release fluoride for up to three years (Garcia-Godoy F, Chan DCN, unpublished data, 1991).[10,12-14] In the oral environment, the cements will "recharge" their fluoride content, however, when exposed to fluoridated products such as dentifrices, mouthrinses, and APF gel treatments. This would strengthen the enamel surrounding teeth restored with glass ionomer cements.[38]

Most glass ionomer cements require protection from hydration and dehydration for at least one hour following placement, and further enhanced if the protection remains for up to twenty-four hours.[44] This protection is best obtained with a low viscosity, single component, light-cured resin bonding agent.[44] This protection is necessary because glass ionomer cements are water-based and during the early phases of the setting reaction, the loosely bound water within the matrix can be readily lost by evaporation.[45] The calcium polyacrylate chains being formed at these early stages can be washed out of the cement because they are water-soluble. If these two reactions are impaired, both the translucency and physical properties of the cement will be reduced. A waterproof seal is required, therefore, because clinically, the restoration will be exposed to saliva during its critical setting stages.

The present study shows that two coats of the resin glaze provided a greater protection to the glass ionomer surface from the erosive action produced by the APF gel. Glass ionomer restorations should be protected, therefore, before applying the APF gel.

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The APF gel treatment will increase the chemical erosion of the cement by acid-etching the surface.

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MICROLEAKAGE OF GLASS IONOMER/COMPOSITE RESIN RESTORATIONS

Acid-etching of enamel margins, often combined with bevelling and use of a low viscosity resin, has resulted in improved sealing of composite restorations. When enamel is absent and margins involve dentine or cementum, microleakage is more often observed. The use of glass ionomer cement, as both a restorative material and as a base combined with a veneer of composite resin, has been advocated as a means of minimizing microleakage where margins are placed in dentine or cementum.

Four restorative techniques incorporating glass ionomer cement were used, *in vitro*, to restore cervical cavities. After thermal cycling, dye penetration was scored along occlusal and gingival margins. In all instances the gingival margin exhibited a less reliable seal than the occlusal margin. The sandwich restorations produced a superior seal at both occlusal and gingival margins when compared with glass ionomer restorative cement.

Smith, E.D.K. *et al*: Microleakage of glass ionomer/composite resin restorations. Australian Dent J, 37:23–30, February 1992

Increasing interest in pediatric dentistry?

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

During the late 1980s and early 1990s, an increasing number of dental school seniors have been expressing an interest in postdoctoral training in pediatric dentistry. Since the second half of the 1980s, there have been parallel increases in the number of students enrolled in the first year of pediatric dental programs. Previous reviews in the Journal of Dentistry for Children have considered the changing number and distribution of pediatric dentists, as well as some consideration of the demographics of pediatric training program directors and postgraduate students.[1-5] More recent data now permit a numeric review of evolving dental student interests in pediatric dentistry and program responses.

SOURCE OF DATA

Since 1978, the American Association of Dental Schools (AADS) has conducted a survey of senior dental students.[6] With a response rate that increased from over 60 percent to more than 75 percent, the survey provides a general picture of student and parental demographics, student financial status, opinions on dental school curriculum, and prospective practice and training plans after graduation.

Data on postgraduate program applicants also are available from the AADS Postdoctoral Application Support Service (PASS).[7] PASS serves as an information clearinghouse by forwarding students' background information, deans' letters, and dental school transcripts to designated programs. Four postdoctoral dental areas receive applications through the PASS service: oral and maxillofacial surgery, pediatric dentistry, advanced education in general dentistry (AEGD), and general practice residency (GPR). Eighty percent of pediatric dental programs (44 programs with 117 first year places) participated in the 1992 cycle.*

In addition, the American Dental Association's Council on Dental Education issues annual reports on postdoctoral students and programs in each of the specialty areas and advanced programs in general practice.[8]

SENIOR DENTAL STUDENTS PLANS

Between 1978 and 1980, 2.3 to 2.4 percent of senior dental students (between 122 and 126 students) reported that they expected to apply to pediatric dental training programs. During the following five years, there were slight decreases in the percent of seniors interested in pediatric dental programs (reaching a low of 1.7 percent in 1983) and marked decreases in the actual numbers of students (ranging from 91 to 102 students). (Note: the decreases in the numbers of senior students interested in pediatric dentistry is a reflection of both the percent decrease and the decreases in the numbers of graduates during this period [from 5,550 in 1981 to 4,957 in 1986][9]). During this period, the number of

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* Except for the year of graduation, all years in this presentation refer to the beginning of the particular academic year.

seniors reporting that they expected to apply to pediatric dental programs was lower than the actual number that eventually enrolled in the programs. This difference could be a reflection of the inadequacies of the survey instrument, the indecision of respondents at the time of the survey, and the numbers of foreign-educated dentists who increasingly are becoming a factor in filling places in U.S. pediatric dental training programs.[10])

But since 1988, at a time of continued decrease in the numbers of dental school graduates (from 4,581 in 1988 to 3,995 in 1991), there have been increases in the percent and numbers of senior dental students expecting to apply to pediatric dental programs. (Note: 1991 was the first year since 1971 that there were less than four thousand graduates from schools of dentistry.[11]) Between 1988 and 1991, the percent of senior dental students who reported that they expected to apply to pediatric dental training programs increased from 3.5 percent to 5.4 percent (from 164 to 217 students) (Figures 1 and 2).**

In 1991 and 1992, approximately 200 to 205 applicants applied through the PASS system for pediatric dental programs. In 1992, the 205 applicants submitted 1,170 applications to the 117 first year places (almost 1.8 applicants per seat) in the 44 programs in the PASS system. There were 2.7 entering places per program.[7,12]

** The numbers of students were developed by multiplying the number of graduates by the percent of AADS survey respondents who planned to pursue a postgraduate education. In turn, this number was multiplied by the percent of applicants to specialty programs planning a program in pediatric dentistry.

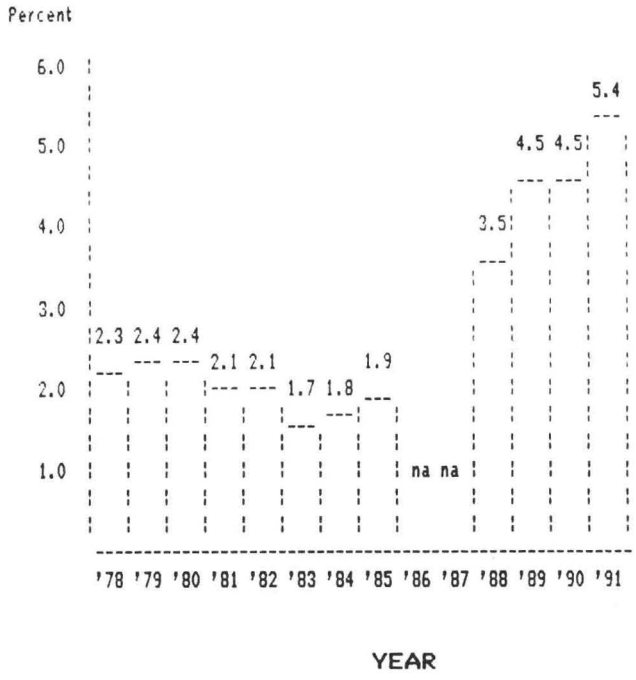

Figure 1. Percent of senior dental students who plan on pursuing graduate education in pediatric dentistry: 1978-1991.[6]

PEDIATRIC DENTAL PROGRAMS

In 1992 there were fifty-six pediatric dental training programs: thirty-eight, dental school; and eighteen, nondental school. The number of programs remained relatively stable since the mid 1980s. In the first years of the 1980s, there were between sixty-one and sixty-five pediatric dental training programs. During the past decade, approximately two thirds of the programs were within dental schools and a third were nondental school programs (Figure 3).

There have been marked fluctuations in the numbers of first year students in pediatric dental programs dur-

Between 1988 and 1991, the percent of senior dental students who were expected to apply to pediatric dental training programs increased from 3.5 percent to 5.4 percent (from 164 to 217).

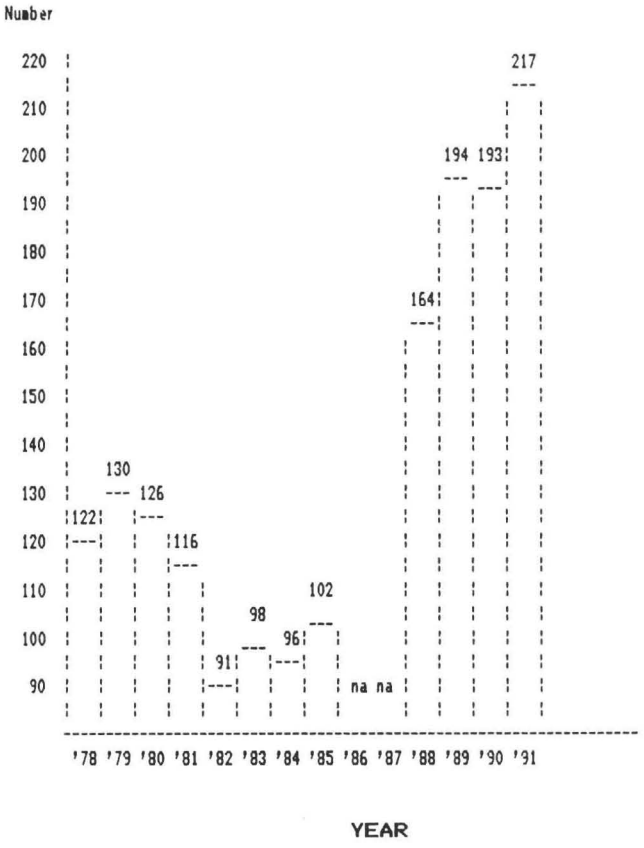

Figure 2. Number of senior dental students who plan on pursuing graduate education in pediatric dentistry: 1978-1991.[6]

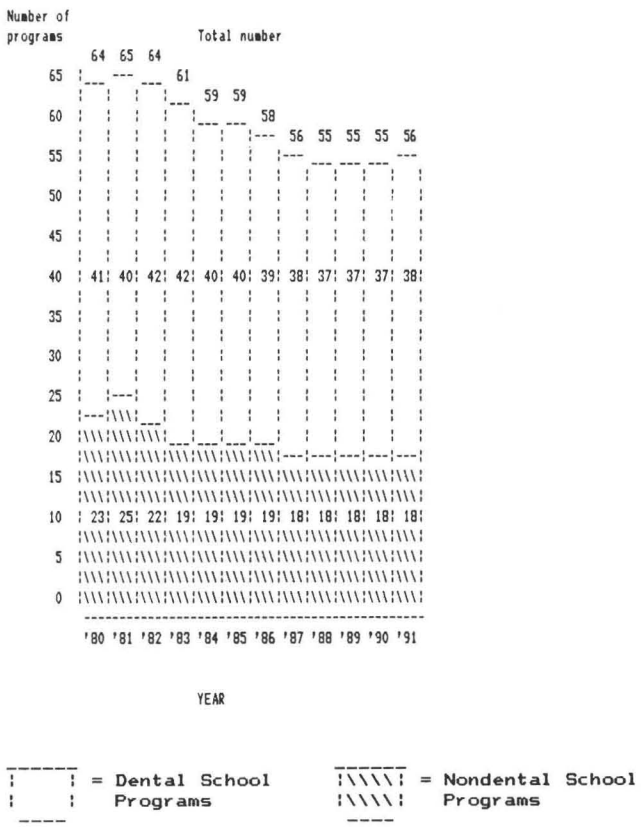

Figure 3. Number of pediatric dental training programs: 1980-1991.[8]

ing the past fifteen years (ranging from 176 students in 1975 to a high of 190 students in 1980 and a low of 149 students in 1983). Since 1984 there has been an irregular increase in the numbers of the first year students reaching levels in the first years of the 1990s that were comparable to the levels in the mid 1970s (Figure 4). (Note: "... in 1990, almost 20 percent of first year enrollees in pediatric dental programs were foreign educated dentists; many of them will be unable to secure licensure in the United States."[3])

INCREASED INTEREST - A POSSIBLE EXPLANATION

While the increasing numbers of students in pediatric dental programs is to some extent a reflection of increasing numbers of foreign students pursuing studies in this country, the increasing numbers of senior dental students expressing an interest in these same programs requires further exploration.

It has become axiomatic when discussing the future of dental services for children, to recite the litany of:

- ☐ Declining rates of dental disease.
- ☐ The continued oral health needs of special patient populations (many of which lack sufficient financial resources).
- ☐ A general leveling off in the number of children, a generally constant pediatric dentist-to-population ratio.
- ☐ An increasing use of services by an ever greater cross section of our communities.[1,13]

Despite this rather mixed set of signals, an increasing number of students indicate an interest in pediatric dental training programs.

One possible explanation for this development may reside in a review of the gender makeup of the dental school graduating class and the entry classes in pediatric dental programs. Between the late 1970s and early 1990s, the female composition of graduating dental school classes almost tripled (from 11 percent in 1978

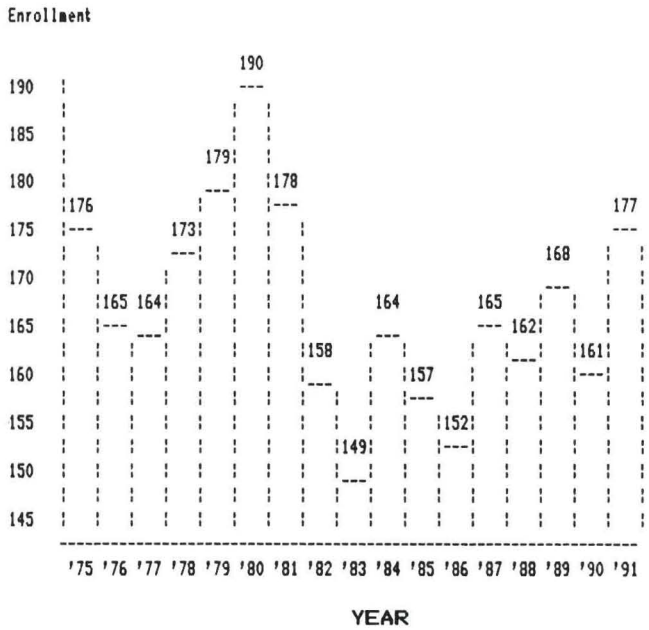

Figure 4. First year enrollment in pediatric dentistry training programs: 1975-1991.[8]

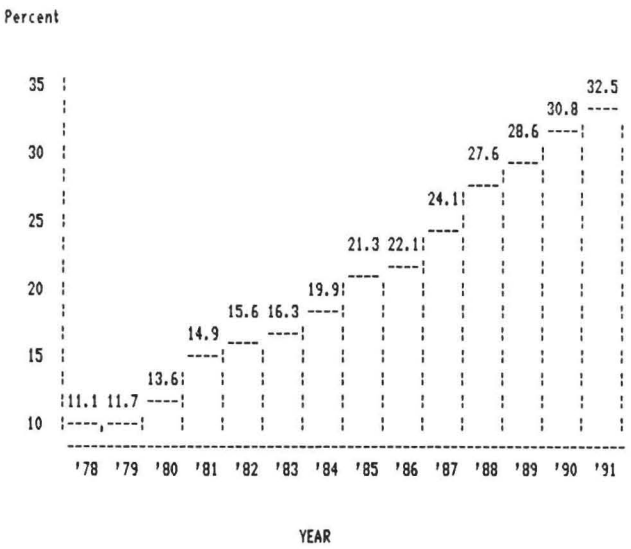

Figure 5. Percent of women in dental school graduating class: 1978-1991.[9]

to 32.5 percent in 1991) (Figure 5). Despite the increasing numbers of women enrolled in postdoctoral programs, the ratio of women-to-men in advanced programs was below the ratio for dental school graduates. By contrast, the ratios of women-to-men applying to and enrolled in pediatric dental programs were far greater than the women-to-men ratios of dental school graduates and all applicants participating in the PASS postdoctoral program.[14]*** Thus, the increase in the numbers of senior dental students expecting to pursue advanced training in pediatric dentistry may be a reflection of the evolving gender demographics of dental school classes and the particular interest that women may have in the care of younger patients.

THOUGHTS ON THE SWINGS OF A PENDULUM

The proverbial overreaction to any set of circumstances is not reserved to the fluctuations in the numbers of applicants to pediatric dental programs. Consider the example of the fluctuating number of applicants to dental schools in general. The dental profession only recently has begun to extricate itself from a period when, as a result of concerns including the oversupply of practitioners, decreasing rates of dental decay and a host of other factors that have been repeated in the literature ad nauseam, the number of applicants to dental schools fell from more than fifteen thousand in 1975 to less than five thousand in 1989, eventually approximating the number of available entering places in dental schools (e.g. in 1988, there were 5,019 applicants for 4,196 entering places - a ratio of 1.2 applicants per entering place). By 1991, the number of applicants had increased to 5,632 for 4,047 entering places - a ratio of 1.4 applicants per entering place.[9]

Increasing numbers of applicants not only reassure the future of any program, but also permits the admission committees (be it for dental school or advanced dental programs) to select more qualified applicants, rather than from a limited group whose "...criteria for admission (is) a checkbook, some semblance of performance in college, and a heartbeat."[15]

The dental profession in general, and pediatric dentistry in particular, finally may have begun to get the message out that the "...job is far from finished and the future of pediatric dentistry is most favorable."[16] But data over a longer period of time from the PASS graduate applicant system will be necessary to respond to the question, "an increasing interest in pediatric dentistry?"

*** For a more detailed presentation on gender, race and ethnicity of enrollees in pediatric dentistry programs, see an earlier report in the Journal of Dentistry for Children.[3]

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INCREASED INCIDENCE OF ASTHMA IN CHILDREN OF SMOKING MOTHERS

The relationship between parental smoking and both subsequent development of asthma and subsequent lung function (before age 12) was studied in more than 700 children enrolled before age five. Children of mothers with 12 or fewer years of education and who smoked 10 or more cigarettes per day were 2.5 times more likely (95 percent confidence interval 1.42 to 4.59; $P = .0018$) to develop asthma and had 15.7 percent lower maximal midexpiratory flow ($P < .001$) than children of mothers with the same education level who did not smoke or smoked fewer than 10 cigarettes per day. These relationships were independent of self-reported respiratory symptoms in parents. There was no association between maternal smoking and subsequent incidence of asthma or maximal midexpiratory flow among children of mothers with more than 12 years of education. It is concluded that children of lower socioeconomic status may be at considerable risk of developing asthma if their mothers smoke 10 or more cigarettes per day. It is speculated that recently reported increases in prevalence of childhood asthma may be in part related to the increased prevalence of smoking among less educated women.

Martinez, F.D. *et al*: Increased incidence of asthma in children of smoking mothers.
Pediatrics, 89:21–26, January 1992.

The relationship of the changing structure of families and the health of children

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

"...more than half of all children are likely to experience a period of living with a single parent during the 1990s..."

There is no such thing as a typical family in the United States in the 1990s. That was the conclusion of a previous presentation in the Journal of Dentistry for Children.[2] The consequences of the changing environment for rearing children increasingly is being reported in the lay and professional literature.[3,4] Forty percent of children are being reared in divorced families and questions are being asked about the effects of the variety of divorce procedures in our court system. "The commonness of divorce—half of marriages contracted in the 1970s will not last—may have reduced societal scorn and parental shame, but shows no signs of alleviating the anguish of children.[3]

In addition, the continuing rise in "out-of-marriage" childbearing has become a significant reality in our nation. For example, in 1950, 4 percent of all births were to unmarried mothers. In 1986, births to unmarried mothers accounted for 23 percent of all births. The number of births to unmarried mothers increased from 142,000 in 1950 to 878,000 in 1986. Among blacks, more than three out of five births occur outside of marriage.[5]

An extended series of studies indicated that, children from divorced families and those living with single parents have been found to have

- ☐ More emotional, behavioral and academic problems.
- ☐ More instances of juvenile delinquency.
- ☐ More often to be clients at outpatient psychiatric clinics or other mental health facilities than children living with both of their biological parents.[4]

The following presentation will review the results of the 1988 National Health Interview Survey on Child Health (NHIS-CH) in an effort to provide pediatric dental practitioners with an increased appreciation of the relationship between the health of the children and the family structure within which they are being reared.*[4]

STUDY FORMAT

A continuous nationwide household interview survey representing a probable sample of the civilian noninstitutionalized population is conducted by the National Center for Health Statistics. For purposes of the 1988 study, the total interview sample was 47,485 households containing 122,310 individuals. Interviews with adult household members were completed for 17,110 children. There was a response rate of 91 percent for the NHIS-CH.

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*Unless otherwise specified, all data are drawn from the publication of the National Center for Health Statistics.[4]

FAMILY STRUCTURE

In 1988, 24.8 million U.S. children (39 percent of all children) did not live with both their biological parents (including 11 percent who lived with a formerly married mother with no father present and 7.5 percent who lived with a never-married mother with no father present) (Table 1).

There were particular family structural variations based upon different demographic characteristics. For example:

- ☐ Children living in households with no father or stepfather present were more likely black than those living in two-parent households. Black children represented 16 percent of all children. By contrast, of all children living in a household with a never-married mother and no father, 63.4 percent were black.
- ☐ Children whose mothers were mostly higher educated were those living with both biological parents. Eighty-five percent of these children had mothers with twelve or more years of education. Only 60 percent of children in households with a never-married mother and no father had a mother with comparable education.
- ☐ Children whose mothers were mostly employed were those living with both biological parents. Fifty-nine percent of these children had mothers who were employed, compared to 43 percent of children with never-married mothers.
- ☐ Children living in mother-only households were economically disadvantaged relative to those living in two-parent households (Table 2).

PHYSICAL PROBLEMS

In a general "health vulnerability" index (based upon perceived probability of illness and injury), children with both biological parents consistently scored lower than others in terms of health vulnerability.

There is no such thing as a typical family.

Children who lived in households with the separation of their natural parents, either by divorce or death, were more likely than other children to have the most frequently reported health problems (accidents, injuries and poisonings).

A number of associations have been documented or hypothesized between emotional problems of stress and anxiety, and a series of chronic health problems (e.g. asthma, frequent headaches, speech defects and enu-

Table 1 ☐ Percent distribution of children 17 years of age and under by family type: 1988.[4]

	Percent
Both biological parents	61.3%
Never married mother and no father present	7.5
Mother and stepfather	9.2
Formerly married mother and no father present	10.9
Other*	11.0
Total (63.6 million children)	100.0%

* Includes: Biological fathers and no mother present, biological father and nonbiological mothers, two adoptive parents, grandparents, nonbiological mother and no father, adult female relatives with no adult male relatives.

Table 2 ☐ Number of children 17 years of age and under and percent distribution by family type and selected demographic and social characteristics: 1988.[4]

	Biological mother and father	Formerly married mother and no father	Never married mother & no father	Mother and step father	All children
*Total**					
Number (millions)	38.9	6.9	4.7	5.8	63.6
			Percent		
Percent	100.0%	100.0%	100.0%	100.0%	100.0%
Gender					
Male	51.4	50.8	50.4	49.0	51.2
Female	48.6	49.2	49.6	51.0	48.8
Race					
White	91.8	76.2	36.6	87.4	84.0
Black	8.2	23.8	63.4	12.6	16.0
Hispanic origin					
Hispanic	11.2	12.8	14.8	10.6	11.6
Non Hispanic	88.8	87.2	85.2	89.4	88.4
Education of mother					
Less than 12 years	15.7	22.6	40.0	20.0	19.6
12 Years	42.9	43.2	41.3	47.3	42.2
More than 12 years	41.4	34.2	18.7	32.7	38.2
Employment of mother figure					
Employed	59.4	66.5	42.8	66.5	59.3
Not employed	40.6	33.5	57.2	33.5	40.7
Annual family income					
Less than $10,000	5.7	33.4	59.0	8.1	14.0
$10,000–$19,999	16.2	30.3	24.4	19.6	19.3
$20,000–$34,999	33.0	25.5	11.7	35.3	30.2
$35,000–$49,999	24.9	7.1	2.1	20.9	20.2
$50,000 or more	20.2	3.7	2.8	16.1	16.3

* Totals include children with other unknown values on individual demographic and social characteristics.

resis). In this national study, except for a higher incidence of chronic asthma in children living in households without fathers, there were minimal differences by family demographics.

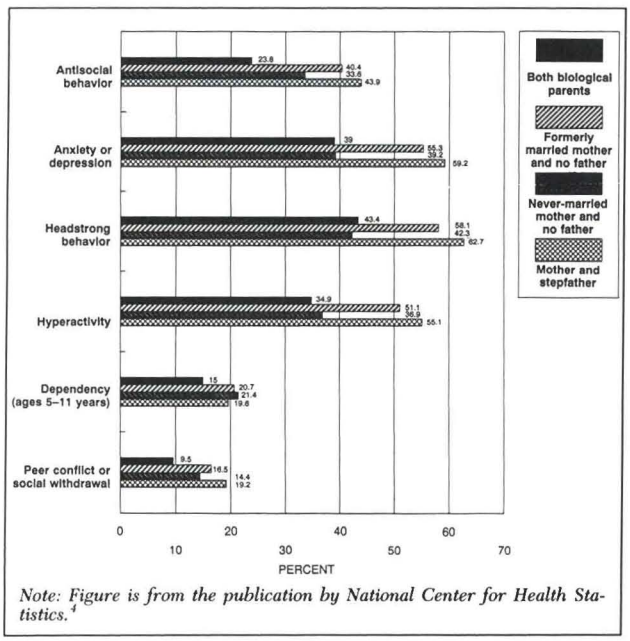
EMOTIONAL PROBLEMS

Children reared in a household with both biological parents consistently had the lowest incidence of at least one behavioral problem (e.g. antisocial behavior, anxiety or depression, headstrong behavior, hyperactivity, dependency, peer conflict or social withdrawal). Children living in households with the separation of parents had the highest incidence of one or more behavioral problems. By contrast, children living with never-married mothers were no more likely than those living with both biological parents to have one or more indicators of anxiety or depression, headstrong behavior or hyperactivity (Figure 1).

Indicators of antisocial behavior varied by various household and other demographic characteristics. The percent children with one or more indicators of antisocial behavior was:

- ☐ Lowest in older children.
- ☐ Lower in females.
- ☐ Lowest in families with both biological parents.
- ☐ Highest in households with parent separation.
- ☐ Lower in white households.
- ☐ Lower in non-Hispanic households.
- ☐ Lower in households with better-educated mothers.
- ☐ Higher in households with employed mothers.
- ☐ Highest in lower income households (Table 3).

There was considerable variation according to family type in the proportion of children who were treated for emotional or behavioral problems during the past year. The figure was lowest for children living with both biological parents; somewhat higher for those living with a never-married mother and considerably higher for children living in separated-parent households (Figure 2).



Note: Figure is from the publication by National Center for Health Statistics.[4]

Figure 1. Percent of children five to seventeen years of age with at least one indicator of various types of behavioral problems, by family type: 1988.[4]

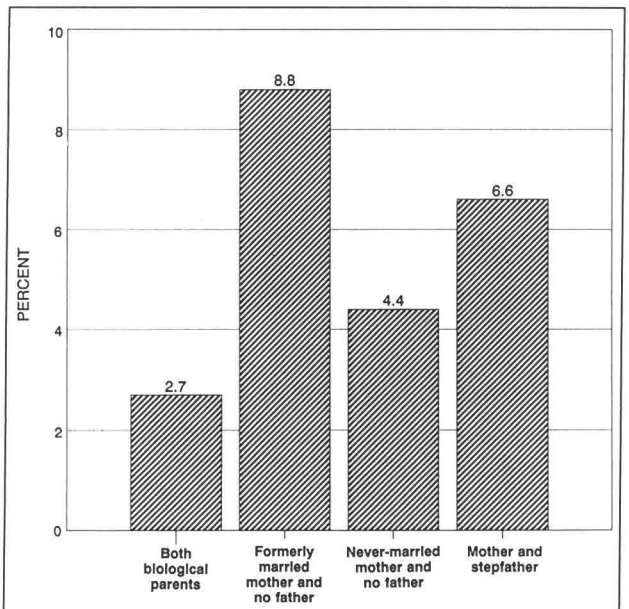
ACADEMIC PROBLEMS

The performance in school was associated strongly with family structure. Children in households with both bio-

Table 3 ☐ Number of children 5–17 years of age and percent with one or more indicators of antisocial behavior, by family type and selected demographic and social characteristics: 1988.[4]

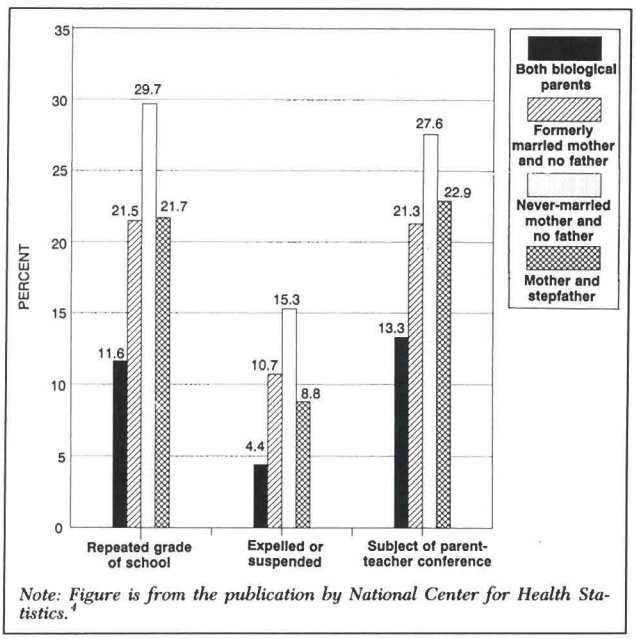
	Biological mother and father	Formerly married mother and no father	Never married mother & no father	Mother and step father	All children
*Total**					
Number (millions)	25.9	5.7	2.7	5.1	45.1
			Percent		
Percent	23.8%	40.4%	33.6	43.9	29.6
Age					
5–9 years	40.8	49.7	62.7	59.9	46.1
10–14 years	34.2	51.0	62.0	48.0	41.1
15–17 years	31.9	47.1	49.9	41.8	38.4
Gender					
Male	27.5	44.9	36.0	48.8	33.3
Female	19.9	35.7	31.1	39.1	25.6
Race					
White	23.5	37.9	27.0	43.6	28.2
Black	28.6	47.4	37.4	46.3	36.9
Hispanic origin					
Hispanic	28.1	42.1	34.1	48.6	33.0
Non Hispanic	23.6	40.4	34.0	43.5	29.5
Education of mother					
Less than 12 years	31.5	42.6	40.5	47.1	36.5
12 years	24.6	39.1	31.4	45.7	30.0
More than 12 years	20.3	40.7	24.1	39.3	25.6
Employment of mother figure					
Employed	25.7	39.7	34.8	46.4	31.0
Not employed	21.2	41.8	34.1	39.4	27.4
Annual family income					
Less than $10,000	23.8	46.0	37.9	49.0	37.0
$10,000–$19,999	25.1	42.2	30.6	54.0	32.2
$20,000–$34,999	23.4	40.0	31.9	43.7	29.0
$35,000–$49,999	24.9	31.8	34.9	39.2	27.5
$50,000 or more	23.5	29.9	8.0	43.7	27.3

* Totals include children with other unknown values on individual demographic and social characteristics.



Note: Figure is from the publication by National Center for Health Statistics.[4]

Figure 2. Percent of children three to seventeen years of age who were treated for emotional or behavioral problems in the past twelve months, by family type: 1988.[4]



Note: Figure is from the publication by National Center for Health Statistics.[4]

Figure 3. Percent of children five to seventeen years of age who had ever experienced academic problems by family type: 1988.[4]

logical parents had the lowest rates for 1) repeated grade of school, 2) expelled or suspended from school and 3) subject of parent-teacher conference. The percent of children in other household arrangements who had academic difficulties was one and one-half to three times greater. In particular, children in never-married-mother households had the greatest percent of academic difficulties (Figure 3).

IMPACT ON DENTAL PRACTICE

"Taking a patient's history in today's world must move beyond the 'usual' dental, medical and social factors."[2]

The earlier presentation on the changing family environment stressed the need for pediatric dental practitioners to modify practice arrangements, in order to respond to the increasingly diversified population of children who are seeking dental care. The current findings indicate that practitioners (as well as educators and

Today, taking a patient's history must move beyond the usual dental, medical, and social factors.

other community officials) must consider child management as an increasingly more complex set of factors that are affected by family structure. While most health and social services providers have been aware of these factors, the need is to stress these realities in a society that is attempting to develop solutions, when "there is no such thing as a typical family."

The attention of the pediatric dentist to changing family arrangements can provide critical clues to the physical and mental health status of the child patient. While children in two-parent biological families can test the mettle of any practitioner, the results of this national study would indicated that the continuing diversity of family structure will test further practitioner abilities to provide services to increasing numbers of troubled and compromised patients. But isn't that why pediatric dentists selected this specialty?

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PREVALENCE OF CARIES IN ADOLESCENTS IN RELATION TO DIET

The aim of the present study was to compare dietary habits between adolescents with high or low dental caries prevalence. All 15-yr-old adolescents living in a small community in Northern Sweden were studied in 1987, 1988, and 1989. The median values for energy and nutrient intake exceeded or were close to the recommendations (SNR89) given by the Swedish National Food Administration. The fiber intake did not reach the recommended daily amount even for the 90th percentile of the studied cohort. Nineteen percent of the adolescents had caries free teeth and 10 percent had nine or more decayed or filled surfaces. There was no difference in daily sucrose intake or average number of meals per day between these two groups. The group with nine or more decayed or filled surfaces had worse dietary habits, expressed as a higher fat intake, lower intake of complex carbohydrates, and lower density of iron (mg/MJ) than the group with no dental caries. Dietary counseling by dentists should be a valuable addition to other caries prophylactic measures taken by the dentists.

Larsson, B. *et al*: Prevalence of caries in adolescents in relation to diet. Community Dent Oral Epidemiol, 20:133–137, June, 1992.

Sedation

The assessment of two oral sedation drug regimens in pediatric dental patients

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Careful planning and assessment of the behavior of a child in the dental environment is essential to successful management of the patient. A detailed and thorough health and social history must be obtained before providing dental treatment. During the initial oral examination of the child and consultation with the parent(s), valuable insight can be obtained as to the type of behavior modification techniques needed for treatment, when behavior problems are anticipated. Techniques such as tell-show-do, HOME, voice control, hypnosis and restraints are a few examples of behavior management techniques that may prove successful. In the event nonpharmacological approaches are unsuccessful, the dentist may need to pursue other treatment approaches, such as conscious sedation.

In 1985, The American Academy of Pediatric Dentistry established guidelines for conscious sedation which is defined as: "a minimally depressed level of consciousness that retains the patient's ability to maintain a patent airway independently and continuously, and respond appropriately to physical stimulation and/or verbal command."[1] According to these guidelines, patients for conscious sedation should be ASA classification I or II, and each patient should be evaluated for allergies, medications, diseases, disorders and previous hospitalizations. These guidelines define ASA classification I as " there is no organic, physiologic, biochemical, or psychiatric disturbance. The pathologic process for which operation is to be performed is localized and is not a systemic disturbance." ASA classification II is defined as "mild-to-moderate systemic disturbance caused either by the condition to be treated surgically or by other pathophysiological processes." These guidelines describe preoperative instructions to parents, diet restrictions, monitoring techniques and postoperative treatment instructions.

Malamed reported oral administration was the oldest, safest, most convenient, and most economical route for drug administration.[2] Other advantages of oral administration are no specialized training required, minimum equipment utilized, low incidence of adverse reactions, highly acceptable, and easily administered.[2] Kopel reported palatable mixtures can be created with oral administration of sedative agents, as well as the advantage of administering the medication in a home or office environment.[3] Disadvantages of the oral route include prolonged duration of anxiety, reliance on patient compliance and parent cooperation, inability to titrate, incomplete absorption of drugs from the gastrointestinal tract, inability to readily lighten or deepen the level of sedation, and dietary restrictions.[2,3]

There have been numerous publications on con-

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scious sedation in treating pediatric dental patients; there are fewer articles, however, that report on specific techniques and different drug regimens for conscious sedation. Employing any type of sedation technique requires the practitioner to be knowledgeable about the mechanism of drug action, dosage, adverse reactions, side effects, and drug interactions between drugs being used or other medications the patient may be taking. The two drug combinations evaluated in this study were chloral hydrate/promethazine and meperidine/promethazine, which are used in the postdoctoral pediatric dentistry program at the University of Alabama School of Dentistry for oral sedations. The purpose of this retrospective study is to establish the prevalence of adverse reactions associated with two oral sedation regimens in pediatric dental patients, as well as the efficacy of these regimens.

MATERIALS AND METHODS

Dental records were reviewed at The Children's Hospital and UAB School of Dentistry for patients treated from January to December, 1988. A combined total of seventy-three different patient records were reviewed for 112 sedation procedures. All patients were ASA Classification I. Appointment schedules also were reviewed as a means of verification of treatment and documentation of scheduled and broken appointments.

In reviewing the sedation procedures, the following items were assessed: age, weight, drug dosages, the use of nitrous oxide - oxygen in combination with oral sedatives, and documentation of pulse oximeter use. Baseline vital signs were taken before drug administration, which included blood pressure, heart, and respiratory rate. Pulse oximeter readings were recorded in 61 percent of the patients treated. Difficulty in maintaining the sensor in position occurred in some patients during the procedure because of excessive body movement. Readings, therefore, were not available in all 112 patients. One hundred ten patients out of 112 received dental treatment successfully with the oral sedatives, local anesthetic, and nitrous-oxide oxygen analgesia. The occurrence of any preoperative, intraoperative, and postoperative complications were recorded. Naloxone, a narcotic antagonist, was available in case severe respiratory depression was encountered during any of the meperidine/promethazine sedations.

At the school of dentistry, fifty-six sedations were done on thirty-four patients and at The Children's Hospital, fifty-six sedations were done on thirty-nine patients. Forty males and thirty-three females were sedated. Sedation regimens were not randomly assigned. Since this was a review of dental records of oral sedation treatment sessions, the operators administered the medication and were aware of the regimen and dosage given, therefore, with no attempt at blinding the study. The overall rating of each oral sedation case was scored using a modification of the scoring system reported by Barker and Nisbet (Table 1).[4] The scoring was done subjectively by seven operators who were not standardized. Sedation outcomes were statistically evaluated using the nonparametric analog of the t-test accepting $p < O.O5$ as significant.

Hypoxemia was evaluated based on pulse oximeter recordings*. Normal oxygen saturation was considered above 95 percent, mild hypoxemia was defined as oxygen saturation between 91-95 percent, moderate hypoxemia 75-90 percent, and below 75 percent was considered severe hypoxemia Mueller *et al.*[5]

*Datascope Accustat Datascope Corp., Paramus, NJ. - Children's Hospital Nellcor Pulse Oximeter N-10 Nellcor, Inc., Hayward, CA - UAB.

All cases were treated with oral sedatives, nitrous oxide-oxygen, and a local anesthetic.

Table 1 ☐ Scoring system for evaluation of sedation effectiveness.

		Score
I.	Reception area:	
	Apprehensive	0
	Fully awake	1
	Drowsy	2
II.	Reception area to operating room:	
	Cry and/or struggle	0
	Apprehensive	1
	Deterioration from drowsy or awake state	1
	No change from drowsy or awake state	2
III.	Reaction to injection:	
	Cry and/or struggle	0
	Wince and/or vocalization	1
	None to minimal	2
IV.	Reaction to dental procedures:	
	Cry and/or struggle	0
	Vocal, but cooperative	1
	None to minimal	2
V.	Patient's perception at end of appointment:	
	Continued crying and/or struggle	0
	Apprehensive, yet cooperative	1
	Patient has positive attitude	2
VI.	Patient's alertness at end of appointment:	
	Patient must remain longer than 15 minutes because of excessive drowsiness or nausea	0
	Patient sleepy, but alert enough to leave office	1
	Patient in good mental alertness	2

Evaluation of sedation:

Score	Evaluation
8-12 points	Good
6-7 points	Fair
0-5 points	Poor

(*Modification of the modified scoring system reported by Barker & Nisbet 1973.)

Table 2 ☐ Distribution of patients and degree of hypoxemia. Chloral hydrate/promethazine sedations(n = 24).

Age (mos)	Weight (kg)	Dosage CH/P (mg)	Oxygen saturation	Degree of hypoxemia
31	11.4	600/12.5	86%	Moderate
33	15.0	750/12.5	93%	Mild
40	11.4	570/12.5	90%	Moderate
32	12.0	590/12.5	95%	Mild
24	11.4	570/12.5	95%	Mild
25	10.5	525/12.5	95%	Mild
36	13.2	660/12.5	95%	Mild
24	14.0	800/12.5	86%	Moderate
21	11.0	545/5.45	95%	Mild
24	13.0	636/12.5	88%	Moderate
24	15.0	750/12.5	94%	Mild
36	17.3	865/12.5	93%	Mild
36	17.3	865/12.5	94%	Mild
29	13.2	700/15.0	82%	Moderate
29	13.2	700/15.0	79%	Moderate
36	14.0	750/15.0	94%	Mild
59	16.4	820/12.5	92%	Mild
59	16.4	820/12.5	84%	Moderate
36	13.0	640/12.5	93%	Mild
36	13.0	750/12.5	77%	Moderate
39	14.3	715/7.15	79%	Moderate
34	11.4	600/12.5	94%	Mild
44	15.0	900/15.0	95%	Mild
31	15.0	750/12.5	84%	Moderate

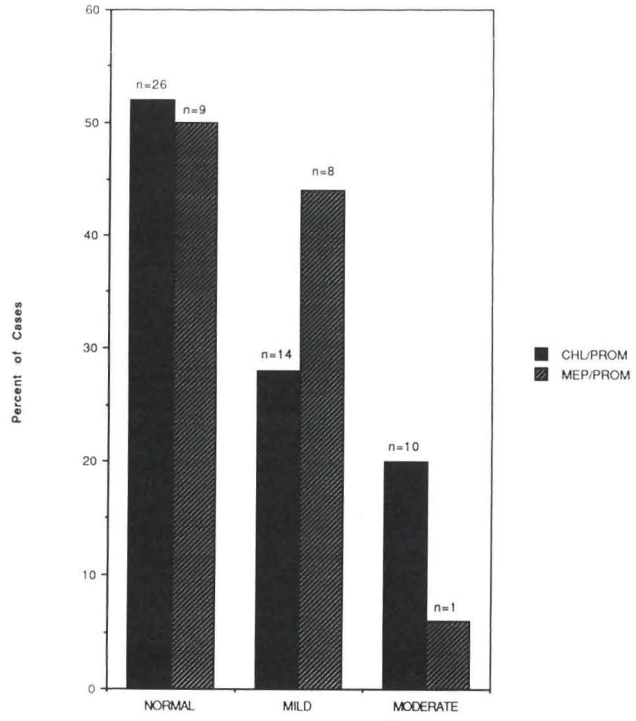
Table 3 ☐ Distribution of patients and degree of hypoxemia. Meperidine/promethazine sedations(n = 9).

Age (mos)	Weight (kg)	Dosage MEP/P(mg)	Oxygen saturation	Degree of hypoxemia
36	14.1	21.0/12.5	92%	Mild
43	17.3	25.0/12.5	94%	Mild
60	16.0	25.0/12.5	95%	Mild
53	14.0	30.0/20.0	94%	Mild
53	15.0	30.0/20.0	95%	Mild
24	13.2	20.0/12.5	92%	Mild
75	16.4	25.0/25.0	90%	Mild
24	11.4	15.0/12.5	93%	Mild
25	11.4	20.0/6.00	80%	Moderate

RESULTS

Approximately 2,650 patient contacts were recorded for treatment in the postdoctoral pediatric dentistry program for 1988. Of those, 112 (4.2 percent) patient contacts were oral sedation cases that ranged in ages from 20 months to 120 months. Seventy-one sedations (63 percent) were done with chloral hydrate/promethazine and 41 (37 percent) were done with meperidine/promethazine. The average patient age and weight for all the study participants were 39 months and 32 pounds. The average age and weight of patients sedated with chloral hydrate/promethazine were 32.6 months and 28.6 pounds while the average age and weight of the meperidine/promethazine sedated patients were 51.2 months and 36.5 pounds. Statistical analysis using the unpaired t-test showed the meperidine/promethazine group was significantly older ($p < 0.05$) compared to the chloral hydrate/promethazine group. The average drug dosages used were 53.3 mg/kg of chloral hydrate (range 50 mg/kg - 69 mg/kg) with lmg/kg of promethazine, and lmg/kg of meperidine (range .5mg/kg - 1.5mg/kg) with 1.0mg/kg promethazine. All cases were treated with oral sedatives, nitrous oxide - oxygen, and a local anesthetic (2 percent lidocaine 1:100,00 with epinephrine). Concentrations of nitrous oxide - oxygen varied from 30 percent nitrous oxide to 70 percent; however, 73 percent of the cases used 50 percent nitrous oxide and 50 percent oxygen during treatment.

Sixty-eight cases were reviewed for assessment of oxygen saturation. Thirty-three patients experienced episodes of hypoxemia; twenty-two with mild states, and eleven with moderate episodes of hypoxemia (Tables 2 and 3). Figures 1 and 2 illustrate the hypoxemic conditions and percentages of sedations done with chloral hydrate/promethazine and meperidine/promethazine. The patient age-range of those with episodes of oxygen desaturation with meperidine/promethazine was from twenty-four to seventy-five months with an average age of forty-four months. Those patients taking chloral hydrate/promethazine with episodes of oxygen desaturation had an age range from twenty-one to seventy-five months and an average age of thirty-four months. Of the fifty cases with pulse oximeter documentation of chloral hydrate/promethazine, 48 percent had hypoxemic conditions: fourteen patients with mild hypoxemia and ten patients with moderate hypoxemia. Fifty percent of the patients (9 of 18) sedated with meperidine/promethazine had episodes of desaturation. Eight patients experienced mild desaturation and one patient had an episode of moderate oxygen desaturation. All desaturations responded to repositioning of the head



CHL PROM=Chloral hydrate/promethazine
MEP/PROM=Meperidine/promethazine

Figure 1. Degree of hypoxemia

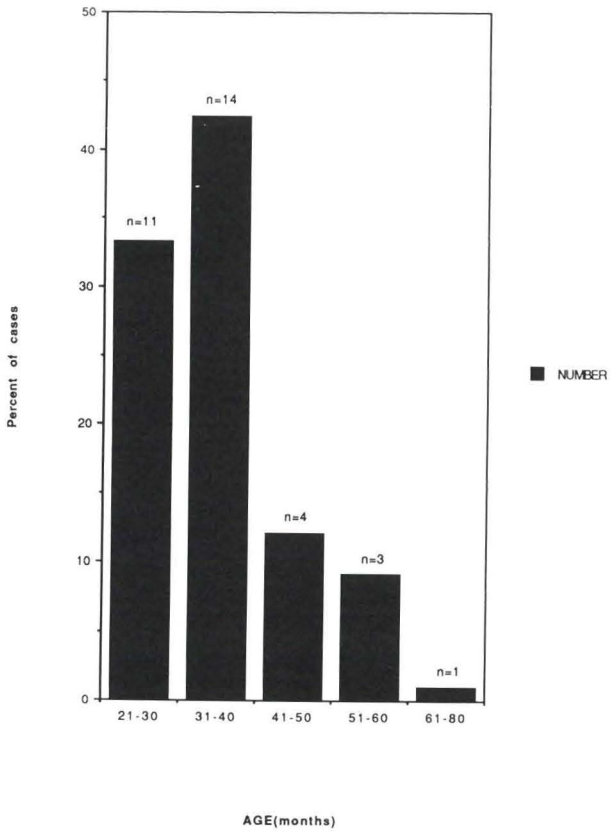


Figure 2. Distribution of hypoxemic patients

and returned to normal after position adjustment.

Two patients experienced severe nausea and vomiting after drug administration, which required cancellation of the planned treatment procedure. One child, forty-four months and twenty-four pounds, was sedated with chloral hydrate (545mg)/promethazine (12.5mg) and the other child, thirty-nine months and thirty-eight pounds, with meperidine (25mg)/promethazine (25mg). Intraoperatively, four cases of emesis were documented. This complication occurred approximately one hour after drug administration. Three patients were sedated with chloral hydrate/promethazine and one with meperidine/promethazine. Despite the emesis, treatment was not cancelled. One post-operative complication was documented. A patient, thirty-six months and thirty-two pounds returned to The Children's Hospital Dental Clinic with postoperative fever and nausea five hours after the sedation procedure. The patient had been sedated with 800mg chloral hydrate and 15mg of promethazine. The patient was observed with palliative therapy rendered and no further complications occurred. There were no other complications recorded in this study. The administration of naloxone was not required in any of the cases of meperidine/promethazine sedation.

The overall effectiveness ratings of the sedations had a combined mean score of 7.6 and a combined median score of 9. One hundred two cases with recorded ratings were evaluated. Of the 102 rated sedation cases, 65.7 percent (n = 67) were administered chloral hydrate/promethazine and 54 percent (n = 36) of these cases had good behavior ratings. The sedations with meperidine/promethazine made up 34.3 percent (n = 35) of our cases with 62.8 percent (n = 22) yielding good ratings. Figure 3 illustrates the number of patients and ratings of the sedations. The mean behavior rating score for the chloral hydrate/promethazine sedations was 7.61 (Good) and for the meperidine/promethazine sedations the mean rating score was 8.38 (Good). Statistically, there was no difference between the outcome of the two drug regimens used based, on the nonparametric analog of the t-test.

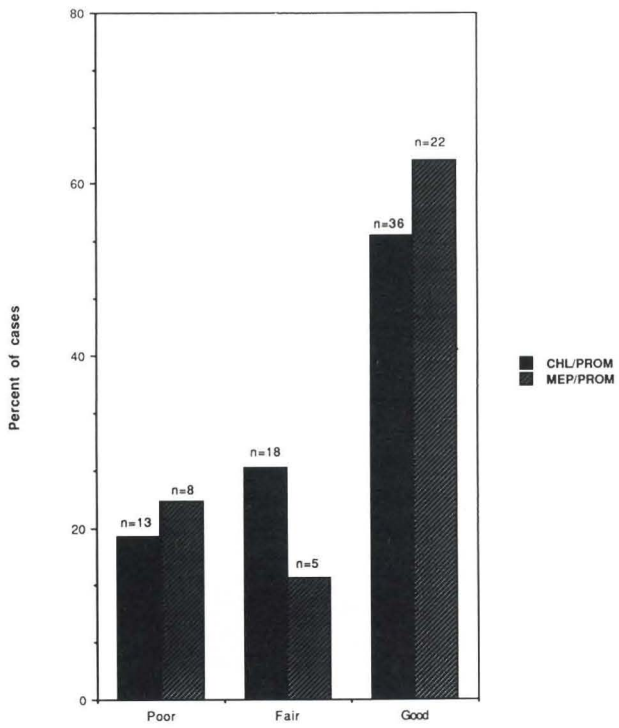


Figure 3. Ratings of sedations

DISCUSSION

Adverse Reactions

HYPOXEMIA

The most common adverse effect of oral sedation found in the present study was transient hypoxemia. In this study, 48 percent (n=33) of the sixty-eight sedation cases with pulse oximeter recordings had decreased oxygen saturation below normal levels. Mild desaturation was experienced by 32 percent (n=22) of our patients and 16 percent (n=11) experienced moderate desaturation. Iwasaki *et al* reported that 100 percent of their patients (n=10) were desaturated and of those, 50 percent also experienced moderate desaturation, when sedated with 75mg/kg of chloral hydrate as determined by pulse oximetry.[6] The patients in their study ranged in ages of twenty-four to sixty months with a mean age of thirty-four months (2 years 10 months). In our study, the mean age of patients who experienced hypoxemic conditions sedated with chloral hydrate/promethazine was also thirty-four months. Of those, the age distribution of patients ≥36 months and ≤35 months was evenly divided among those who had episodes of mild hypoxemia. There were more patients ≤35 months with moderate states of hypoxemia.

Hypoxemic conditions due to a decrease in blood oxygen may be detected noninvasively using a pulse oximeter.[7] In a study by Whitehead *et al*, early changes in oxygen levels were readily detectable with a pulse oximeter in patients sedated with 50mg/kg chloral hydrate and 25mg hydroxyzine.[7] Mueller *et al* conducted a study that addressed oxygen saturation levels in forty sedated pediatric dental patients who were randomly given 100mg/kg (n=20) chloral hydrate or 1.0mg/kg (n=20) of alphaprodine. All the patients received 50 percent - 50 percent nitrous oxide-oxygen analgesia. The participants in this study ranged in age from twenty-four to seventy-two months (2-6 years). All twenty of the subjects administered 1.0mg/kg alphaprodine experienced oxygen saturation levels below normal physiological levels, while the patients sedated with meperidine/promethazine in the present retrospective study ranged in age from twenty-four to seventy-five months and only 50 percent experienced oxygen saturation below normal levels. Only seven of twenty subjects receiving 100mg/kg chloral hydrate experienced

The most common adverse effect of oral sedation found in this study was transient hypoxemia.

oxygen saturation levels below normal physiological levels in the study by Mueller *et al.*[5] In contrast, twenty-four of fifty (48 percent) patients in the present study receiving chloral hydrate/promethazine demonstrated hypoxemia. The frequency of hypoxemia varies from study to study and is partially dependent on the drugs employed for sedation. It is significant to point out that in our study, there was essentially no difference in the percentage of cases experiencing hypoxemia between chloral hydrate/promethazine and meperidine/promethazine. It is also interesting to note that the majority of patients who experienced moderate hypoxemia regardless of the drug regimen were under thirty-six months of age.

According to Mueller *et al* using the traditional techniques of patient monitoring, including heart rate, blood pressure, respiration, visual observation of oral mucosal tissues and nail beds for signs of cyanosis, are valuable but may not reflect hypoxemia until moderate to severe oxygen saturation levels are reached.[5] The precordial stethoscope is an important monitoring device for listening to heart and breath sounds; the pulse oximeter has proven to be an extremely effective device for detecting hypoxemic states, however, during oral sedations. This was confirmed in their study using pulse oximeter along with the traditional monitoring techniques. In states of mild hypoxemia detected by pulse oximetry readings, there were no detectable changes in rate of respiration, blood pressure, or heart rate. There were significant changes, however, in rate of respiration, blood pressure, and heart rate during episodes of moderate hypoxemia. By changing the position of the head of the patient to open the airway, the subjects in their study with signs of oxygen desaturation returned to normal.

Advantages of pulse oximetry monitoring are accuracy, reliability, convenience, and multiple potential probe sites.[8] Yelderman and New concluded from a study assessing the accuracy of pulse oximetry that this method was reliable with oxyhemoglobin saturation measurements in the 70-100 percent range.[9] The disadvantages of this monitoring technique are the inability to measure the partial pressure of oxygen (PaO_2), motion sensitivity, and dependence upon a reliable vascular pulsating site. The PaO_2 is the amount of oxygen dissolved in the plasma and body tissue, and changes in oxygenation are not detected until the PaO_2 drops where desaturation of the oxyhemoglobin occurs. Recognition of this relationship between values is important, because desaturation is indicative of potential respiratory depression; small changes in desaturation must be addressed, however, immediately.[8] Wilson outlined potential factors that may elicit false episodes of desaturation with pulse oximetry use, such as patient movement, relative hypothermia, ambient light, abnormal hemoglobinemias, and peculiar physiologic factors associated with regional nail beds.[10] In the 2-part study conducted by Wilson with various doses of chloral hydrate and a placebo, 87-90 percent of the desaturation episodes experienced by the patients were attributed to movement by the patient. The author concluded that this method of monitoring could be useful in deeper sedation levels and general anesthesia. The duration of hypoxemic episodes in the present retrospective review did not exceed three minutes. All the hypoxemic episodes were transient, therefore, requiring only patient positioning to correct. Since there were no objective data recorded on patient behavior during treatment, it is difficult to assess movement as a contributory factor to these episodes.

Aside from its sedative-hypnotic effects, chloral hydrate has very little effect on inspiratory action Hershenson *et al.*[11] An animal study was conducted by Hershenson *et al* analyzing the effects of chloral hydrate on the musculature involving airway maintenance, mainly the genioglossus muscle.[11] The results showed that chloral hydrate definitely depressed the activity of this muscle. Head position is very important in order to facilitate, therefore, the forward movement of the tongue, to provide an adequate passageway for air flow and aid in the prevention of hypoxemia. The importance of head position or maintaining an adequate airway has been shown in several previous studies and is corroborated by the current investigation where all occurrences of hypoxemia were reversed by altering head position.

EMESIS

In this study, vomiting occurred in 7.0 percent of the patients sedated with chloral hydrate/promethazine and in 4.8 percent of patients sedated with meperidine/promethazine despite all being NPO. Vomiting was the most common adverse reaction reported by Houpt *et al* in their evaluation of twenty-one chloral hydrate sedations with and without promethazine.[12] Vomiting was experienced by 43 percent of their chloral hydrate sedated patients without promethazine and only 14 percent sedated with promethazine. They recommend promethazine whenever chloral hydrate is used to sedate young children since it significantly reduced nausea and vomiting in their patients. In another study by

Nathan and West, who reported on 142 sedations using chloral hydrate/hydroxyzine with and without meperidine, only 2.8 percent of their patients vomited.[13] The antiemetic properties of promethazine appear to reduce greatly the prevalence of emesis in sedated children and probably account for the low emesis rate in this study. All of these studies illustrate the high likelihood of having an emetic episode in patients sedated with oral agents requiring that clinicians be ready with appropriate equipment, i.e. suction to prevent aspiration and maintain a patent airway.

As in the studies done by Houpt *et al* and Nathan and West, nitrous oxide was also used with our sedation cases.[12,13] It is important, therefore, to note that the most common adverse reaction to nitrous oxide is nausea and vomiting Duncan and Moore.[14] According to a review by Duncan and Moore on nitrous oxide, the frequency of vomiting ranged from as low as 1 percent to as high as 10 percent. Several factors may increase the likelihood of emesis, including high concentrations of nitrous oxide, young age, and duration of use; there is no evidence that nitrous oxide has a greater potential to induce nausea and vomiting, however, than other sedative-hypnotic agents.

EFFECTIVENESS OF SEDATIONS

Overall, the drug regimens used in our study yielded good behavior ratings. There was no statistically significant difference in effectiveness between the two drug regimens evaluated. Due to the fact that this study reviewed records of oral sedation treatment sessions that were not randomly selected or designed to be a blinded study and different sedation regimens were utilized as well as a different rating process, it is very difficult to compare our behavioral rating results with other studies such as Houpt *et al*[12,15] Although not directly comparable, the present study revealed the majority of cases as having good results, using the two drug regimens. To assess properly whether these two drug protocols are effectively similar, a double-blinded randomized design is required.

CONCLUSIONS

- ☐ Emesis occurred in 5.0 percent (5 of 110) of the total cases treated, while oxygen desaturation was documented in approximately 48 percent of the cases based on pulse oximeter recordings.
- ☐ There was no statistical difference between the behavioral assessments of these two drug regimens. Both regimens yielded good ratings.
- ☐ This study indicates there is no difference in the prevalence of hypoxemia with the use of a sedative-hypnotic (48 percent; 24 of 50 cases) or a narcotic agent (50 percent; 9 of 18 cases) for oral sedation when used for sedating pediatric dental patients.
- ☐ Clinical studies have documented the occurrence of mild to moderate hypoxemia in pediatric patients sedated with the commonly used protocols; further controlled studies are needed to differentiate actual desaturation episodes, however, to rule out recordings associated with motion sensitivity.

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Prevention

Caries preventive effect of high fluoride and xylitol containing dentifrices

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Numerous clinical and field trials have established the benefits of regular applications of fluoride-containing dentifrices as a simple, self-applied procedure for reducing the risk of dental caries.[1]

In populations at high risk for caries, promotion of topical fluorides in dentifrices, particularly where it is impractical to fluoridate water supplies, appears to be a rational approach to caries control. Formulations of popular dentifrices commonly include fluoride at concentrations of 1000 ppm, a level based on an empirical decision made almost forty years ago. While this level of fluoride provides significant protection against caries, the effectiveness of dentifrices with higher fluoride content remains unresolved. There is evidence that dentifrices with fluoride concentrations in excess of 1000 ppm do have a greater caries preventive effect; also that fluoride concentrations of less than 1000 ppm are less effective.[2-7] To date, the conclusions are that the higher the fluoride content the more effective is the reduction of caries incidence irrespective of whether the test sample of children is resident in a fluoridated or nonfluoridated; or the brushing is supervised nonsupervised.[2-8]

Studies of xylitol as a nonfermentable (and therefore noncariogenic) natural sugar identified it as a potential caries inhibitor when used daily at a level of 15 mg percent.[9] Although a field trial involving regular daily use of xylitol (in chewing gum) failed to identify any such effect on the incidence of caries in children, its potential has not been adequately explored.[10]

A school-based dental caries prevention program was implemented by the Service d'Hygiene Dentaire in French Polynesia. In 1983, a three-year field trial of controlled daily brushing of the teeth, using dentifrices which varied in their fluoride content from 1250 to 5000 ppm fluoride was implemented. Two formulations, with the higher levels of fluoride, also incorporated 15mg percent xylitol. The dental products were supplied by the Laboratories Goupil S.A.A., Paris. Problems with data coding frustrated reporting of the 1983 baseline and 1986 end-of-trial outcomes.

A posttrial evaluation of the prevalence of caries (DMF teeth) of children in the trial was undertaken by independent consultants, a year after the completion of a three-year trial. This was a supervised school-based trial of dentifrices containing 1250, 2500 or 5000 ppm fluoride, with and without incorporated xylitol (15mg percent).

This project was undertaken as a Technical Services Project of the Oral Health Unit, WHO.

We acknowledge M.E. Ball for his statistical analyses.

METHODS

Test groups

Identification and location of participants in the trial were made through the Chief of Dental Services, French Polynesia (PH). At the time of the survey, the examiners were unaware of the distribution of the respective test dentifrices between children or schools.

Treatment groups

For the three-year-trial schools, classrooms and children were randomly selected to provide five groups of 300 children, six to nine years of age, on the island of Tahiti. The 1983 baseline sample was 1508. These groups of children were allocated to one of the five treatment groups J, K, L, M, N. Treatments implied self-applications of the fluoride or fluoride and xylitol containing dentifrices (Table 1). Brushing was teacher-supervised and dentifrice application was once daily under teacher supervision and limited to school-days only, that is about 200 applications a year.

Oral examinations

Examinations were carried out on school premises with children seated on school chairs; illumination was primarily by natural lighting supplemented with artificial lighting as necessary. The children were required to have brushed their teeth before the oral examination.

Assessments for diseased (D), missing (M) and filled (F) permanent teeth were conducted, using WHO recommended procedures.[11] Smooth surface caries was diagnosed by identification of cavitation in enamel or dentine using a standard dental probe. Fissure caries was identified as positive only if the examiner suspected dentinal involvement and there was definite resistance to probe removal.

All observations were recorded on appropriate charts directly at the chairside by a clinical assistant.

Table 1 ☐ Fluoride and xylitol content of test dentifrices.

Dentifrice containing:	Group
1250 ppm fluoride	J
2500 ppm fluoride	K
2500 ppm fluoride + 15 mg% xylitol	L
5000 ppm fluoride	M
5000 ppm fluoride + 15 mg% xylitol	N

Data processing

On completion of the field survey, data were transferred to a computer for evaluation. The data were evaluated with respect to the five treatment groups identified during the trial and evaluation as J, K, L, M, and N.

RESULTS

Five hundred and twenty children were located and examined in 1987; 53 percent were boys and 47 percent girls. They represented 68.8 percent of the 756 children who completed the three-year trial. Intergroup distribution of children was unequal, ranging from 15 percent to 24 percent of the 520 children. Children aged ten, thirteen, fourteen, and fifteen years were not

Fissure caries was identified as positive only if the examiner suspected dentinal involvement and there was strong resistance to removal of the probe.

represented in all groups. Over 70 percent of children were aged eleven and twelve years, and only these ages were represented in all five groups (Table 2).

A preliminary evaluation of the data showed an imbalance in the distribution of children by age and between treatment groups. In addition, the distribution of DMF scores by age were statistically skewed. For these reasons and the small sample sizes in some age-groups, evaluation of the basic data was limited to observations of patterns and trends. Statistical evaluation was conducted on data transformed to normalize the DMFT (means and percentages) distributions by age and treatment groups. The data were not considered separately by sexes.

Table 2 ☐ Distribution of children by group, age and sex.

Age (Years)	Dentifrice treatment, ppm F 1250	2500	2500x	5000	5000x	All
10	3	0	35	34	0	72
11	46	35	36	39	40	196
12	20	42	44	25	40	171
13	41	0	12	20	0	73
14	7	0	0	0	0	7
15	1	0	0	0	0	1
Male	61	36	74	68	38	277
Female	57	41	53	50	42	243
Total	118	77	127	118	80	520

x – with 15 mg% xylitol

Table 3 ☐ Number and percentage distribution of children by DMFT and fluoride treatment. Summarized and full data.

No. DMFT	Dentifrice treatment 1250 n	%	2500 n	%	5000 n	%
			Summary			
0	9	7.6	20	9.8	32	16.2
1-3	39	33.0	87	42.6	110	55.6
>3	70	59.3	97	47.5	5	8.3
			Detail			
0	9	7.6	20	9.8	32	16.2
1	8	6.8	20	9.8	34	17.2
2	11	9.3	39	19.1	46	23.2
3	20	16.9	28	13.7	30	15.2
4	10	8.5	33	16.2	26	13.1
5	15	12.7	18	8.8	17	8.6
6	11	9.3	16	7.8	6	3.0
7	15	12.7	10	4.9	3	1.5
8	12	10.2	10	4.9	2	1.0
9	1	0.8	5	2.5	1	0.5
10	3	2.5	1	0.5	0	0
11	0	0	4	2.0	1	0.5
12	3	2.5	0	0	0	0
Totals	118		204		198	

Anaysis of variance
F = 29.65***, DF = 4,507
t tests on differences between mean values:

	t	P
2500 v 5000	5.1	0.001***
2500 v 1250	3.2	0.001***
5000 v 1250	7.7	0.001***

Exploratory evaluation

Mean DMFT scores increased by age in all groups; an inverse relationship was apparent between the scores and the fluoride content of the dentifrices under test, when age was not considered (Figure 1). The xylitol content of the dentifrice was not associated with any clinical scores and for this reason groups K and L, and, M and N were grouped for all further statistical testing.

The mean number of D and M teeth was low. On average, each child had 3.0 F teeth, ranging between 2.4 teeth for children on 5000 ppm fluoride and almost 5.0 teeth of children on 1250 ppm fluoride.

The mean percentage of DMFT was inversely related to the fluoride concentration in the dentifrice used. Between 10 percent and 18 percent of teeth were D, M or F and showed the same ranking as the mean number of DMF; children on 1250 ppm fluoride had the highest percent affected (18 percent) and those on 5000 ppm fluoride the lowest percent (10 percent).

A summary of the distribution of children with DMF scores = 0, 1-3, or >3, showed (Table 3) that only 8 percent of children on 1250 fluoride had DMF = 0 compared with 20 percent of children on treatment 5000 fluoride. Less than 30 percent of children on 5000 fluoride had scores greater than 3, as compared with almost 50 percent of those on 2500 fluoride and 67 percent of those on 1250 fluoride. The full distribution is also shown.

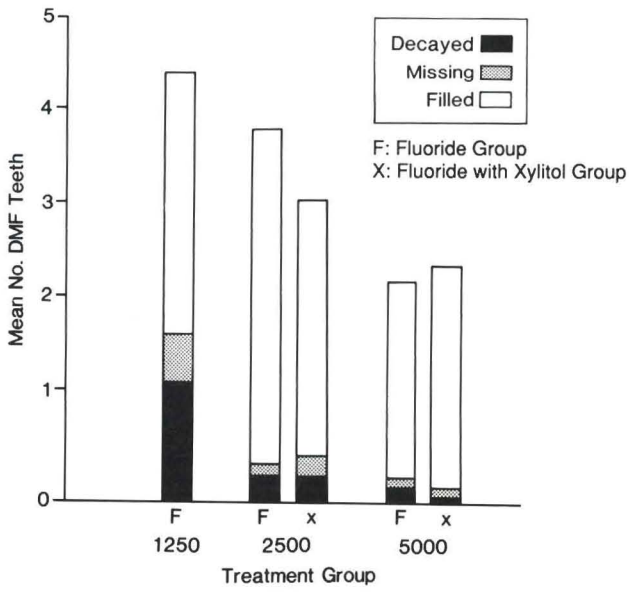

Figure 1. Mean number of DMF shown by respective dentifrice test-groups, for children aged eleven to fifteen years of age.

DMF scores were also examined by type of tooth, i.e. molars, premolars, canines and incisors (Table 4). Between 50 percent and 64 percent of first molars were DMF (most of these teeth had erupted at least one to two years before the start of the trial) whereas 10 percent to 43 percent of second molars were found to be affected (all of these teeth erupted during the course of the three-year trial). Incisors and canines were least affected by D,M or F. Children in the 1250 ppm fluoride group tended toward the higher DMFT scores for all tooth-types.

Children of eleven and twelve years of age were selectively evaluated because of their equal (approximate) distribution between all five groups. This partially overcame the age influence on the mean DMFT scores between groups. An inverse relationship was evident between fluoride treatment (ppm) and DMFT scores, but not between xylitol and DMFT (Table 5).

Conclusions of an exploratory evaluation of the basic data were: The distribution of children between treatment groups and by age was unbalanced; there was a significant variation in the number of teeth erupted within and between treatment groups.

The distribution of the number and percentage of DMFT by age and by groups was statistically skewed and their variances were not homogeneous.

The DMF scores increased with age; the mean and percentage DMF scores were inversely related to respective levels of fluoride (ppm) in the dentifrice used.

DMF scores were not associated with the xylitol content of the test dentifrice.

More appropriate statistical testing of the relationships between DMF scores, age and treatment groups was carried out to overcome the nonnormal distribution of data, nonhomogeneity of variances, and the imbalance of children by numbers and ages between treatment groups.

The relationship between DMF and fluoride treatments was evident when the 512 sets of data were normalized by transformation to log and arc sine. Predicted mean and percentage DMF values for treatment groups together with the observed values indicated that scores for children using 2500 fluoride were approximately 15-19 percent; and for children using 5000 fluoride, 40-45 percent lower than for those in the 1250 ppm fluoride

Table 4 ☐ Number and percent of DMF teeth by tooth-type and groups.

Tooth type	Fluoride treatment 1250	2500	5000
Incisors			
No. teeth	994	1624	1558
% DMFT	4.8	1.1	0.9
Canines			
No. teeth	449	726	694
% DMFT	0	9.5	0
Premolars			
No. teeth	879	391	1319
% DMFT	6.0	5.0	1.7
1st Molars			
No. Teeth	474	814	792
% DMFT	63.9	59.6	50.3
2nd Molars			
No. teeth	373	592	508
% DMFT	43.2	29.9	10.4

Table 5 ☐ The prevalence, mean number and percent, of DMF teeth in 11 and 12 year old children by fluoride tretament. Number of children (364).

Age	DMFT	Fluoride treatment, ppm 1250	2500	5000
11	Mean	4.2(46)	3.4(71)	2.6(77)
12	Mean	4.2(19)	4.5(86)	2.7(65)
11	%	17.0(46)	14.0(71)	10.5(77)
12	%	15.6(19)	16.3(86)	9.8(65)

The mean and percentage DMF scores were inversely related to respective levels of fluoride (ppm) in the dentifrice used.

group. Scores for the 5000 fluoride group were 30 percent lower than those for 2500 ppm fluoride group.

The statistically derived regression lines between age and DMF scores for mean number and percentage of DMFT (Figures 2 and 3) showed an inverse relationship between scores and the fluoride content of the dentifrice used. A direct relationship was evident between DMF scores and age.

Analysis of the two age-groups eleven and twelve years which included 70 percent of the total sample and all treatment groups, was also done. The findings confirmed those for the total sample.

There was a significant relationship between the fluoride treatment (type of dentifrice) and the number and percentage of DMFT. The greater fluoride content of the dentifrice, the lower the DMF scores. No significant relationship was indicated, however, between xylitol content of the dentifrices and DMF scores.

DISCUSSION

In French Polynesia the high prevalence of dental caries has been a long-term public health problem. Baume reported a high DMF(=14) by age fifteen years in Tahiti compared with a low DMF(=3) in the more remote islands of French Polynesia.[12] Fluoridation of water supplies is not feasible in Tahiti. A school-based, well-developed, public-health, dental care system implemented topical fluoride programs, however, to control the high prevalence of caries in children. Unfortunately the findings of the 1983-1986 field data proved unusable because of the method of scoring.

This independent assessment of the caries prevalence after three years use of fluoridated dentifrices did not attempt a caries diagnosis based on severity, but followed the basic methods procedure. The 520 children located and examined in 1987 represented only 34 percent of the original randomized baseline sample of 1508, but 69 percent of the 756 children who completed the three-year study.

Nevertheless our findings are essentially in agreement with several other reports that identify more protection with higher fluoride content in the

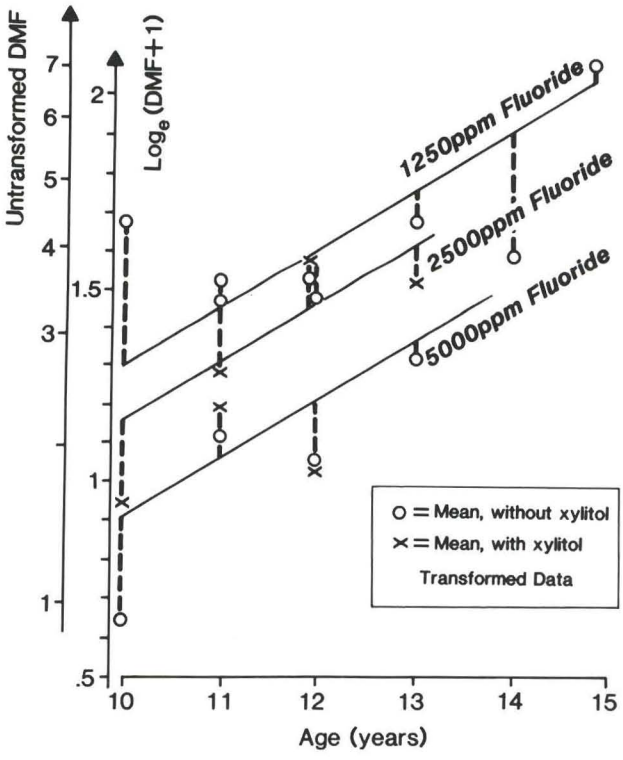

Figure 2. Regression of the mean number of DMF by age for respective dentifrices by age. Data transformed to a log base; an untransformed scale of DMF is also shown.

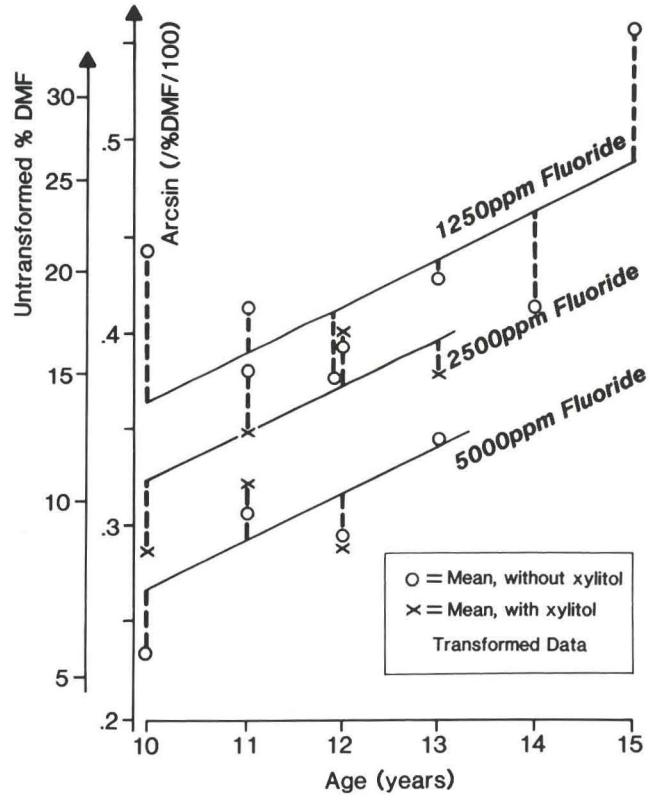

Figure 3. Regression of the percent DMF by age for respective dentifrices. Data transformed to an arc sine base: an untransformed scale of percent DMF is also shown.

formulation.[4,6,7] While Triol *et al* found that dentifrices formulated with 1000 ppm fluoride were less effective than those with 1450 or 2000 ppm fluoride, the highest fluoride concentration had no apparent advantage over the intermediate level. Insufficient studies have been conducted, however, to identify the fluoride concentration in a dentifrice formulation that provides the maximum protection against caries. Reed's regression analysis of increments in DMF surface scores (primary teeth) in a trial with 250, 500, and 1000 ppm fluoride dentifrices identified an inverse relationship between the two variables.[7] The present study indicates that this beneficial relationship improves with higher concentrations of fluoride in dentifrice. Fogels *et al* proposed that use of high fluoride content dentifrices is appropriate for caries protection in susceptible children, during the ages of eruption of premolar and second molar teeth.[6] The higher caries prevalence in French Polynesia justifies all reasonable Public Health measures being implemented to control the disease. As evidence points to topical uptake of fluoride into the surface environment of enamel as the explanation of fluoride action, the selected implementation of self-applied high fluoride dentifrice treatments appears a reasonable preventive action.

The possible hazards to oral and general health following regular ingestion of small amounts of high fluoride are well-recognized. They were effectively eliminated in the 1983-1986 study, however, by restricting dentifrice brushing under supervision at school and only during the school year. Concern for 'excessive' ingestion of fluoride on dental fluorosis was overcome by limiting the use of dentifrice to children beyond the tooth-formative years.

An anticaries therapeutic role for xylitol was not upheld at 15mg/gm level used in this study. This substantiated a previous clinical trial and rat study.[10,13]

The number of DMFT for eleven to sixteen-year-old children reported for this study (4.5, 3.5 and 2 respectively for low, medium and high fluoride dentifrices) was appreciably less than the DMF of five to nine teeth reported in 1969 for eleven to fourteen year old Tahitians.[13] A significant decrease in caries appears to have occurred over the past thirty years.

Only 756 of the children who completed the three-year study were located and examined in 1987. Assuming that these children were at least approximately representative of the original baseline randomized sample (of 1508), this prevalence signifies that improved caries protection is achievable, using dentifrices with higher than conventional levels of fluoride. Such formulations would have value for high caries-risk individuals. In the case of children they should be used under supervision to prevent excessive use.

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ABSTRACTS

Van Dorp, Corien S.E.; Ten Cate, Jacob M.: Preventive measures and caries progression: An *in vitro* study on fissures and smooth surfaces of human molars. J Dent Child, 59:257-262, July-August 1992.

The aim of this study was to compare pit-and-fissure sealants with fluoride treatments in their effectiveness to inhibit or reduce the progression of enamel lesions, particularly in the fissure region. The effects of fissure probing as used in diagnosis were compared with in the same protocol. Using a combination of image analysis of X-ray pictures of full crowns and a light microscopic evaluation of cross-sections provided information on the three dimensional spread of enamel demineralization. Pit-and-fissure sealants were superior in protecting enamel against progression of demineralization, as long as the walls of the fissures were well covered. The protection against demineralization offered by fluoride was mainly restricted to the smooth enamel surfaces; in fissures no protection could be measured. Surface defects of the enamel caused by probing or abrasion aided the progress of the lesion.

Sealants; Probes; Fluoride

Weerheijm, K.L.; de Soet, J.J.; van Amerongen, W.E.; de Graaff, J.: Sealing of occlusal hidden caries lesions: An alternative for curative treatment? J Dent Child, 59:263-268, July-August 1992.

The bacterial composition of the dentine of thirty molars with sealed occlusal surfaces (Delton tinted®) was examined. Undiagnosed hidden caries was present at the time of treatment. Although clinically assessed as good (age 3.4 years, s.d. 2.1), 47 percent of the sealants had a marginal defect, when assessed with SEM. The dentine of the treated teeth was of a soft consistency. The median of the number of microorganisms was 400 (range 0-3.10^5) cfu per sample. Mutans streptococci and lactobacilli were found in 53 percent of the samples. No relationship was found between the number of microorganisms and the marginal adaptation of the sealant, when examined under SEM; neither was a relationship found between the age of the sealant and the number of microorganisms (Kendall's Tau-C = 0.17, n.s. and -0.01, n.s., respectively). At present, there are insufficient grounds for treating nonvisible lesions (with a radiolucency on the bitewing) with a resin sealant.

Hidden caries; Sealant, marginal adaption; Microorganisms

Neuman, Esther; Garcia-Godoy, Franklin: Effect of APF gel on a glass ionomer cement: An SEM study, J Dent Child, 59:289-295, July-August 1992.

This SEM study evaluated the micromorphological effect of a 1.23 percent acidulated phosphate fluoridated gel (Oral B)(APF) on the surface of a glass ionomer cement (Ketac-Fil). Glass ionomer (GI) cylinders (area 6.69 mm) were prepared and divided into seven groups of ten specimens each: Group 1, glaze, no polishing; Group 2, glaze, polishing, glaze; Group 3, glaze, no polishing, APF for four minutes; Group 4, glaze, polish, glaze, APF for four minutes; Group 5, no glaze, no polish, APF for four minutes; Group 6, no glaze, polish, APF for four minutes; Group 7, glaze, polish, two coats of glaze, APF for four minutes. The glass ionomer was handled according to manufacturer's instructions, except for groups 5 and 6, where no glaze was used. Polishing was done with medium Sof-Lex discs, using slow-speed and water. The glaze resin (Ketac-Glaze) was painted with a brush over the GI surface and cured with visible light (Demetron) for thirty seconds. In Group 7, the first coat was cured and then the second coat was applied. The APF was applied with a cotton applicator for four minutes, rinsed, and dried. All specimens were then mounted on aluminum stubs, coated, and evaluated under the SEM. The results indicated that the glaze tends to contract or incorporate into the GI matrix in all groups. When APF was used over the GI, the amount of glaze remaining over the surface was diminished, exposing the GI surface. When two coats of the glaze were used, minimal GI surface was exposed after APF treatment.

Glass ionomer cement; APF; SEM

Waldman, H. Barry: Increasing interest in pediatric dentistry? J Dent Child, 59:296-300, July-August 1992.

Increasing numbers of senior dental students anticipate careers in pediatric dentistry. A review is provided of the evolving dental student interests and some insight into these developments—particularly in terms of the increasing numbers of women in dental programs.

Student interests; Pediatric dentistry; Women in dentistry

Waldman, H. Barry: The relationship of the changing structure of families and the health of children. J Dent Child, 59:301-305, July-August 1992.

The changing family structure impacts on the physical and mental health, emotional state and academic performance of children. Children reared in other than a family with both biological parents have increased difficulties. Pediatric dentists will need to consider these realities in their treatment of an increasing diverse population of children.

Family structure; Children, mental health, emotional state, academic performance; Pediatric dentists

Sams, Deirdre R.; Thornton, John B.; and Wright, J. Timothy: The assessment of two oral sedation drug reg-

imens in pediatric dental patients. J Dent Child, 59:306-312, July-August 1992.

Oral sedation remains a common method for managing uncooperative and/or extremely fearful pediatric patients requiring dental treatment. The purpose of this retrospective review is to report on the adverse reactions associated with the use of two oral sedation drug regimens commonly employed in pediatric dental patients. Of a combined total of 73 different patient records, 112 sedation cases from the pediatric dental program at the University of Alabama School of Dentistry were reviewed for this report. The two drug regimens were (1) chloral hydrate/promethazine and (2) meperidine/promethazine. Documentation was taken from the sedation cases, which included the following: (1) age, (2) weight, (3) the drug regimen and dosages, (4) the use of nitrous oxide, (5) the effectiveness rating of each sedation, and (6) adverse reactions. The adverse reactions included emesis and oxygen desaturation (hypoxemia) the latter being determined by the use of a pulse oximeter. The results of the study revealed that approximately 48 percent of the sedation cases with pulse oximetry recordings experienced mild to moderate hypoxemia, and in 6.2 percent of the cases, emesis occurred. The review and statistical analysis of the sedation ratings using the nonparametric analog of the t-test indicated no significant difference of effectiveness between the two drug regimens. This study shows that oxygen desaturation occurs frequently in pediatric dental patients being treated with conscious oral sedation techniques and that the prevalence of adverse reactions was similar for the drug regimens evaluated.

Sedation, oral; Chloral hydrate/promethazine; Meperidine/promethazine; Hypoxemia; Pulse oximetry

Cutress, Terry; Howell, P. T.; Finidori, C. et al: Caries preventive effect of high fluoride and xylitol containing dentifrices. J Dent Child, 59:313-318, July-August 1992.

Dental examinations were conducted in 1987 on 520 of the 753 children who fully participated in a three-year field-trial, 1983-1986, of the anticaries effect of dentifrices containing fluoride and xylitol. The prevalence of decayed (D), missing (M) and filled (F) permanent teeth differed significantly among the five treatment groups. Caries prevalence was inversely related to the level of fluoride, 1250, 2500 and 5000 ppm, in the dentifrice used, but was not associated with the presence or absence of 15 mg percent xylitol. The age, number of children, and number of erupted teeth were unequally dispersed among treatment groups. The DMF teeth scores showed non-normal distributions and nonhomogeneous variances. Following an exploratory scrutiny, the DMFT data were transformed to normal distributions for intra- and inter-treatment-group evaluation. All groups showed positive, significant regressions of DMF scores with the age of the children and an inverse significant regression with DMFT scores in relation to the fluoride content of the dentifrice under test.

DMFT scores; Dentrifice, fluoride and xylitol

Erratum

In the May-June 1992 issue of the Journal, in an article titled "Dentocraniofacial structure with complete anodontia of permanent teeth: Report of case" by Yoshihisa Yamashita, DDS, PhD, *et al*, the following information was omitted: Department of Preventive Dentistry, Kyushu Dental College, Kokurakita-ku, Kitakyushu 803, Japan.