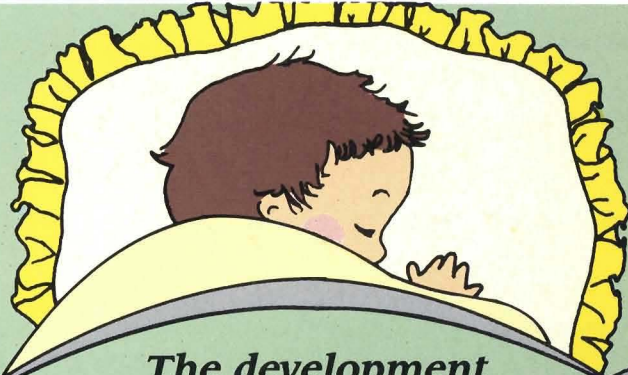


## JOURNAL OF DENTISTRY FOR CHILDREN



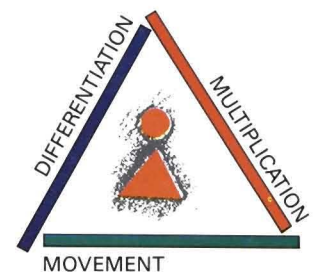
*The development of the foundations of intelligence may be encouraged during Phase III (3.5 to 5.5 months) by giving the child a variety of things to look at and handle. You can accomplish this first goal by supplying your infant with good crib toys, moving him about the house in an infant seat as you work, and taking him for carriage rides. This does not mean that he needs a constant change of scenery, but you should avoid leaving him in a playpen or in a crib for six or seven hours a day. Perhaps most important to a child in regard to the development of his mind in Phase III is having appropriate nearby objects that he can examine and handle.*

Burton L. White, 1975

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THE HAND THAT ROCKS THE CRADLE  
IS THE HAND THAT RULES THE WORLD.

—William Ross Wallace, 1819-1881





## JOURNAL OF DENTISTRY FOR CHILDREN

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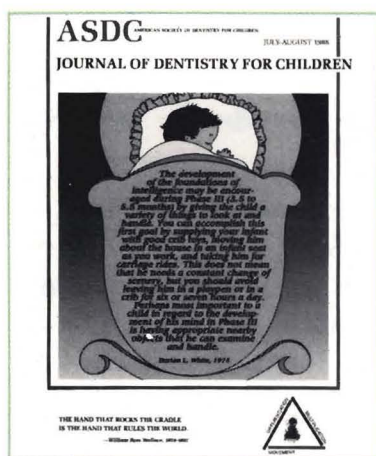
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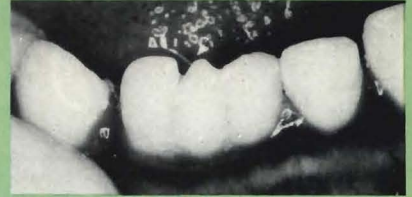
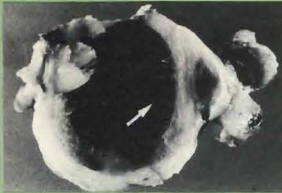
Roberto E. Sanchez-Woodworth, DDS; Richard W. Katzberg, MD; Ross H. Tallents, DDS; Jeffrey A. Guay, DMD

*This study demonstrates the various types of internal derangements of the TMJ observed by the authors in patients younger than age sixteen.*



It is time that society realize the importance of providing environments for children, virtually from conception, conducive to the normal development of the whole person.

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# For the busy reader

## **A national survey of sealant use by pediatric dentists—page 257**

Sealant use by pediatric dentists has increased substantially during this decade. This study surveyed pediatric dentists nationally to determine their level of sealant use and to examine the factors that affected level of use. The twelve-page questionnaire had seventy-two items and numerous sub-items. Overall, practitioners expressed a positive attitude toward sealant use; nearly all (96.9 percent) stated that they had tried using sealants in private practice.

Requests for reprints should be directed to Dr. Elaine Romberg, Educational and Instructional Resources, The University of Maryland, Baltimore College of Dental Surgery, Dental School, 666 West Baltimore Street, Baltimore, MD 21201-1586.

## **Penetration of gel and solution etchants in occlusal fissures—page 265**

The results of this study suggest that the liquid or the gel phosphoric acid agents are equally effective for use in pit-and-fissure surfaces, as each produces a similar etch-pattern, and neither is effective in removing residual debris from the pits and fissures. Due to its superior clinical handling qualities, the use of the gel etchant is recommended when applying sealants.

Requests for reprints should be directed to Dr. John O. Burgess, 8504 Modred, San Antonio, TX 78250.

## **The assessment of two dental anxiety-rating scales for children—page 269**

A major problem in studying anxiety is how to quantify this emotion. This study set out to examine the test-retest reliability of the Complex and Simple Rating Scales. It was found that the subscales of the Complex Scale relating to the "Cooperative, Relaxed, Compliant and Passive" dimensions showed a strong relationship.

Requests for reprints should be directed to Dr. Stanley F. Parkin, Children's Department, The Dental School, School of Medicine, University College London, Mortimer Market, London WC1E 6JD, England.

## **Reinforced practice of children's cooperative behavior during restorative dental treatment—page 273**

A procedure in which very young children were reinforced for practicing cooperative behaviors before actual dental treatment was shown to be effective in reducing frequent and violent disruptive behavior. The occurrence of multiple disruptive behaviors was eliminated almost completely.

Requests for reprints should be directed to Dr. Keith D. Allen, Department of Psychology, Meyer Children's Rehabilitation Institute, University of Nebraska Medical Center, 444 S. 44th Street, Omaha, NE 68131-3795.

## **Radiographic assessment of temporomandibular joint pain and dysfunction in the pediatric age-group—page 278**

Of 150 patients referred, with signs and symptoms suggestive of TMJ internal derangement, there were 131 girls and 19 boys; 114 were examined by arthrography, 16 by CT, and 14 by MR. One hundred twenty-eight of the 150 showed evidence for an internal derangement of one or both sides, in this pediatric age-group.

Requests for reprints should be directed to Dr. Richard W. Katzberg, University of Rochester Medical Center, Department of Radiology, Box 648, Rochester, NY 14642.

## **Ectodermal dysplasia with partial anodontia: prosthetic treatment with implant fixed prosthesis—page 282**

The principal aim of dental treatment in patients with ectodermal dysplasia is to replace missing teeth and bone. Replacement of missing natural teeth by implanted prostheses would significantly improve the treatment of patients with severe anodontia. This case illustrates a new possibility provided by osseointegrated implants.

Requests for reprints should be directed to Dr. Karl Ekstrand, Department of Prosthodontics, Stockholm County Council, Gotgatan 100, S-11662 Stockholm, Sweden.

**A modified flap design in exposing the palatally impacted canine—page 285**

The majority of impacted maxillary canines are found in the palate, with diagnosis and localization of the impacted canine usually made clinically and radiographically. Localization is important to determine the surgical approach and the relationship of the teeth in the area. This case report describes a seventeen-year-old Caucasian female.

Requests for reprints should be directed to Dr. Herbert Abrams, Department of Periodontics, College of Dentistry, University of Kentucky, Lexington, KY 40536.

**Radicular cysts of primary teeth mimicking premolar dentigerous cysts: report of three cases—page 288**

These three cases illustrate the necessity of careful evaluation of radiographs. Radiological signs that enable the clinician to differentiate the two are provided. The correct diagnosis of radicular cyst will lead the responsible clinician to perform the necessary conservative steps. These three cases also underscore the importance of close cooperation of pediatric dentist, radiologist, and pathologist.

Requests for reprints should be directed to Professor C.J. Nortjé, Department of Maxillofacial Radiology, Faculty of Dentistry, University of Stellenbosch, Private Bag XI, Tygerberg, 7505, Republic of South Africa.

**The curved-bristle toothbrush: an aid for the handicapped population—page 291**

When working with individuals who depend on others for their care, it is very important for the health-care provider to take the initiative to create or to investigate other devices that would be efficient and practical for both parties. The curved-bristle toothbrush, by its design, brushes the buccal, lingual, and occlusal surfaces simultaneously, in half the time required with a conventional toothbrush.

Requests for reprints should be directed to Ms. Nancy Johnson Williams, Assistant Professor, Department of Dental Hygiene, College of Allied Health Sciences, The University of Tennessee, 800 Madison Avenue, Memphis, TN 38163.

**Separation of fused primary incisors: report of case—page 294**

Requests for reprints should be directed to Dr. Deborah A. O. Himelhoch, 46 Waverly Street, Belmont, MA 02178.

**Triple teeth: case reports of combined fusion and gemination—page 298**

Requests for reprints should be directed to Dr. Aaron Trubman, Associate Professor, Department of Diagnostic Sciences, School of Dentistry, The University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216-4505.

**Scaphocephaly associated with other abnormalities: report of case—page 300**

Requests for reprints should be directed to Dr. Athanasios Athanasiou, Assistant Professor, Department of Orthodontics, Royal Dental College, Vennelyst Blvd., DK-8000 Aarhus C, Denmark.

**Timing of orthodontic tooth movement in a case with traumatized and avulsed anterior teeth—page 304**

Requests for reprints should be directed to Dr. Esther Gazit, Chairman, Department of Occlusion, The Maurice and Gabriela Goldschlege School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel.

# A national survey of sealant use by pediatric dentists

# Sealants

**Elaine Romberg, PhD**  
**Leonard A. Cohen, DDS, MPH, MS**  
**Ann D. LaBelle, DDS, MS**

**R**esearch has shown pit-and-fissure sealants to be safe, efficacious and potentially cost-effective. Despite these findings, acceptance by the dental profession has been slow. Little is known about the professional, scientific, social, and economic factors that might influence the pediatric dentist's decision to use sealants.

Numerous reports have examined the reasons for using or not using sealants among dentists in general. Gift, in 1973 and again in 1983, related non-use to lack of research support for sealants, the possibility of sealing in decay, uncertainty about the length of time sealants might be retained, and a preference for placing occlusal fillings rather than sealants.<sup>1,2</sup> A 1981 American Dental Association conference cited lack of sealant efficacy, the possibility of sealing in decay, the questionable cost-effectiveness of sealants versus amalgams, and patient resistance as reasons for not using sealants.<sup>3</sup>

Sealant use by pediatric dentists has increased substantially during the 1980s. A study reported at the 1981 ADA conference revealed that of sixty-two pediatric dentists surveyed, the majority favored amalgam restorations over sealants, because they were easier to place and were more cost-effective. Other objections related to sealants were problems with moisture control during application, patient and parent acceptance, lack of sea-

---

Dr. Romberg is Associate Professor, Dr. Cohen is Associate Professor, Departments of Oral Health Care Delivery and Educational and Instructional Resources, University of Maryland Dental School. Dr. LaBelle was a member of the faculty at the time of the study.

lant retention, cost-effectiveness, and development of carious lesions on sealed teeth.<sup>3</sup>

In 1981, pediatric dentists trained at the University of Michigan School of Dentistry were surveyed. Seventy-three percent of the respondents reported using pit-and-fissure sealants. The reasons cited for non-use were similar to those reported previously: preference for amalgams; lack of insurance coverage; need for more research; and the difficulty experienced with explaining sealants to patients and parents.<sup>4</sup>

Iowa pediatric dentists were also surveyed in 1981. Fifty percent of the respondents stated that they used sealants regularly while approximately 19 percent reported no use whatsoever. Reasons for not using sealants included lack of retention and the greater cost-effectiveness of amalgams. The strongest predictors of sealant use were attitudes toward sealants, preventive orientation, and the number of journal articles read.<sup>5</sup>

Members of the American Academy of Pediatric Dentistry were surveyed in 1984. Routine use of sealants was reported by 29.4 percent of the respondents, while 83.9 percent reported use at least some of the time. Factors identified with sealant use included fluoridation, caries level of the patient, individual tooth anatomy, and acceptance by patient and parents. Moisture control was cited as the most common reason for failure, by 85.5 percent. Eighty-one percent charged \$9.00 or more per tooth for sealants.<sup>6</sup>

A 1985 survey of pediatric dentists in Virginia found 97.1 percent of respondents were sealant users. Fifty percent reported use of a clear sealant material and the visible light curing method.<sup>7</sup>

The purpose of this study was to survey pediatric dentists nationally to determine their level of sealant use and to examine the factors that affected level of use. Since most previous studies had failed to quantify levels of sealants use, a goal of this research was to collect this more specific information.

## METHODS AND MATERIALS

A mail survey was utilized for data collection. From the sampling frame of members and nonmembers of the American Dental Association, the names of 591 practicing pediatric dentists, representative of the total population of practitioners stratified by geographic distribution and year of graduation from dental school, were drawn. In a companion study, 1193 general dentists were surveyed with the same instrument.<sup>8</sup>

The questionnaire was twelve pages in length with seventy-two items and numerous sub-items. It was infor-

mally pretested on a convenience sample of fifteen dentists, revised and then formally pretested on a random sample of fifty dentists drawn from the survey population. The final questionnaire was mailed in December, 1984. A reminder postcard and a follow-up mailing were used to encourage response. Finally, a random sample of thirty nonrespondents were sent a postcard that included nine key questions taken from the original survey.

The dependent variable in the study was the level of sealant use. Respondents were asked to estimate the percent of their patients aged eighteen and under who received sealants. Descriptive statistics were generated for all demographic data and all survey items. Chi-square was used to test for relationships between selected survey items and sealants use, categorized as low (0-10 percent), moderate (11-25 percent), or frequent (greater than 25 percent). Pearson product moment correlation coefficients were used to find the strength of the relationship between item responses and sealant use measured in percent.

After adjusting the original sample for nondeliverable questionnaires and ineligible respondents, the response rate to the survey was 61.2 percent (329/538). Response rate on the nonresponse postcard survey was 55.6 percent. Several tests were conducted to assess non-response bias. No significant differences were found between respondents and nonrespondents, in geographic location and year of graduation. In addition, no significant difference was found between respondents and nonrespondents for level of sealant use, percent of practice devoted to patients aged eighteen and under, or on an abbreviated scale made up of six of the most important items dealing with attitude, knowledge, and outlook.

This research was supported by a grant from the American Fund for Dental Health.

Table 1 □ Percentage of patients eighteen and under who received sealants (N = 321).

Number of patients	Percentage respondents
0	6.2
1-9	10.9
10-19	14.0
20-29	12.8
30-49	11.5
50-69	20.2
70-100	24.3

Table 2 □ Dentists' responses concerning attitudes toward sealants, in percentages.

	Strongly agree	Agree	Unsure or undecided	Disagree	Strongly disagree
1. Sealants are difficult to apply.	4.3	17.4	2.5	52.2	23.6
2. Pit-and-fissure sealants are of great value in reducing caries.	60.4	32.8	5.3	0.9	0.6
3. Sealants are not practical in the private office setting.	0.6	2.2	4.4	27.4	65.4
4. More effort should be made by the profession to increase the public demand for sealants.	42.3	39.8	10.5	5.6	1.9
5. More effort should be made by sealant manufacturers to increase the public demand for sealants.	32.4	32.7	18.8	10.5	5.6
6. The greater use of sealants by dentists may lead to an overall decrease in dental incomes.	5.6	18.8	26.9	34.6	14.2
7. The appropriate use of sealants by dentists offers the opportunity to maintain public confidence and trust in the dental profession.	35.9	51.7	9.3	2.2	0.9
8. Sealants are easy to sell to patients.	18.3	56.0	11.1	13.6	0.9
9. Sealants are not cost effective. Placing amalgams is more economical in the long run.	2.5	8.4	17.1	42.1	29.9
10. The greater application of sealants by dental auxiliaries may further erode the autonomy and professional image of dentists.	5.9	10.5	16.4	39.9	27.2
11. Dental hygienists can be easily trained to place sealants.	33.7	52.3	6.2	5.3	2.5
12. Sealants are as valuable as other preventive activities.	44.1	42.0	6.8	6.2	0.9
13. Dental assistants can be easily trained to place sealants.	28.8	45.5	12.1	9.3	4.3
14. Much more time is involved in applying sealants than amalgams.	2.5	7.7	5.9	48.5	35.5

## RESULTS

### Sealant Use

Nearly all respondents (96.9 percent) stated that they had tried using sealants in private practice. More than half (53.7 percent) of these respondents stated that they were either pleased or very pleased with their first sealant encounter and 93.8 percent of the respondents stated that they were still using sealants. The respondents were asked to quantify their level of use by estimating the percentage of their patients eighteen years of age or younger who received sealants (Table 1). In all, 55.4 percent of the respondents stated they used sealants on less than half of their patients aged eighteen and under. The average percentage of patients eighteen and under receiving sealants was 39.4 percent (Std. Dev. 26.26). The average length of time the respondents indicated they had been providing sealants on a regular basis was 6.3 years (Std. Dev. 4.26).

Those few respondents who reported no use of sealants were asked to rank the three most important reasons for not using sealants. Of the five most frequently cited first, second, or third choices, three dealt with the filling material and procedure itself:

- They do not last long in the mouth.
- Placing occlusal fillings is preferred.
- It is possible to seal in decay.

The remaining two categories dealt with cost:

- Not cost effective, when compared with amalgam restorations.
- Not reimbursable by prepayment programs.

### Decision-making factors

To begin to clarify the factors involved in the process of deciding to use or not use sealants, a number of variables

were examined. The respondents were asked which group would have the most positive influence on their decision to try a new material or technique. Four groups were most frequently cited as a first choice:

- Researchers/scientists (43.0 percent).
- Nationally known clinicians (15.3 percent).
- Professional colleagues (14.4 percent).
- Specialty associations (19.3 percent).

These groups also were the most frequently indicated as the top four second choices. No association was found between the respondents' choices regarding influence and their levels of sealant use.

The respondents were asked how they first learned about sealants. Four choices were most frequently indicated as the first source of information:

- Postgraduate dental program (26.5 percent).
- Journal article (25.0 percent).
- Undergraduate dental program (19.4 percent).
- Scientific meeting (15.4 percent).

No association was found between the sources of information and the respondent's level of sealant use.

Although only a few practitioners indicated that they did not use sealants, these non-users were asked to indicate the factor that would be the most important influence in their decision to try sealants (or try them again). Additional research (29.4 percent), insurance coverage (29.4 percent), parent request (23.5 percent), and ability to delegate sealants to an auxiliary (17.6 percent) were the choices indicated most frequently.

### Attitudes and knowledge about sealants

Practitioners, overall, expressed a positive attitude toward sealant use (Table 2). The items receiving the most support concerned the value of pit-and-fissure sealants in terms of caries reduction and the practicability of sealant application in a private practice office. The item



receiving the least support concerned the need for additional effort by sealant manufacturers to increase public demand for sealants. The effect of sealants on dentists' incomes, the effort of sealant manufacturers to increase demand, cost effectiveness of sealants versus amalgam restorations, and the effect of sealant placement by auxiliaries on the professional image of dentists, were the items for which the respondents expressed the greatest uncertainty.

On questions regarding insurance and third-party coverage, one-half (50.0 percent) of the respondents felt that an absence of third-party coverage had no influence on their frequency of sealant use (19.1 percent major influence; 30.9 percent minor influence). Over half of the respondents also felt that sealant procedures would be either very likely (22.0 percent) or somewhat likely (31.8 percent) to be abused, if they were covered by insurance.

Regarding the need for the profession to develop guidelines for sealants use, the majority of pediatric dentists (65.5 percent) felt that guidelines should be developed. There was a statistically significant association between the perceived need for guideline development and the level of sealant use, with the more frequent users more likely to feel that guidelines were unnecessary (Chi-Square = 10.14;  $df = 4$ ;  $p < .05$ ).

When respondent knowledge regarding sealants was examined, the majority answered correctly for nearly all items (Table 3). The percentage of unsure or incorrect responses indicated there was still some degree of confusion surrounding the facts about sealants. Pediatric

dentists were still concerned about sealing in decay (Item 2). Confusion about the retention rates of new materials existed. Approximately 40 percent of the respondents indicated that they were either unsure or answered incorrectly concerning new material-retention rates (Item 5). There was also confusion surrounding the longevity of sealant versus amalgam restorations (Item 9). Almost one-fifth of the respondents were unaware of the American Dental Association endorsement of sealants as a useful preventive measure (Item 4).

### Sealant awareness

The majority of respondents indicated that they were aware of continuing education courses available in their area for dentists (62.3 percent) and for assistants (51.8 percent). Less than half (41.4 percent) of the respondents and less than one-third (26.9 percent) of their auxiliaries had ever attended a continuing education course on pit-and-fissure sealants. Neither attendance at continuing education courses by the respondents or their auxiliaries was found to be associated with the level of sealant use.

The majority of respondents (84.0 percent) believed that sufficient educational materials on pit-and-fissure sealants were available. Nearly half of the respondents (46.8 percent) had noted a great deal and 47.1 percent had noted some advertising in professional journals. No association was found between level of awareness of advertising in professional journals and level of sealant use. Fewer respondents noticed articles in lay maga-

Table 3 □ Dentists' responses concerning knowledge of sealants, in percentages.

	Agree	Unsure or undecided	Disagree
1. As long as the sealant stays on the tooth, the sealed pit or fissure will not decay (agree = correct).	73.8	13.0	13.3
2. Sealants are somewhat risky because decay may be sealed (disagree = correct).	17.0	22.0	61.0
3. Loss of sealant is generally attributable to problems at the time of application (agree = correct).	83.4	12.3	4.3
4. The American Dental Association does not accept sealants as a useful preventive measure (disagree = correct).	1.5	16.6	81.9
5. Newer brands of sealants have better retention rates than do previous brands (agree = correct).	59.7	26.8	13.5
6. The current literature does not demonstrate that sealants are retained for very long (disagree = correct).	4.9	13.2	81.8
7. If the drinking water is adequately fluoridated, sealants aren't really needed (disagree = correct).	3.4	7.4	89.3
8. Newly erupted permanent molars are the most important candidates for sealants (agree = correct).	93.2	2.8	4.0
9. Research has shown that the average amalgam lasts at least three times as long as the average sealant (disagree = correct).	24.7	52.8	22.8
10. Sealants are most accurately classified as a restorative material (disagree = correct).	19.2	19.5	61.3

zines and newspapers. Only 16.0 percent reported to have noticed many lay articles, 74.5 percent a few, and 9.5 percent reported to have never seen an article on sealants in the lay press. The quantity of articles noticed in the lay press was positively associated with the level of sealant use (Chi-Square = 11.03;  $df = 4$ ;  $p < .01$ ).

Most pediatric dentists indicated that they did not feel that sealant products were vigorously promoted in their dental offices by dental-product representatives. This lack of promotion was not significantly associated with the level of sealant use. Nearly one-third of the dentists (31.3 percent) responded that at least one-half of their patients or parents exhibited prior knowledge or awareness of sealants during a discussion with them. Only 1.2 percent indicated that none of their patients or parents had prior knowledge of sealants. This prior patient knowledge of sealants was positively associated with the level of sealant use (Chi-Square = 10.43;  $df = 2$ ;  $p < .01$ ).

When asked to estimate the level of sealant use by private practitioners in their community, the majority of respondents (56.3 percent) felt that few or none of their general dentist colleagues were regular sealant users, while a majority of respondents (81.5 percent) felt that fellow pediatric dentists in their area were regular users. Estimates of their generalists colleagues' sealant use were not significantly associated with the level of sealant use of the respondent. The respondent's level of sealant use, however, was positively associated with their estimate of the pediatric dentist use in their community (Chi-Square = 16.63;  $df = 4$ ;  $p < .01$ ).

The vast majority of respondents believed that all four professional organizations were at least somewhat supportive of sealants. Most respondents demonstrated that they know the level of support and endorsement by the two pedodontist organizations: The American Society of Dentistry for Children (86.1 percent) and The American Academy of Pediatric Dentistry (87.0 percent). The respondents felt less sure of the level of endorsement of the NIH Consensus Development Conference (22.5 percent indicating do not know) and the ADA Council on Dental Materials, Instruments and Equipment (9.3 percent indicating do not know). A little more than half of the respondents (55.2 percent) perceived the ADA position to be very supportive. Only the responses regarding the position of the American Academy of Pediatric Dentistry were positively associated with the respondent's level of sealant use (Chi-Square = 9.7;  $df = 2$ ;  $p < .01$ ).

### Characteristics of sealant use

Pediatric dentists were divided into two groups based upon the year they reported first using sealants (in any setting). The year 1976 was chosen to represent the year that the newer generation of sealants (self-polymerizing) was first available. No significant difference in the current rate of sealant use was found among practitioners who first used sealants prior to 1976 and those who first tried them in 1976 or later.

There was a significant difference, however, in the level of satisfaction reported for the first encounter. Practitioners whose first encounter with sealants was reported to be after 1975 were more likely to indicate a positive level of satisfaction with their encounter than their colleagues who tried sealants at an earlier date (Chi-Square = 10.32;  $df = 2$ ;  $p < .01$ ). No association was found, however, between level of satisfaction with first encounter and current rate of sealant use.

When the level of patient and parent acceptance of sealants as a recommended preventive regimen was examined, a majority of respondents (67.2 percent) reported that "most" of their private practice patients and parents accepted their recommendation for sealants. Patient acceptance was positively associated with sealant use (Chi-Square = 63.57;  $df = 4$ ;  $p < .001$ ). Of respondents who indicated that most of their patients and parents accepted their sealant recommendations, 68.7 percent were frequent sealant users, compared to 48.6 percent for those who estimated that roughly half of their patients and parents accepted them, and only 3.2 percent for those who indicated that few of their patients accepted sealants.

The estimated mean time to place a single surface amalgam was 12.9 minutes (std. Dev. 5.91). The mean time estimated for a sealant was 7.1 minutes (Std. Dev. 3.99). Single surface amalgam placement was estimated to take longer, by 94.1 percent of the respondents. There was no significant correlation between the relative length of time estimated for sealant versus amalgam placement and the rate of sealant use. There was, however, a negative correlation between length of time for sealant application and sealant use ( $r = -.21$ ;  $p < .01$ ). The rate of use was slightly higher for respondents who took less time. The average fee for the placement of a single sealant in a permanent tooth by a pediatric dentist in private practice was \$15.30 (Std. Dev. \$5.30). Fees ranged \$1.00 to \$40 with the most frequent fee being \$15.00 (27.9 percent) followed by \$10 (16.3 percent). When multiple teeth were sealed, the mean fee for a single sealant dropped slightly to \$14.50 (Std. Dev.

\$5.72). The range of fees per tooth for multiple sealant applications was the same as for single sealant application (from \$1.00 to \$40.00). By comparison, the mean fee for a single surface amalgam charged by practitioners was \$26.50 (Std. Dev. \$6.37). The most frequent fee was \$25.00 (15.3 percent) followed by \$20.00 (12.3 percent) and \$30 (12.3 percent).

When queried regarding their preference for particular sealant physical properties, the majority (65.3 percent) preferred a visible light-cured system, followed by 30.0 percent who stated that they preferred an auto-polymerizing sealant material. Only 5.9 percent indicated that they preferred using a UV light sealant system. When asked to rank sealant system property characteristics which were most important to them, the type of activation system was the most important aspect of a sealant material (51.2 percent), followed by ease of handling (35.3 percent). These same two qualities were also chosen most frequently as second choices. The vast majority of respondents were using one of three products: (1) Delton (47.2 percent), (2) Prisma Shield (21.9 percent), and (3) Helioseal (20.3 percent).

#### Undergraduate dental school experience with sealants

Only one-fifth (20.1 percent) of the respondents stated that they were taught about sealants during undergraduate dental school. The undergraduate sealant experience was not found to be associated with the respondent's current level of sealant use. No association was found between the number of sealants applied in dental school and the respondents' current level of sealant use. When asked to rate clinical and classroom training, 82.3 percent of the respondents indicated that their clinical experience was either adequate or very adequate. Classroom training, however, was noted to be either inadequate or very inadequate by 35.4 percent of the respondents.

#### Auxiliary factors

More than one-third (39.8 percent) of the respondents' hygienists were formally trained in sealant application while in school, as compared to 15.0 percent of the dental assistants. Over one-half of the respondents indicated that neither their hygienists nor their assistants were formally trained in sealant application. More than three-quarters of the respondents felt that the auxiliaries who placed sealants in their offices enjoyed doing so. The following trend was noted: the respondents who

Table 4 □ Association between expressed degree of influence of insurance coverage on sealant use and sealant use.

Degree of influence	Percentage of patients receiving sealants		
	0-10	11-25	>25
Major influence	46.8	17.7	35.5
Minor influence	21.9	22.9	55.2
Does not influence	18.9	15.1	66.0

Chi Square 23.81; df 4; p< .001

indicated that their dental hygienist or dental assistant enjoyed using sealants appeared to be a more frequent user. Respondent's perception of whether their state dental practice act permitted the delegation of sealant application to either hygienists or assistants was found to influence positively the level of sealant use. Those respondents who said that their states permitted delegation were more frequent users (Chi-Square = 12.17; df = 2; p<.01).<sup>9</sup>

#### Impact of insurance

Nearly 20 percent of the respondents indicated that they felt that the lack of insurance coverage played a major role in their level of sealant use, while 30.9 percent felt it was a minor influence. The expressed degree of influence of insurance was found to be associated with current sealant use. (Chi-Square = 23.81; df = 4; p<.001). Nearly half (46.8 percent) of those respondents who said that the lack of insurance was a major influence were low users as compared with 18.9 percent of those respondents who said that the lack of insurance did not influence their sealant use (Table 4). Nearly one-quarter (23.2 percent) of the respondents stated that none of their patients insurance policies made provisions for sealant application reimbursement. The average percentage of patients' policies that covered sealant application was 11.4 percent (Std. Dev. 15.53). The percentage of patients with sealant insurance was weakly correlated with level of sealant use ( $r = .19$ ;  $p < .001$ ). Only 9.2 percent stated that Medicaid reimbursement for sealant application was available in their state. The availability of Medicaid coverage was not significantly associated with the level of sealant use.

#### Characteristics of dental practice

The preventive messages given most often to patients and their parents concerned the importance of oral health and brushing; the least frequent messages included discussion of fluoridated water, diet, and sealants (Table 5). The most frequent services provided were oral

Table 5 □ Percentages of patients receiving educational messages concerning caries preventive methods.

Educational messages	None	Some	Most	All
Importance of oral health	0.3	2.1	16.2	81.3
Brushing	0.6	0.9	17.5	81.0
Flossing	0.6	12.0	31.6	55.8
Fluoride dentifrices	1.9	12.9	25.1	60.2
Topical fluorides	0.6	6.5	20.4	72.4
Fluoridated water	4.1	28.5	24.8	42.6
Diet	0.6	23.1	31.2	45.2
Pit-and-fissure sealants	2.2	33.3	38.6	25.9

hygiene instruction and professionally applied topical fluoride; the least frequently provided services were sealants and home fluoride prescriptions (Table 6).

When asked what percentage of their time treating patients during a typical week was devoted to certain selected procedures, the respondents reported that the majority of their efforts were devoted to operative procedures (39.3 percent), followed by preventive (24.2 percent), diagnostic (20.5 percent), and orthodontic procedures (15.3 percent). Approximately one-third of the respondents (32.2 percent) worked with at least one other full-time dentist, while only 15.2 percent of the respondents worked with part-time dentists. The majority of respondents (61.4 percent) did not work with a full-time hygienist, but only 8.5 percent did not have a full-time, chair-side assistant available. The largest percentage of respondents (33.4 percent) employed two full-time assistants, while 25.5 percent employed one.

More than one-third (38.9 percent) described their practices as not busy enough, while 2.2 percent said they were too busy to treat all patients who wanted appointments. It was stated by 7.7 percent that they provided care to all who requested appointments, but their practices were overworked. A little more than half of the respondents (51.2 percent) stated that they provided care to all requesting it, but still their practices were not overworked. No association was found between the perceived level of practice busyness and the respondents' level of practice busyness and the respondents' level of sealant use.

The respondents were asked to estimate their net income from all private practice sources for 1983. Those who estimated they had made under \$30,000 encompassed 4.2 percent; between \$30,000 and \$50,000, 21.5 percent; between \$50,000 and \$70,000, 26.4 percent; and over \$70,000, 47.9 percent. No association was found between net income and level of sealant use. When asked to estimate their net income changes over the past year, those respondents reporting an increase in net income of more than 10 percent (25.8 percent) were generally more frequent sealant users than their colleagues whose incomes remained unchanged (25.2 percent) or had decreased by 5 percent or more (19.1 percent).

The greatest percentage of respondents (38.5 percent) practiced in large metropolitan areas with populations greater than 500,000, while the smallest percentage were located in rural areas (2.8 percent). No association was found between practice location and level of sealant use.

Table 6 □ Percentage of child patients receiving preventive services.

Preventive services	None	1-5%	6-10%	11-25%	26-50%	>50%
Professionally applied topical fluoride	1.2	1.2	0.3	0.3	1.8	95.1
Oral hygiene instruction	0.0	0.3	1.2	2.2	8.3	88.0
Pit-and-fissure sealants	4.6	11.1	9.9	15.4	23.8	35.2
Diet counseling	1.8	11.7	9.5	13.5	16.9	46.5
Home fluoride prescription	3.7	16.3	16.0	19.0	20.2	24.8

## Interaction with colleagues

The number of times in a typical month in which the respondents contacted a dental colleague for information or advice on dental matters was not associated with the respondents' level of sealant use. The number of times the respondents were contacted by their colleagues on dental matters was, however, found to be positively associated with level of sealant use (Chi-Square = 22.73; df = 4;  $p < .001$ ). Frequent sealant users represented 50.0 percent of the respondents who reported being consulted by their colleagues three times or less per month, compared to 60.3 percent for those respondents who stated that they were contacted seven or more times.

Trends also were noted for the number of times per month the respondents met with colleagues on a professional or a social basis. Of those respondents meeting three times or less on a professional basis, 54.0 percent were frequent sealant users, compared to 64.6 percent for those meeting four or more times. Similarly, of those respondents who met with colleagues on a social basis, three or less times per month, 53.0 percent were frequent users, compared to 65.9 percent for those who met with colleagues four or more times per month.

## Characteristics of patient populations

The mean percentage of patients, eighteen years of age or younger, who were personally treated by the respondents was 92.6 percent (Std. Dev. 18.45). When asked to estimate the distribution of their patient's family annual income, the resultant distribution showed 13.7 percent of the patients to have on the average, an income under \$10,000; 50.2 percent between \$10,000 and \$30,000; and 36.4 percent to have incomes over \$30,000. Percentage of families with incomes under \$10,000 was negatively related to level of sealant use (Spearman's Rho =  $-.13$ ,  $p < .01$ ) and percentage with incomes above \$30,000 was positively correlated with level of use (Spearman's Rho =  $-.12$ ,  $p < .05$ ). On average, the practitioners reported that 57.3 percent (Std. Dev. 18.95) of their patients are covered either fully or partially for dental services by private insurers. The respondents also indicated that 13.9 percent (Std. Dev. 15.30) of their patients have some form of public assistance that fully or partially covers payment for dental care services. Nearly three-fourths (72.7 percent) of the respondents indicated that the majority of their patients lived in communities with fluoridated water (either naturally fluoridated or adjusted). No association was found between the percent of patients with fluoridated drinking water and the level of sealant use.

## DISCUSSION

This study corroborated the increase in sealant use reported in the Rubenstein study, also conducted in 1985. Although virtually all pediatric dentists used sealants on at least some of their patients, the percent of child patients receiving sealant treatment was still low for a significant portion of the respondents. Level of pediatric dentist sealant use was higher than was reported by general dentists in the companion research completed at the same time as this study. While 68.9 percent of general dentists reported using sealants on at least some of their child patients, the percentage was 93.8 percent for pediatric dentists. The mean percentage of pediatric-dentist child-patients receiving sealants (39.4 percent) was significantly higher ( $t = 11.70$ ,  $p < .0001$ ) than the mean percentage of general-dentist child-patients (18.7 percent). Pediatric dentists' knowledge about sealants was significantly more accurate and their attitudes toward sealants significantly more positive than the general dentists' ( $t = 12.51$  and  $7.99$ , respectively,  $p < .0001$ ).

Fees for sealant placement in this national study were higher than those reported in the Jerrell study, published in 1984. No indication was given, though, as to when the Jerrell survey was administered, so it is difficult to determine whether the results of the two studies are in conflict or whether the difference is solely due to inflation. Mean fees, as reported in the companion study, charged by general dentists for sealant placement (\$13.50 Std. Dev. \$6.52) were significantly lower ( $t = 4.80$ ,  $p < .0001$ ) than mean fees charged by pediatric dentists (\$26.50, Std. Dev. \$5.30). Pediatric dentists, on the average, spent almost twice as much time overall (24.2 percent) with preventive procedures as did general dentists (13.8 percent,  $t = 9.56$ ,  $p < .0001$ ).

Analyses of the factors that led to the decision to use sealants and level of sealant use were not unexpected. Research, specialty association endorsement, colleagues, and nationally known clinicians were influential in decision-making. Undergraduate and specialty training, journal articles, and scientific meetings were the most frequent sources of information about sealants. Legality of delegation, insurance coverage, and patient acceptance were significantly associated with sealant use, so it was not surprising to find that non-users felt that additional research, insurance coverage, parental requests, and a change in state delegation laws might convince them to use sealants. Reasons given for not using sealants by the few pediatric dentists who did not use them continued to be similar to reasons reported earlier. In addition, the inaccurate responses made by a small number of respondents to the knowledge items in the survey were the same as the reasons given by non-users for not using sealants. One may wonder why these

few dentists have not seen recent literature, which should have allayed their concerns.

Education aimed at the practitioner and the patient might be effective in increasing sealant use. Since non-users appear not to have read about sealant efficacy in journals nor heard about it at scientific meetings, continuation of this strategy may not be productive in encouraging use by these non-users. Negative response to an item dealing with manufacturer efforts to increase the public's demand for sealants indicated that education of the public should not be primarily through this vehicle. Few respondents had noticed articles about sealants aimed at the general public, although those who had were more likely to be frequent sealant users. Despite this, most respondents reported that at least some of their patients were aware of sealants before discussion with the dentist and this previous patient knowledge was related to level of sealant use. Other vehicles for providing information about sealants to the practitioner and the public need to be developed.

In conclusion, almost all pediatric dentists reported using sealants on some of their patients, and a large percentage of practitioners were still using them infrequently. The variables, which were significantly associated with sealant use, included availability of insurance, ability to delegate, and patient acceptance. In addition, practitioners who were more aware of sealant issues were more likely to be frequent users. They were more aware of articles in lay journals about sealants, were more likely to estimate correctly the high level of use by their colleagues, and were more aware of pediatric professional association endorsements. They also tended to be professionally consulted by their colleagues more frequently.

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## Penetration of gel and solution etchants in occlusal fissures

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**T**he effectiveness of pit-and-fissure sealants for the prevention of occlusal caries is well-documented.<sup>1-3</sup> The sealant must remain intact and bonded to the enamel, however, to maintain its beneficial effect.<sup>4</sup> The basis for the sealant retention is the acid-etch technique, first described by Buonocore, who used a phosphoric acid treatment to create mechanical interlocks within the enamel.<sup>5</sup> Maximum surface area of etched enamel and a meticulous technique are necessary to ensure the retention of an effective sealant.

The longevity of the pit-and-fissure sealant is critical to its preventive effectiveness.<sup>6</sup> A factor that may affect the longevity of the sealant is the wear and abrasion of the sealing material. If the sealant is worn past the deepest point of the etch into the fissure, retention for the sealant is lost and it will fail. The integrity of the sealant, therefore, is crucial to the prevention of caries and this is directly dependent upon the etch of the acid-treated enamel.

Recently phosphoric acid etchant has been marketed in a gel form, with the distinct clinical advantage of better placement control. This control of application

reduces acid overflow onto gingival tissues and minimizes the accidental etching of adjacent tooth structure. These are extremely desirable features, especially when dealing with young children. Walker and Vann compared the acid-etch solution to the acid-etch gel on smooth enamel surfaces and reported a more uniform pattern of etch using the acid solution. The depth of the resin tag penetration and the shear strength of bonded orthodontic brackets were nearly identical, however, when comparing the two products.<sup>7</sup> Sheykhleslam and Brandt feel that using a viscous gel reduces the effectiveness of the acid.<sup>8</sup> They reason that the chemical reaction occurs at the enamel-acid interface, and the acid is gradually neutralized by the reaction by-products at this site. When using a viscous gel etch, the ability to keep fresh agitated acid at this interface is lost. In contrast, Brännstrom, in two separate studies, found no differences in the degree of surface irregularity, when using an acid solution or an acid gel.<sup>9</sup> He favored the use of the gel form due to the superior clinical handling qualities.<sup>10</sup> A recent investigation by Garcia-Godoy and Gwinnett compared liquid phosphoric acid and differing viscosities of gel etchants.<sup>11</sup> They reported no morphologically distinguishable differences at the occlusal site, when treated with various forms of phosphoric acid etchants.

Because of the thixotropic nature of the gel form of the acid, the ability to penetrate into the depths of the pits

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and fissures of permanent teeth is questionable. Furthermore, if the retention of the sealant is dependent upon the quantity of etched enamel, it is imperative that the surfaces are conditioned to a maximum depth into the pits and fissures. This study measured the ability of gel and liquid phosphoric acid etchants to penetrate into occlusal fissures.

## MATERIALS AND METHODS

Extracted mandibular molar teeth, free of obvious occlusal surface defects, were examined under a dissecting microscope to view the occlusal surface, and were discarded if decalcification, caries or other malformations were detected. The occlusal surfaces were cleaned using a water slurry of fine pumice and a rubber cup. Twenty teeth were sectioned through the facial-lingual groove, yielding twenty mesial and twenty distal specimens. The teeth were then sectioned through the cemen-toenamel junction, the apical portions were discarded, and the coronal portions served as the test samples (Figure 1). The mesial and distal groups were divided into two subgroups, resulting in four groups of ten samples. This controlled the variation in pit-and-fissure anatomy between the mesial and distal halves of the teeth. Before treating the samples with the etchant, a narrow slot was cut into the apical portion of the crown toward the occlusal surface using a carborundum disc (Moyco Industries, Philadelphia, PA). This slot was in the midportion of the sample, parallel to the facial-lingual groove, and allowed a clean fracture of the sample by inserting a wedge-shaped instrument into the prepared slot. The sample was fractured after the etching treatment. The fractured halves allowed a direct view of the depths of the central groove of each tooth. Each sample was thoroughly rinsed with water and dried, using an oil-free stream of air, before the etch-treatment. The specimens from one mesial and one distal group were treated with a 37 percent liquid phosphoric acid (Kerr Sybron, Romulus, MI) for fifteen seconds; the occlusal surface was kept constantly moist with the acid, which was applied with a small cotton pellet with a gentle dabbing motion. The acid was thoroughly rinsed for twenty seconds and dried with oil-free air for twenty seconds. The remaining mesial and distal specimens were treated similarly with a 37 percent gel phosphoric acid (Kerr Sybron, Romulus, MI). The specimens were then cleaved utilizing the previously described slot in the apical portion of the samples. They were prepared for scanning electron microscopy by placing the samples in a Nalgene Vacuum Desiccator, model 53-10, (Fisher

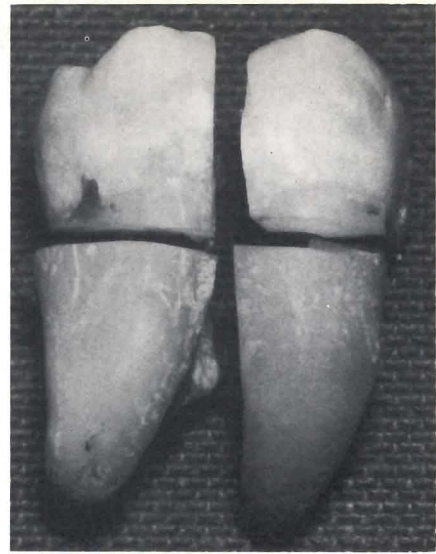


Figure 1. Photograph of sample sectioned in preparation for acid etch treatment.

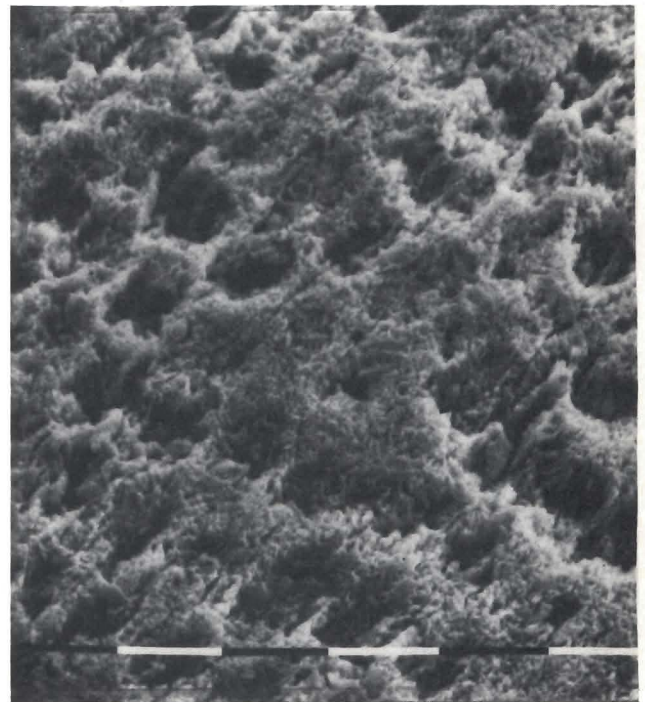


Figure 2. Characteristic etch pattern (1490x) (marker = 10 microns).

Manufacturing, Springfield, NJ) for a minimum of three days. Before viewing, the samples were sputtercoated with gold-palladium, using a Hummer 6 Sputtercoating unit (Anatech Ltd, Alexandria, VA). Each sample was viewed in a Phillips Scanning Electron Microscope, model 515, (Phillips Electronics, Mahwah, NJ). Each sample was viewed at 1550x magnification for adequate definition of the etch pattern and to standardize the measuring technique. The base of the central fissure was identified and a linear measurement made (in microns)



Figure 3. Common finding showing debris occluding the occlusal fissure (194x) (marker = 0.1 mm).

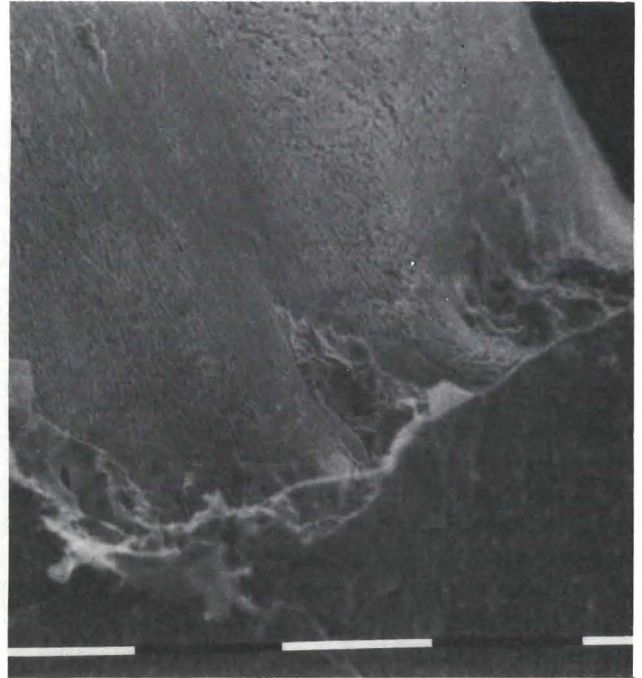


Figure 4. Treatment of sample with gel etchant showing partial blockage at base of fissure; however, there is complete penetration to base of fissure (194x) (marker = 0.1 mm).

from the terminus of the groove to the first demonstrable etch pattern as described by Silverstone.<sup>12</sup> Polaroid photographs were made of the Scanning Electron Microscope view of the samples, allowing a direct comparison of the specimens and providing a method for accurate measurements directly from the photograph.

## RESULTS

The raw data obtained were analyzed using a paired t-test. No statistically significant difference was found between the groups ( $0.5 < p < 0.8$ ). When the fissures were shallow and the removal of debris was complete, both forms of phosphoric acid penetrated to the base of the groove. Previous studies have described failure of complete acid penetration due to air entrapment.<sup>11</sup> The phenomenon was not noted in this study. The most significant impediment to complete penetration was debris that partially or completely blocked the orifice of the fissures. Some type and some degree of debris was noted in nearly every sample.

## DISCUSSION

There was no difference in the penetration into occlusal pits and fissures, when either the liquid or gel phos-



Figure 5. Sample treated with liquid acid etchant showing clean fissure and complete penetration to base of fissure (600x) (marker = 0.1 mm).



phoric acid etchants were used. The inability of the acid to penetrate a fissure completely was not dependent upon the form of the acid, but on the presence of debris within the grooves. If the efficacy of the sealant is dependent upon the integrity of the bond of the resin and enamel, it is critical to etch the enamel as completely as possible into the fissures of the occlusal surfaces. It would be desirable to have a uniform etch-pattern throughout the area being sealed to increase bonding sites. In the present study, a subjective assessment of the uniformity of the etch pattern was recorded (Table). The results of this study suggest that the liquid or the gel phosphoric acid agents are equally effective for use in pit-and-fissure surfaces, since each produces a similar etch-pattern and neither is effective in removing residual debris from the pits and fissures. Due to its superior clinical handling qualities, the use of the gel etchant is recommended when applying sealants. Further research is needed to find a method to clean more completely the residual debris from the fissures of the teeth, allowing complete penetration of the etching agent and the sealant materials.

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Table □ Summary of Data. Samples were measured from the deepest portion of the fissure to the first distinguished pattern of etch. Uniformity of etch pattern observed using a three point scale; + = uniform pattern throughout, 0 = pattern present but not uniform, - = no uniform pattern only patches of etched enamel observed.

I. Liquid Acid		II. Gel Acid	
A. Mesial group microns	uniformity	B. Mesial group microns	uniformity
1. 15	-	1. 0	0
2. 7	+	2. 15	+
3. 0	+	3. 5	-
4. 0	0	4. 0	-
5. 5	0	5. 0	0
6. 3	+	6. 15	0
7. 0	0	7. 0	0
8. 5	-	8. 5	0
9. 0	0	9. 5	-
10. 4	0	10. 0	+
Mean = 3.9		Mean = 4.5	
C. Distal group microns	uniformity	D. Distal group microns	uniformity
1. 5	0	1. 0	+
2. 10	0	2. 0	0
3. 6	-	3. 0	0
4. 15	-	4. 5	+
5. 5	0	5. 0	+
6. 0	-	6. 5	-
7. 3	-	7. 5	+
8. 0	+	8. 10	-
9. 5	0	9. 0	+
10. 0	0	10. 0	+
Mean = 4.9		Mean = 2.5	

Mean of the differences: 0.9

Standard deviation of the differences: 7.0255

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# The assessment of two dental anxiety rating scales for children

# Behavior

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A major problem encountered in studying anxiety lies in the quantification of this emotion.<sup>1</sup> Anxiety may be assessed by measurement of the physiological signs of anxiety; by projective techniques such as human figure drawing; by the use of questionnaires; by systematic observation; and by rating scales used by the subject or by an observer.<sup>2-13</sup> Perhaps the most consistently employed measure of behavior in dental settings involves the analysis of a child's overt behavior through the use of rating scales.<sup>14</sup>

The purpose of this study was to assess the validity and reliability of two published rating scales constructed for use by an observer assessing a child's level of anxiety in the dental surgery.

Because broad psychological symptoms can be evaluated in global, general assessments, one method of judging anxiety may be undertaken by observing the subject and trying to quantify the extent of his anxiety by instinct. People are constantly assessing other people from moment to moment during the normal conduct of human affairs and a fund of perhaps unjustified self-confidence exists for most observers, particularly those in the caring professions, such as dental surgeons.

The problem, from a scientific point of view, lies in the translation of behavior observed to provide an objective measure of anxiety. Observations may be systematized, however, by the employment of rating scales. In this method, the trained observer rates the subject's be-

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havior on several pertinent dimensions, which combine to produce a measure of anxiety. Freyd (1923) described rating scales, when used carefully and skillfully, as the only practical equivalents of objective measurement for many types of psychological phenomena.<sup>15</sup> A graphic scale freed the observer from quantitative terms in judging and gave the facility as fine a discrimination as the rater chose. It was quick, simple, easily scored, universal in application and demonstrated high test-retest correlations. Later Hamilton (1959) produced a five-point rating scale for anxiety.<sup>16</sup> Aitken (1969) also advocated the use of such scales, because although a person may appreciate precisely the selected dimension, words may fail to describe it exactly and thus continuous phenomena had to be graded in artificial categories.<sup>17</sup> He suggested that these problems could be overcome by using a visual analogue: a horizontally placed line, 100-mm long, with measurement to a resolution of 1 mm. The numerical data obtained were in a form that lent themselves to statistical analysis.

The visual analogue rating scales examined in the present study were the Complex and Simple Scales for the assessment of dental anxiety developed by Swallow and Sermet (1972).<sup>18</sup> The Simple Scale, based upon Aitken's Scale (1969) used a 100 mm line with terminal boundaries denoting anxiety and nonanxiety, while the Complex Scale, based on the work of Frankl *et al* (1962) used pairs of polar extremes denoting components of anxious behavior (Figure). In their study two observers together rated two groups of fifty children. In the first group, one observer used both scales, while the other used only the Simple Scale. For the second group both observers used only the Simple Scale. A high intercorrelation between the nine variables in the Complex Scale was suggested and also the summed scale related significantly with all nine scales. The Simple Scale correlated with the individual scales and also with the total score ( $r = 0.88$ ). They reported that with the Complex Scale there were interscale correlations in excess of  $r = 0.50$  for twenty out of the thirty-six possible pairs.

In addition, factor analysis of the data isolated two factors, with only the "talkative-quiet" scale having a factor loading of less than 0.5 with the total score of all ten scales. The Simple Scale correlated with the summed Complex Scale at  $r = 0.88$ .

Although the stated interscale correlation level of 0.50 satisfied Swallow and Sermet, this figure does not indicate a high level of shared variance between the scales (25 percent). It was suggested, nevertheless, that the Complex and Simple Scales were related and probably measured parallel responses, reflecting the child's reaction to dental treatment. Thus, their study identified this instrument as a potentially useful method of assessing children's anxiety in the dental situation.

Further investigation was still required to discover, whether these results could be replicated, and to examine the inter-rater and test-retest reliability of both scales.

Figure □ The boundaries of the Complex (1 to 9) and Simple (10) Scales for Rating Dental Anxiety. These are placed at the extremes of a 100 mm line.

1. Laughing	Crying
2. Noisy	Quiet
3. Docile	Tantrum
4. Curious	Withdrawn
5. Self-sufficient	Dependent
6. Cooperative	Uncooperative
7. Relaxed	Tense
8. Compliant	Cautious
9. Passive	Active
10. Low Anxiety	High Anxiety

A refinement for assessing observational techniques is offered by the use of video-recorded material. Allen and Evans (1968), for example, used video-tapes of patients for rating purposes and discussed the advantages of this method of collecting information.<sup>20</sup>

## MATERIALS AND METHOD

Technicians from the Audio-Visual Department of UCL School of Medicine were asked to collect video-recordings of forty children as they sat in the dental chair undergoing dental treatment in the Children's Department of UCL Dental Hospital. Each recording was to be in excess of two minutes duration. Subsequently the tapes were edited by the technicians to provide four separate tapes, each containing three-minute recordings of ten subjects.

The forty subjects contained in the tapes were fourteen boys and twenty-six girls: Mean Age, 7.69 years; SD, 2.87.

Rating was carried out in a quiet room, away from the clinic, viewing a standard monitor. The order in which the cases were viewed was chosen arbitrarily by the technician on each rating occasion, but they were always different. A tape ran for thirty seconds for each case, before the ratings were conducted. Ten cases were rated at a time, with a five-minute rest period between groups. There was no consultation between the observers about their ratings. Tape 4 had been used to practice the method on two occasions, before the trial group of thirty cases was viewed. The thirty cases were rated simultaneously by three observers (a dental surgeon and two experienced dental surgery assistants) with a test-retest interval of fifty hours. The scales were measured in millimeters from the left end of the line.

## RESULTS

### Interscale correlations within the complex scale

The correlations found (using Spearman's Rank Correlation Coefficient) were not as high as those of Swallow and Sermet (1972).<sup>18</sup> For example, with the dental surgeon's ratings: on the first occasion, only five; and on the second, only seven interscale correlations out of the possi-

ble thirty-six achieved the level of  $r = 0.50$ . There was a certain degree of stability, however, in the pattern of intercorrelations between the component scales across occasions. It could be seen that the 'Noisy-Quiet' and 'Curious-Withdrawn' scales had a considerable proportion of negative correlation, and this appeared to be reversed in the whole assessment. Certain scales showed a stronger relationship. These were "Cooperative-Uncooperative", "Relaxed-Tense", "Compliant-Cautious", and "Passive-Active".

### Correlation of scales in the complex scale with the simple scale

Five of the Complex Scale subscales correlated significantly, but not particularly highly, with the Simple Scale. These were "Docile-Tantrum", "Self-sufficient-Dependent", "Cooperative- Uncooperative", "Relaxed-Tense" and "Compliant-Cautious".

### Correlation of simple scale ratings

Examination of the Simple Scale ratings showed that each observer correlated more highly with his own ratings (median  $r = 0.56$ ) than with those of other observers, but that correlation on the whole was low, ranging between  $r = 0.20$  to  $r = 0.58$ , with median  $r = 0.43$ . The dental surgeon's ratings correlated at  $r = 0.54$ .

### Correlation of the summed complex scale ratings (scales 1-9) with the summed complex and simple scale ratings (scales 1-10)

As the scales of "Noisy-Quiet" and "Curious-Withdrawn" had been shown to tend to a negative correlation with the other scales, their scores were reversed before summation. When only scales 1-9 were summed, inter-observer correlations were not significant in all cases. When the sum of all ten scales was examined all the inter-observer and across-occasion correlations were significant to beyond the  $p = 0.01$  level with the correlations ranging from  $r = 0.48$  to  $0.95$  with a median of  $0.67$ .

### Factor analysis

In order to extract the most important dimensions from the Complex Scale, factor analysis was performed upon the summed rating of the Complex Scale and the Simple Scale ratings made by the dental surgeon on occasions 1 and 2, using principal component analysis (Table).

From this analysis three principal components were identified:

- Component 1 accounts for 36.9 percent of the variance on occasion 1 and has high loadings on scales 6 ("Cooperative"), 7 ("Relaxed"), 8 ("Compliant") and 10 ("Anxious"). On occasion 2, Component 1 ac-

Table □ Principal components matrix for combined complex and simple scales.

1st rating occasion			
Scale	Common 1	factor 2	loading 3
1	.08	.56	.37
2	-.16	.11	.91
3	.57	.25	-.24
4	-.07	.82	.07
5	.48	-.58	.38
6	.87	.15	-.02
7	.83	.09	-.11
8	.81	.12	-.08
9	.47	-.58	.17
10	.87	.17	.18
Percentage variance	36.9	18.0	12.5
2nd rating occasion			
Scale	Common 1	factor 2	loading 3
1	.23	-.51	-.56
2	-.40	.55	.42
3	.84	-.01	.23
4	.01	-.73	.46
5	.34	.27	-.47
6	.79	-.40	.04
7	.85	.03	.18
8	.85	.01	-.03
9	.62	.65	-.12
10	.83	.16	.21
Percentage variance	41.6	17.8	10.7

counts for 41.6 percent of the variance and the high loadings on these scales remain stable.

- Component 2 accounts for about 18 percent of the variance on both occasions. On occasion 1, scale 4 ("Curious"), and to a lesser extent scales 1 ("Laughing"), 5 ("Self-sufficient"), and 9 ("Passive") seemed to have the highest loadings on this component. This pattern is to some extent replicated on occasion 2, although the loading of scale 5 is somewhat reduced. Scale 9, however, appears to change the value of its loading relative to the other scales between the two occasions, thus making the interpretation of this component of somewhat dubious reliability very complex.
- Component 3 accounts for 12.5 percent and 10 percent of the variance, respectively, on the two occasions, and has a high load on scale 2 ("Noisy") on occasion 1; but again this is not stable on occasion 2.

Thus it appears that only component 1 is sufficiently reliable between occasion 1 and occasion 2 to be interpreted. Components 2 and 3 seem unstable and account for a relatively small proportion of the variance. The most likely interpretation of component 1 (by far the most significant component) is that it has high loadings on the scales that together may be said to represent "treatability", a finding that is echoed in the previous examinations of the interscale correlations of all the Complex Scales against the Simple Scale for all observers. This seems to indicate that the operator and his nurse equate a child's anxiety with his capacity to accept dental treatment. Components 3 and 4 are more difficult to interpret. Component 2 perhaps reflects some kind of

mood dimension, while component 3 seems very ambiguous.

These results indicate that the Complex Scales measure several different dimensions; but these dimensions are not particularly stable across occasions. Whether these dimensions are pertinent to the measurement of anxiety is an open question, but the results of the previous analysis indicate that the data yielded by these scales contain too much 'noise' (unaccounted-for variance) for systematic assessment of their construct validity to be made.

### GENERAL DISCUSSION AND CONCLUSIONS

This study set out to examine the test-retest reliability of the Complex and Simple rating Scales. From the data obtained, using non-parametric statistical analysis methods, it was found that the sum of the Complex Scale plus the Simple Scale ratings appeared to provide the most reliable measure of the children's dental anxiety. The overall correlations between the various scales were low, however, and thus the validity and pertinence to an underlying dimension of anxiety were suspect. It was found that the subscales of the Complex Scale relating to the "Cooperative, Relaxed, Compliant and Passive" dimensions showed a strong relationship. These qualities seem to indicate that the operator and his nurse equate the child's anxiety with its capacity to accept treatment, and thus it might be concluded that it is important for the child to be actually undergoing treatment, when the ratings are made. In addition the subscales of the Complex Scale representing "Noisy and Curious" appeared to be reversed in the whole assessment, which indicated that their contribution to the summed ratings should also perhaps be reversed.

In this study the ratings of the TV material were conducted after preliminary practice and discussion. The use of rating scales needs practice. Their very simplicity tempts inexperienced raters to embark on these studies and, as Oppenheimer (1966) warned, in untutored hands the procedure is useless.<sup>21</sup> Almost any rating system can easily be influenced by variables of which the rater is unaware. In the present study, dental

professionals set out to rate the child's anxiety in the dental chair and it is interesting to observe that their judgment was perhaps biased by their perceived need to actually carry out a dental procedure without the intrusion of unwanted disruptive behavior.

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<sup>21</sup>This paper is based on work and data submitted as part of a thesis for the Master in Dental Surgery degree in the University of London.

# Reinforced practice of children's cooperative behavior during restorative dental treatment

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The management of disruptive children receiving dental treatment has long represented a special challenge to dentists. A national survey found that dentists cite the noncompliant child among the most common problems they face in clinical work.<sup>1</sup> In fact, the difficulties and risks that result from attempting to provide dental care to uncontrolled children can be so stressful that some dentists refuse to include children among their patients.<sup>2</sup> For example, a child who is disruptive or noncompliant while receiving restorative dental treatment may increase the likelihood of their own injury, increase the intrusiveness of the procedures, delay or render impossible the completion of treatment, or disrupt the concentration of the dentist, thereby interfering with the quality of his work.

Several procedures have been developed to manage the disruptive behaviors of older (ages 5+) children. These include the use of information, filmed models, live models, distraction, and reinforcement.<sup>3-8</sup> Few studies, however, have investigated procedures for man-

aging children as young as three years of age, who are often the most difficult to manage. Many consider these children to be precooperative.<sup>9</sup> That is, they are thought to lack the capability to behave cooperatively, because they are so young. As a result, more restrictive procedures such as oral premedication are often used in the management of extremely uncooperative or "uncontrollable" young children. Unfortunately, children frequently require more than five hours following sedation before they become fully alert again and some may experience nausea and vomiting.<sup>10</sup> Some dentists are forced to use physical restraint to manage these children, which may include the use of belts, vinyl straps, towels and tape, or "wrapping the child in a mummy-like fashion."<sup>11,12</sup>

It may be, however, that the disruptive behaviors exhibited by these young children are a function of stimuli contacted during the dental visit.<sup>13</sup> For example, some of the sensations experienced during restorative treatment (e.g. the pinch from the injection, vibrations from the drill, the tightness of the rubber dam clamp), may be unpleasant. The sights and sounds of the dental operatory, through pairings with these unpleasant sensations, may become signals for acting in ways that, in the past, have permitted the child to escape similar uncomfortable situations. The dentist and/or dental assistant may then spend several minutes restoring order

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so that dental treatment may continue. Successful escape during restorative dental procedures, even if the escape is only temporary, along with attention provided by the dentist and dental assistant could maintain these disruptive behaviors. If this is true, then it might be possible to use similar conditioning procedures (i.e., temporary escape and attention) to develop more cooperative behaviors, even in very young children. This paper describes an investigation of the use of both escape and reward procedures as a preparation toward improving the cooperative behavior of young, difficult to manage children during dental treatment.

## METHOD

### Subjects and setting

Hayne and Kathleen, both thirty-six months old, were referred because of excessive disruptive behavior during restorative dental treatment. Both children were physically aggressive with staff (e.g., pinching, grabbing, and kicking) and required restraint throughout most of the treatment visit. Previous attempts at managing the children with prizes and distraction had not been effective. The procedures, possible discomforts or risks, as well as possible benefits were explained fully to the children's parents, and their informed consent was obtained prior to the investigation.

Treatment visits were conducted at a University Pediatric Dental Clinic. The operatory was a 3m by 3m room equipped with a dental chair, dental equipment, and decorative posters and mobiles.

All dental work was provided by the fourth author (D.A.N.) and his dental assistant.

### Dependent Measures

#### DISRUPTIVE BEHAVIORS

Four categories of disruptive behavior were observed and scored within 15 sec intervals and included head movements, body movements, crying and complaining, and body movements requiring physical restraint.<sup>5</sup> This continuous recording procedure allowed for an intensive assessment of each child's behavior throughout dental treatment.<sup>14</sup> Psychology students were trained on the code. Two observers began scoring when the dentist was both looking at and touching the mouth of the child.

#### DENTAL PROCEDURES

Six dental procedures typically observed during a restorative dental visit were scored: The use of an explorer,

anesthetic injection, rubber dam placement, drilling, the use of air/water/suction, and restorative procedures. A procedure was scored when an instrument was inside or touching the child's mouth at any time during the 15 sec interval. Dental procedures were scored simultaneously with the disruptive behaviors by the same observers.

#### RATING SCALES

Two six-point rating scales were developed with and then used by the dentist and dental assistant to evaluate the children's cooperativeness and anxiety during the dental procedures. The children were rated from 1 (extremely cooperative or relaxed) to 6 (extremely uncooperative or anxious). The dentist and assistant rated each child within 20 sec after the dentist's entrance, and after injection, drilling, restoration, and the end of the visit (reflecting the entire visit).

#### Reliability assessment

Throughout this investigation, interobserver reliability was assessed on all measures for 83 percent of Hayne's sessions and for 85 percent of Kathleen's sessions.<sup>14</sup> The occurrence reliabilities calculated for Hayne and Kathleen's disruptive behaviors averaged 90 percent (range of 75-99 percent). Procedural reliability averaged 98 percent (range of 96-99 percent). Reliability on the scoring of dentist and dental assistant ratings was 100 percent. Correlations between the dentist's and the dental assistant's ratings for each child were between 0.75 and 0.85.

#### Procedures

Each child's restorative visits were scheduled with one to two weeks between appointments and lasted approximately 15 to 60 min depending on the restorative work required and the severity of the disruptive behavior of the child.

#### BASELINE

Procedures during baseline were those typically followed at the clinic. The dentist and/or dental assistant explained procedures and the sensations that the children might experience. The dentist and assistant praised the child for cooperative behavior and/or remaining quiet. At the end of the appointment the children were given balloons and trinkets of their choice regardless of their behavior during the appointment.

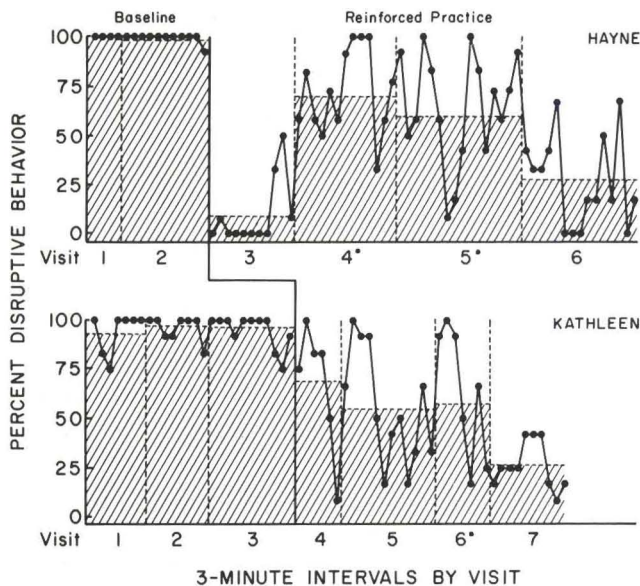


Figure 1. Percent of children's disruptive behavior in 3 min blocks during each restorative dental treatment visit. Shaded areas indicate mean disruptive behavior per visit. Asterisks indicate visits in which the criterion for reward delivery was not met.

### REINFORCED PRACTICE

During the reinforced practice condition, the children were brought into the operatory individually and told by the first author that they would have the opportunity to practice being a "big helper" for the dentist by using "good dental chair behaviors". These behaviors were described as lying still (with the hands either at the side or folded across the chest) and remaining quiet during the visit. The children were then told that they should practice these before the dentist entered and that they would be rewarded for being "big helpers" with the removal of the instruments being used and temporary delay of the procedure in progress. For example, when practicing with the drill, the drill was turned on and moved gradually closer, then moved in and around the child's mouth, and removed after, and only after, the child demonstrated the required duration of cooperative behaviors. The amount of time the child was required to be still and quiet before being rewarded was gradually increased from a few seconds until the child was able to remain quiet and still for 30 sec while undergoing each procedure.

During practice with the dental procedures, cooperation was also rewarded with praise and "big helper" stickers for doing a good job. Small inexpensive stickers were used and placed on a colored index card with a

picture of a pie divided into five pieces. The index card was attached to the dental light where the child could easily see it. When the card was filled with stickers, it was replaced and given to the child.

During practice, none of the actual restorative work was performed. To ensure the safety of the child, the drill bit and the needle of the syringe were removed during practice. The practice procedures were arranged so that practice typically began with a procedure the children were likely to master easily (e.g., explorer). Practice then continued with one of the most difficult procedures (e.g., injection or rubber dam) to increase the salience of the escape contingency. Once this dental procedure has been mastered, the remaining dental procedures were practiced in the order in which they would occur. In addition, some of the instruments were presented simultaneously as they would be during actual treatment.

Following the practice procedures (which ranged in duration from 15-30 min), the children were shown an assortment of age-appropriate, inexpensive toys (all cost less than \$.50). The children were told that by being very quiet and still during dental treatment they could earn any one of the toys. The children earned the toy, if they exhibited a 15 percent improvement in cooperative behavior over the previous visit or if overall, their disruptive behavior was less than 30 percent. The 30 percent criterion was selected based on a report that dentists they studied considered less than 30 percent disruptive behavior as acceptable.<sup>6</sup> If the children did not meet the specified criterion, they were told that the toy and sticker filled cards would be held until next week, when they would have to try harder to be big helpers by using more of the good dental-chair behaviors.

### Experimental design

A multiple baseline design was used to evaluate treatment effectiveness. The practice procedures were introduced sequentially across subjects after varying amounts of time in dental treatment (48 min and 78 min) and number of visits in baseline (2 and 3 days), to show that the behavior changes occurred only after the introduction of reinforced practice procedures rather than at any time before the introduction of the intervention.<sup>15</sup>

### RESULTS

#### Disruptive behavior

Hayne and Kathleen's disruptive behavior during restorative dental treatment are presented in Figure 1.



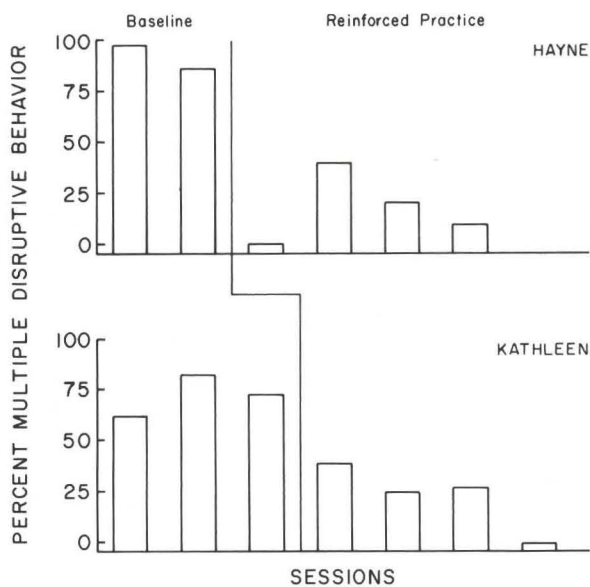


Figure 2. Mean percent of children's multiple disruptive behavior (intervals in which more than 1 disruptive behavior was scored) during each restorative dental treatment visit.

During baseline, Hayne exhibited an average of 99 percent disruptive behavior. More than one class of disruptive behavior could occur in any given interval, and the percentage of intervals involving multiple classes of disruptive behavior are presented in Figure 2.

Ninety-three percent of the intervals during baseline involved multiple disruptive behavior and almost 96 percent of all those intervals involved restraint. Because of Hayne's high levels of multiple disruptive behavior, two visits were devoted to practice before resuming actual dental treatment. During the third practice visit, however, Hayne was able to meet the 30 sec criterion of cooperativeness for each of the procedures. During Hayne's first treatment visit following the reinforced practice, he exhibited only 9 percent disruptive behavior. In addition, multiple disruptive behaviors during this visit were reduced to 0 percent. By the end of Hayne's dental treatment, his disruptive behavior was below the 30 percent success criterion and his multiple disruptive behaviors were reduced to less than 10 percent with no occurrences of restraint.

Kathleen exhibited an average of 95 percent disruptive behavior during baseline and an average of 73 percent multiple disruptive behavior. Following reinforced practice prior to dental treatment, Kathleen's disruptive behavior was reduced to 68 percent and then 55 percent during her first two treatment visits, respectively. Then at her third treatment visit, her disruptive behavior increased to 63 percent and she did not meet criteria for receiving the stickers and prize. On her last treatment visit, however, her disruptive behavior was reduced to 26 percent and her multiple disruptive behavior to 0 percent.

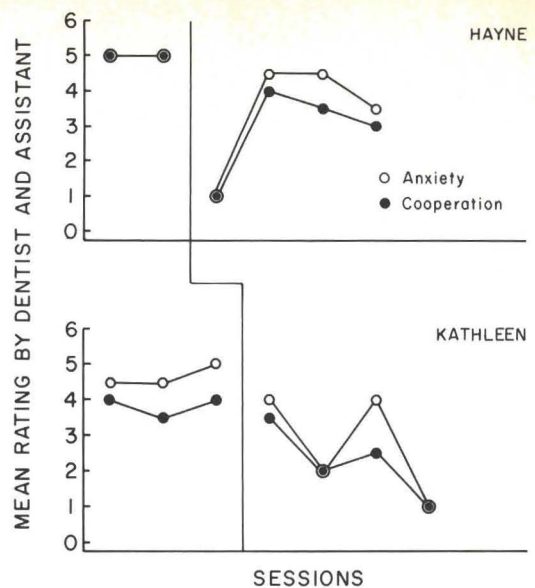


Figure 3. Mean rating by the dentist and dental assistant of each child's cooperativeness and anxiety during each restorative dental treatment visit.

### Ratings

Ratings of Cooperativeness and Anxiety by the dental professionals for each child are presented in Figure 3. Baseline ratings of both cooperation and anxiety were typically above a 4 (i.e., very anxious and very uncooperative) for both children. Ratings after the introduction of reinforced practice showed a generally decreasing trend. Ratings of cooperation and anxiety were 3 (i.e., cooperative and relaxed) or below at the final treatment visit. Note the correspondence between changes in disruptive behavior and those in the ratings of the dental professionals. Correlations between the ratings and disruptive behavior were 0.85 for cooperation and 0.75 for anxiety.

### DISCUSSION

A procedure in which very young children were reinforced for practicing cooperative behaviors prior to actual dental treatment was shown to be effective in reducing frequent and violent disruptive behavior. Extremely high baseline levels of disruptive behavior, averaging greater than 95 percent were reduced to levels less than 30 percent, while the occurrence of multiple disruptive behaviors were almost completely eliminated. These reductions in disruptive behavior were reflected in the ratings by dental professionals who judged the children as more cooperative and relaxed.

A factor which may have contributed to the effectiveness of the procedure, was the delivery of prizes following actual dental treatment. Both Kathleen and Hayne had visits in which their disruptive behavior was too high for them to receive their prizes. Interestingly, following those visits, the children were able to meet the criterion for earning their selected prize. While prizes by themselves have been shown to be insufficient to produce acceptable changes in young disruptive chil-

dren, it may be that losing the prize once or twice enhanced the effectiveness of the reinforced practice during subsequent treatment visits.<sup>16</sup>

The fact that the dental professionals were not blind to the nature of the treatment, or even to the fact that a child had been exposed to treatment, presents some problems. The dentist and his assistant were not aware, however, of how the children performed on the direct observation measure of disruptive behavior. The high positive correlations between their ratings and these direct observations would seem to indicate the sensitivity of their ratings to actual changes in disruptive behavior, rather than to the introduction of an intervention. Thus, the ratings provided by the dental professionals provide a validation of the procedure: they saw two disruptive young children as more relaxed and cooperative.

While formal follow-up observations were not conducted, a cooperation rating was provided by Kathleen's family dentist, nine months following completion of the study. He indicated that Kathleen had been a "very cooperative patient", and gave her a rating of 2 on the cooperation rating scale. We also received information that the treatment effects may have generalized to a nondental setting when Hayne's pediatrician remarked that Hayne had become "remarkably more cooperative during routine exams".

The results indicate that several practice sessions involving the reinforcement of cooperative behaviors may be needed before very young, very disruptive children become manageable during dental treatment. For example, Kathleen's disruptive behavior did not fall below the 30 percent criterion until her fourth intervention visit and, although Hayne reached acceptable levels on this first intervention visit, he was seen on two previous occasions for practice. Given these children's extremely high levels of initial disruptive behavior, this was not entirely unexpected. In another study investigating the treatment of a dental phobic four-year-old, eight consecutive weekly sessions were conducted before treatment was completed.<sup>17</sup> While it is not unusual for positive treatment techniques to require more time than restrictive techniques involving medication or restraint, positive methods such as the reinforced practice have few, if any negative side effects and the results are often maintained over longer periods of time. In addition, rather than attempting to suppress negative or undesirable behavior, a procedure such as the reinforced practice teaches children acceptable ways of responding, while at the dentist.

Although the procedure required additional preparation time, beyond that involved in the actual dental treatment, the results were pleasing to the referring dentists and the monetary costs were minimal. Because

of the severity of these children's disruptive behavior, the treatment was developed in a manner believed most likely to result in acceptable improvements. Clearly, further study is needed to determine the minimum amount of time necessary to produce and maintain acceptable behavior. The reinforced practice procedure does appear, however, to offer a much needed alternative to the more restrictive means of managing such young "precooperative" children. For many dentists (and children) we suspect that the time invested in building acceptable behavior early in the child's dental treatment experiences may make future dental treatment much more likely, pleasant, and successful.

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## Radiographic assessment of temporomandibular joint pain and dysfunction in the pediatric age-group

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**P**ain and dysfunction of the temporomandibular joint (TMJ) are common in the adult, but little is known about the possible existence of internal derangements in the pediatric age-group of sixteen years and younger. The most common TMJ symptoms observed are pain, muscle tenderness, headaches, limitation of jaw opening and/or clicking or crepitus.<sup>1-5</sup> Epidemiologic studies have evaluated symptoms, but very few have related these symptoms to the presence or absence of internal derangements related to meniscal displacements.<sup>6-8</sup>

The purpose of this clinical study is to demonstrate the various types of internal derangements we have observed in individuals of sixteen years and younger.

### CLINICAL MATERIAL AND METHODS

Over the last five years, 150 patients of average age fourteen years (range seven to sixteen years) were referred to Diagnostic Radiology at the Strong Memorial Hospital with signs and symptoms suggestive of internal derangement. There were 131 girls and 19 boys for a female:male ratio of 6.8:1. Most of the patients complained of pain, muscle tenderness, headaches, and/or clicking, or limited movement of the jaw.

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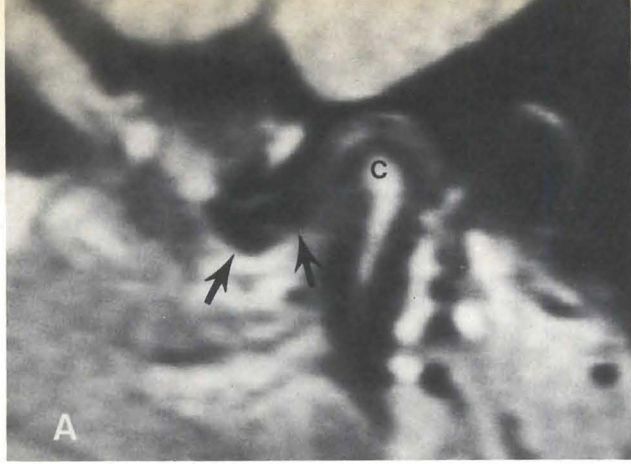
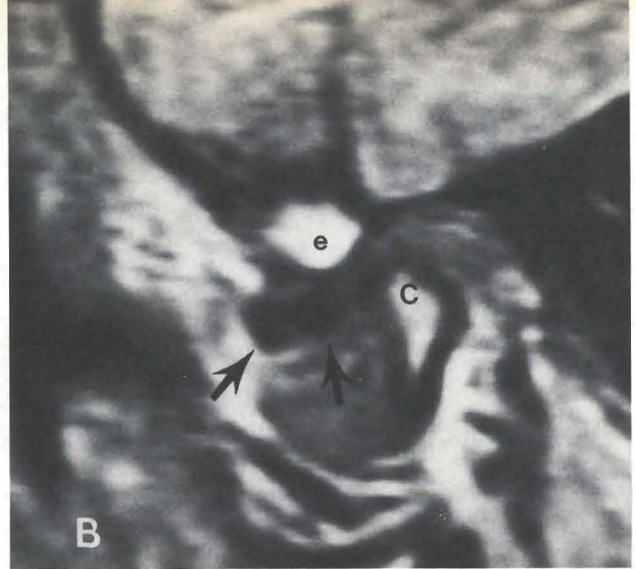


Figure 1. MR examination of a twelve-year-old female with a diagnosis of meniscal displacement without reduction.

A. Sagittal MR scan through the TMJ with the jaws in the closed position. The meniscus (arrows) is shown in a displaced, anterior position relative to the condyle (C).



B. This is the MR scan in the same patient with the jaws in the maximally opened position. The meniscus (arrows) remains displaced anterior to the condylar head with attempted maximal jaw-opening. Note that the condyle does not translate to the apex of the articular eminence (e).

Of the 150 patients, 114 were examined by arthrography of one or both sides as indicated.<sup>9</sup> Multidirectional hypocycloidal tomograms of both TMJs were obtained before arthrography, in all cases. Tomographs were performed with the head in a lateral position and with the jaws in the closed and then in the opened position. A focal spot of 0.3 mm was used with an average section thickness of 3 mm. These radiographs were reviewed for evidence of bone abnormalities. Radiographic evidence for arthritic change included erosion, eburnation, fragmentation, flattening, and/or osteophytosis. Following tomography, the symptomatic joint or joints were studied by arthrography and/or arthrotomography as described previously.<sup>9</sup>

Twenty of the 150 patients were examined by computerized tomography (CT) using a GE 8800 CT/T scanner.<sup>10</sup> Scans were obtained in the direct sagittal position with the jaws closed and open, using a bite block for the open-mouth images. Section thickness was 1.5 mm with 20 contiguous sections extending from the medial to the lateral condylar poles (256 mAs, 120 Kvp) and with both bone and soft-tissue settings. The images were first evaluated at the soft tissue settings to determine meniscal position and then at the bony settings designed to optimize bone detail for the assessment of degenerative arthritis.

Sixteen patients were examined by magnetic resonance using a GE 1.5 Tesla Signa system with the body coil as the transmitter and with a 6.5 cm diameter TMJ surface coil placed over each TMJ region as the receiver. Eight 3-mm contiguous sagittal images of both TMJs were obtained with the jaw in the closed position. Scanning factors included a TR (repetition time) of 1000 msec using a partial saturation or spin echo pulse sequence (20/40 msec TE; 2 averages; 256x256 matrix). Imaging time for this sequence was 8 min and 36 sec. Localization of three optimal closed-jaw, sagittal-imaging planes were selected for a repeat of these imaging planes, when the jaws were in the opened position using a syringe as a

bite block. For the opened jaws images, a partial saturation pulse sequence with a TR of 600 msec (25 msec TE; 256x128 matrix) was used. Imaging time for this sequence was 2 min, 36 sec.

The patients' findings were divided into three subgroups based on the assessment of the soft-tissue anatomy as previously described:<sup>9</sup>

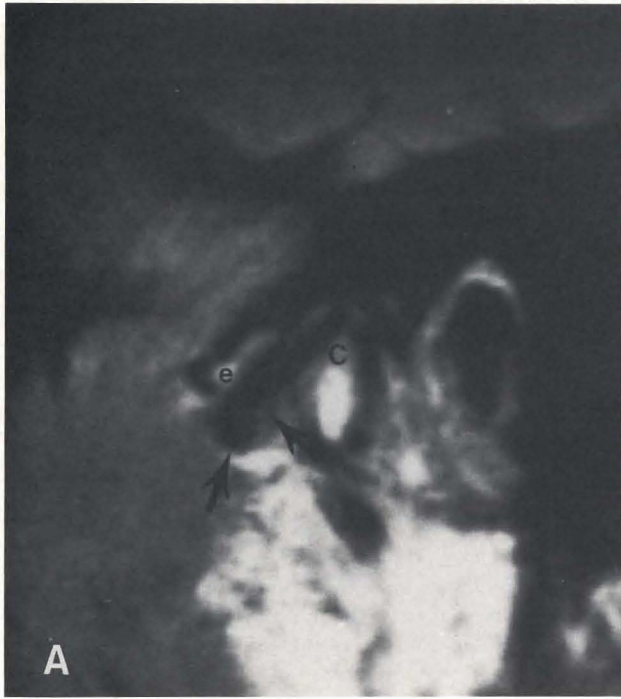
- No internal derangement: The meniscus is superior to the condyle with the jaws closed and is interposed between the condyle and eminence of the temporal bone, when the jaws are opened.
- Meniscal displacement with reduction (MDR): The entire meniscus is anterior to the condyle but reduced, when the condyle moves forward, associated with an audible or palpable click.
- Meniscal displacement without reduction (MD): The meniscus is anterior to the condyle and does not reduce, when the condyle moves forward, and this is often associated with meniscal perforation or detachment.

## RESULTS

One hundred fourteen patients (76 percent; 147 joints) were studied by arthrography, 20 patients (13 percent; 30 joints) by CT and 16 patients (11 percent; 32 joints) by MR.

Of the total number of patients studied, 37 percent (56/150) showed evidenced for degenerative arthritis of one or both sides (8/150; 12 percent with bilateral degenerative changes).

One hundred and twenty-eight of the 150 (85 percent) patients showed evidence for an internal derangement of one or both sides. Of the 209 joints studied, ninety-seven showed meniscal displacement without reduction (Figure 1 A,B); seventy-four showed meniscal displac-



ment with reduction (Figure 2 A,B); and four showed ankylosis secondary to severe mandibular trauma. Thirty-four of the 209 joints evaluated showed no evidence for internal derangement.

## DISCUSSION

This clinical study demonstrates that internal derangements and degenerative arthritis do occur in the pediatric age-group. The surprisingly high occurrence of internal derangement and degenerative joint disease suggests reluctance by the clinician for an imaging assessment. The advent of magnetic resonance, which is noninvasive and simple to perform, should minimize this past reluctance.

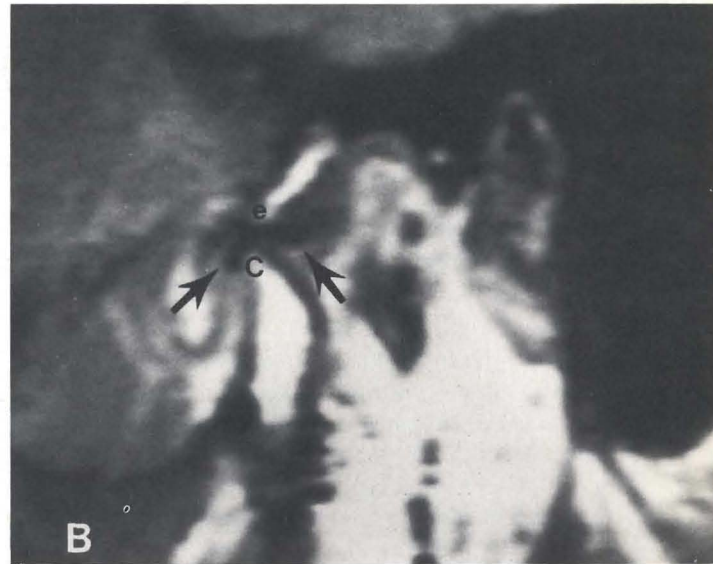
Epidemiologic studies in pediatric populations have demonstrated that subjective signs and symptoms of TMJ internal derangements are present at an early age.<sup>1-6,13-18</sup> Description of signs and symptoms from previous studies demonstrate clicking, muscle tenderness, headaches in the area of the TMJ; all of these suggest the possibility of internal derangements. None of these prior investigations examine the status of the soft-tissue elements of the TMJ. Katzberg investigations examine the status of the soft tissue elements of the TMJ. Katzberg *et al*, however, demonstrated the possibility of internal derangements in the pediatric age-group in a small number of patients, emphasizing the likelihood of pathologic findings in the symptomatic subjects in this age-group.<sup>12</sup>

Degenerative arthritis is commonly associated with internal derangements.<sup>19-22</sup> The current study also demonstrates a high likelihood of degenerative joint disease in patients of the pediatric age-group presenting with evidence for internal derangements. The findings in this

Figure 2. This is the MR exam in a fourteen-year-old patient presenting with painful clicking of the TMJ.

A. This is the MR scan with the jaws in the closed position. The meniscus (arrows) is displaced anterior to the condyle (C).

B. This is the open jaw position for this fourteen-year-old patient and after the occurrence of the opening clicking sound. The MR scan now shows the meniscus (arrows) in a recaptured (normal) position relative to the condylar head (C) and articular eminence (e). Thus, the findings are of meniscal displacement with reduction associated with pain and an audible opening click.



investigation are similar, furthermore, to those of an earlier investigation.<sup>12</sup> The occurrence of degenerative changes is of a higher percentage compared to the figures of Anderson and Katzberg (28 percent) in the adult population.<sup>19</sup>

Bilaterality of internal derangements should be suspected, but very few studies have documented this. Katzberg *et al* reported that 26 percent (8) of the patients in his sample had bilateral arthrograms, three patients had bilateral MD, three had bilateral MDR, and two had MDR in one side and MD in the contralateral side.<sup>12</sup> Manco *et al* reported that 173 adult patients had bilateral meniscus displacement, 193 had unilateral disease, and 88 were bilaterally normal.<sup>23</sup> In our sample, a third (49) of the patients had bilateral studies: 16 percent (8) of the patients were bilaterally normal, 24 percent (12) had unilateral disease, and 60 percent (29) presented bilateral disease of the TMJ. Of those twenty-nine patients affected bilaterally, 15 (52 percent) of the patients showed MD, eight (28 percent) had bilateral MDR; and six (20 percent) presented with MD on one side and MDR on the contralateral side.

Nilner (1981), Egermark-Eriksson *et al* (1981), demonstrated the presence of subjective and objective symptoms in children.<sup>6,8</sup> Dibbets (1977) pointed out that DJD is present in these young populations.<sup>24</sup> He reported an

incidence of degenerative joint disease of 16 percent at the initiation of this study that had increased to 24 percent at the end of a ten-year period.<sup>24</sup> The incidence was higher in females. The presence of clicking and locking, which may lead to degenerative changes, emphasizes the need for early evaluation of children presenting with symptoms of TMJ dysfunction.

MR imaging can be easily performed, is noninvasive, and accurate for the assessment of internal derangements.<sup>25</sup> Earlier recognition of signs and symptoms of internal derangements in children and adolescents should permit earlier treatment regimens or prevention. Reluctance of the clinician to study symptomatic or high-risk, pediatric patients should be alleviated by the technological sophistication and safety of magnetic resonance.

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# Ectodermal dysplasia with partial anodontia: prosthetic treatment with implant fixed prosthesis

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**E**ctodermal dysplasia has been reported in the dental literature over a period of many years. The management of the ectodermal dysplasia patient was discussed by Nortje, Farman *et al* and by Album, who reported a case with a four-year-observation period.<sup>1,2</sup> The facial features are consistently similar, and patients usually exhibit a smooth dry skin, and because of a partial or complete absence of sweat glands, are unable to perspire—and suffer, therefore, from hyperthermia. The sebaceous glands and hair follicles are often defective or absent. The hair of the scalp and eyebrows tends to be fine and blond. Fine lanugo hair may persist into adult life.

Dental findings may consist of total hypodontia of either the primary or permanent teeth. Cone-shaped teeth frequently occur. The maxilla and mandible grow independently and develop to normal size and shape. The presence of teeth produces alveolar thickness and has no influence on the growth and development of the jaws, which in these patients are normal. The absence of salivary glands is not a common finding, and most patients do not complain of xerostomia.<sup>3</sup>

The principle aim of dental treatment is to replace missing teeth and bone. Patients suffering from severe anodontia have little alveolar bone and their prostheses

are usually constructed to replace considerable amounts of missing bone tissue. Replacement of missing natural teeth by implanted prostheses would significantly improve the treatment of patients with severe anodontia.

Different procedures have been advocated to anchor dental prostheses in the soft or hard tissues of edentulous mouths. Osseointegrated implants of the Brånemark type (Figure 1) have been used with good clinical results, but have not yet been used in patients with ectodermal dysplasia.<sup>4,5</sup> The case reported here spans a twenty-year treatment period, where an acceptable solution was obtained by osseointegrated implants.<sup>6</sup>

## REPORT OF CASE

The patient, now twenty-seven, was referred for examination, evaluation, and treatment of his dental condition at age seven. He exhibited the typical features of ectodermal dysplasia. His hair was lanugo type, blond and sparse and he had no eyebrows. Radiographic exam-

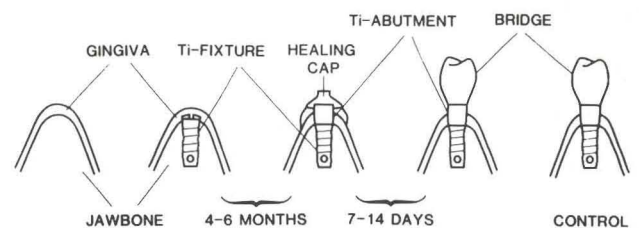


Figure 1. Schematic summary of the basic steps in treatment using bridges anchored to osseointegrated titanium implants.

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hygiene were given. The bridge has now been *in situ* more than six months and has functioned satisfactorily (Figures 5,6).

## DISCUSSION

The dental treatment of patients with severe anodontia presents considerable difficulties. Partial or complete overdentures or a combination of the two provide an alternative treatment for patients with severe anodontia. In the case discussed by Album, serious breakdown of tooth structure under the overdenture was diagnosed.<sup>2</sup> Hygiene and homecare were not adequately performed. Obviously the greatest drawback to this technique is the full coverage of teeth that support the overdenture, which may dispose for caries, periodontal problems, or trauma of the soft tissues. Acid-etched-composite, fixed partial dentures of the type described by Rochette, or the use of electrolytically etched metal work seem promising.<sup>9,10</sup> Little, if any, tooth preparation is necessary for such restoration. A treatment plan is usually best formulated by the collaboration of specialists in pediatric dentistry, prosthodontics, orthodontics, and oral surgery. Dental treatment is necessary to improve their appearance, mastication, and speech. Appearance depresses the patients, because of malformed teeth, spaces due to missing teeth, and overclosure on mastication. Depending upon the age and individual appearance, the condition may cause psychological disturbances and create emotional barriers. Early consultation is essential, therefore, in the treatment of ectodermal dysplasia. It is of utmost importance to prepare a long-term treatment plan. Orthodontic treatment can be invaluable. Spaces can be minimized or widened to improve the esthetic result of the conventional prosthetic treatment. A well-fitting denture appears to be an acceptable alternative to natural teeth in the growing child, as long as the hard and soft tissues provide good retention for the prosthesis. Progressive loss of alveolar bone tends to undermine the relative stability of the dentures. In other cases, the edentulous jaw can be provided with prosthesis anchored in bone according to the principles of osseointegration, also with good and predictable long-term prognosis. The clinical procedures involved in the technique of osseointegration are well established. The technique of osseointegration requires precision and can be performed with minimal trauma for the patient. Sophisticated dental treatment is of little value, however, if the oral hygiene is not maintained, following treatment. The lack of oral hygiene and regular follow-up procedures may result in the failure of the treatment.

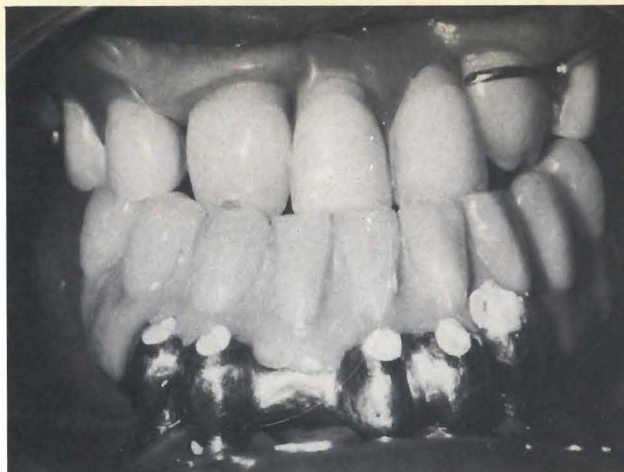


Figure 5. The implant bridge in the mandible and the partial denture in the maxilla. The screw holes are covered by zinc oxide-eugenol which will later be replaced by composite resin.



Figure 6. Radiograph with the five implants and the bridge in situ.

This case illustrates a new possibility provided by osseointegrated implants.

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Figure 2. Radiograph of patient seven years old.



Figure 3. Oral view of the maxilla without partial denture.

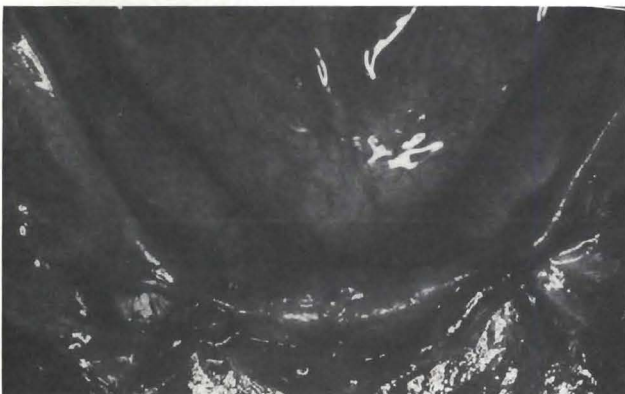


Figure 4. The mandible during the healing period of the titanium implants. Note the cover-screw for protection of the implant. This area has not yet healed completely.

ination showed three unerupted permanent teeth, 16, 11, 21 and 36 (Figure 2). Intraoral examination showed four erupted teeth, 55, 53, 63, and 65. They were all cone-shaped. There were no primary teeth in the mandible. The oral mucosa was normal in clinical appearance.

Examination of the mother and an elder sister revealed partial anodontia. Anodontia was only known among the mother's family.

### Previous dental treatment

The boy became aware of his condition, when he started school. At age seven, a partial, maxillary denture was made of heat-cured acrylic resin. New partial, maxillary dentures were made when he was eleven and thirteen years old. Between the ages of thirteen and seventeen years, he was treated orthodontically, to separate 21 and 11 (Figure 3). Another removable, maxillary denture was made, and a full denture for the mandible. They were remade, when he was twenty and twenty-three years old; then it was decided to install titanium fixtures of the Brånemark type in the mandible.<sup>4</sup>

### Surgical procedure

The patient was treated according to the principles designed by the Brånemark group.<sup>4</sup> The surgical procedure was carried out in two phases: fixture installation and abutment connection. After a healing period of three months in the mandible (Figure 4), the second phase with the abutment connection was performed. The third stage, which consists of the prosthetic procedures, was started as soon as the soft tissues around the abutment cylinder had healed.

### Prosthetic procedure

A gypsum impression was taken of the lower jaw with abutment copings, and an alginate impression of the maxillary teeth. Models were made and mounted in an articulator after bite registration. Acrylic resin teeth were set up on an articulator. After casting, the bridge was soldered and the resin teeth attached to the bridge. The complete prosthesis was carefully inspected, inserted and screwed on the abutments with gold screws. The screw holes were covered with gutta-percha and with a layer of composite-resin.<sup>7</sup> The occlusal contacts were adjusted according to the principles of optimal occlusion described by Beyron.<sup>8</sup> The first recall checkup was made after a week and careful instructions in oral

# A modified flap design in exposing the palatally impacted canine

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**T**he incidence of maxillary canine impactions is second only to third molar impactions.<sup>1</sup> Unlike third molars, the maxillary canines are vital to the continuity of the dental arch. They also play a key role in establishing and maintaining the form and function of the dentition.<sup>2,3</sup> It is for these reasons that an attempt should be made to maintain these teeth rather than extract them.

The majority of impacted maxillary canines are found in the palate.<sup>2,4</sup> Local etiology may be associated with inadequate space in the arch, the position of the erupting tooth, trauma to tooth germ, ankylosis, malformation of the erupting tooth, and delayed root resorption of the primary teeth.<sup>5,6</sup>

The diagnosis and localization of the impacted canine is usually made on the basis of a clinical and radiographic examination. Localization of the impacted tooth is important, in order to determine the surgical approach and the relationship of the impacted tooth to the adjacent teeth and surrounding structures.

Different radiographic techniques can be used to localize the position of the erupted canine. The tube shift technique or Clark's Rule and the Buccal Object Rule both give information concerning the tooth's buccolingual position.<sup>7</sup> Occlusal radiographs, panoramic radiographs, frontal and lateral cephalograms, singly or in

combinations, may also be used to aid in the diagnosis.<sup>2,4,5</sup>

A clinical examination may reveal one or a combination of the following findings: Prolonged retention of a primary canine; delayed eruption of one or more of the permanent canines, after fourteen years of age; distal migration of the lateral incisors with and without a midline shift; or soft tissue elevation of the palatal or labial mucosa. Clinical palpation on the labial aspect, however, is not reliable since the tissue elevation may be either the impacted tooth or the labially displaced root of the incisor or premolar.<sup>4,5</sup>

If the exact location of the impaction cannot be determined clinically and radiographically, proper flap design becomes very critical. It is essential not only to pinpoint the position of the tooth, but also to provide adequate access to determine the amount of overlying osseous tissue to be removed. Flap reflection without adequate access may traumatize tissue and limit visibility. In addition, good access is necessary to isolate the tooth, avoid saliva and blood contamination and obtain a dry field for attachment of orthodontic brackets.

Numerous articles are available that describe flap designs to expose palatally impacted canines for extraction or orthodontic intervention.<sup>2,3,8-12</sup> The flap design frequently advocated in publications and texts recommends making a sulcular incision along the necks of the teeth and elevating a flap which would include the gingival margins and the lingual aspect of the interdental papillae (Figure 1).<sup>9-13</sup> The purpose of this article is to

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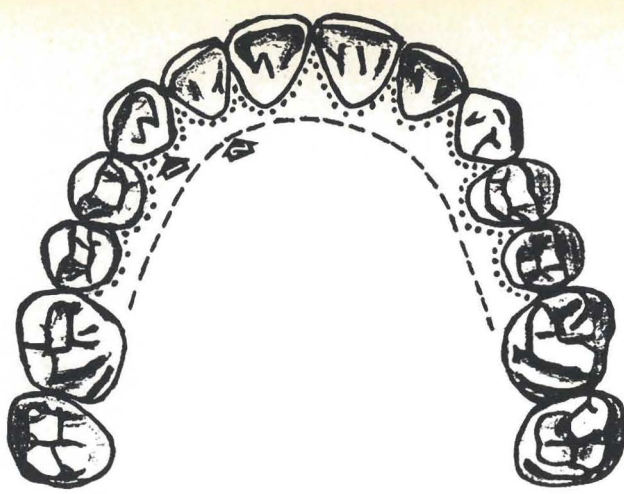


Figure 1. Diagram of flap designs utilizing a sulcular incision (1) and a modified flap incision (2) which does not include the interdental papilla and gingival margin.

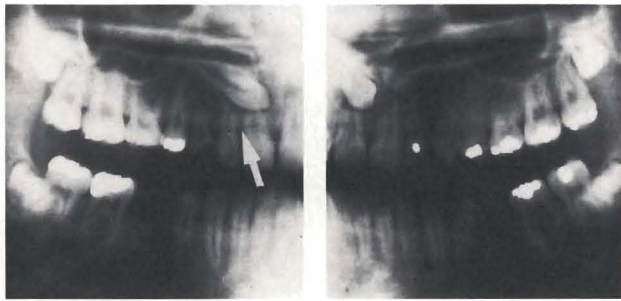


Figure 2. Panorex film depicting palatally impacted canine.

describe a modified flap design that provides the necessary surgical access for orthodontic manipulation without compromising the integrity of the periodontium of the adjacent teeth. This type of flap design utilizes an incision which follows the arch form but is made 4-5mm apically to the free gingival margin (Figure 1). The marginal gingival contour and the interdental papilla are left intact upon reflection of the flap. Postoperatively, this appears to result in less marginal inflammation and more rapid healing.

## PROCEDURE

This patient was a seventeen-year-old Caucasian female in good health. She was referred to the Department of Periodontics for surgical exposure of an impacted left maxillary canine.

Clinical and radiographic examinations located the canine lying horizontally in the palate with its incisal edge approximately beneath the root apices of the maxillary left central and lateral incisors (Figure 2). The root appeared to trail directly to the distal. The radiographs allowed a general localization of the impaction, but not specific enough to pinpoint the exact location of the anatomic crown of the tooth. The canine's locations could not be ascertained clinically by palpation or sounding through the palatal tissue with a sharp explorer.

A palatal incision was made from the mesial of the



Figure 3. The primary left canine extracted and a full-thickness flap elevated.

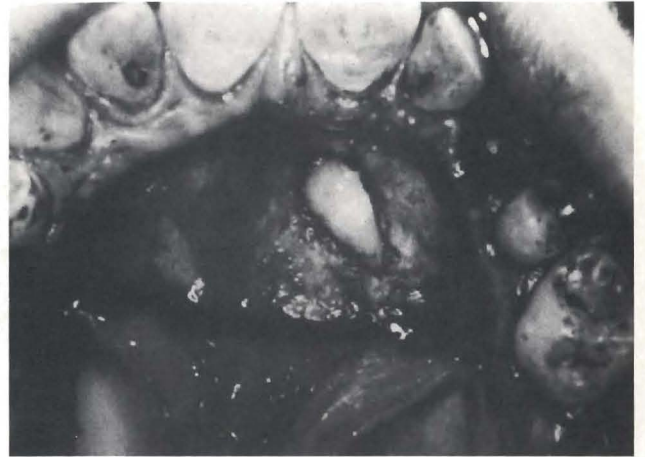


Figure 4. Crown of impacted canine exposed.

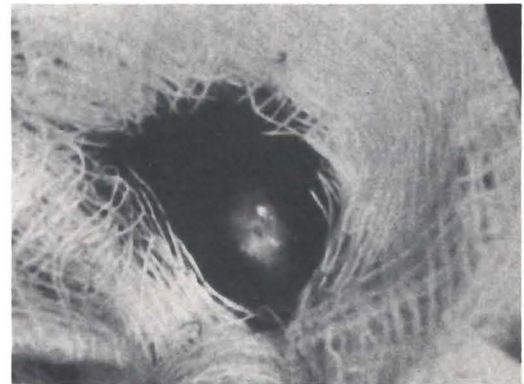


Figure 5. Isolation of canine before bonding.

right first molar to the mesial of the left first molar. This broad flap design was utilized to provide adequate access and visibility. The line of the incision followed the arch form and was approximately 4mm from the marginal gingiva. A full-thickness flap was elevated (Figure 3). The tooth was located by sounding through the bone with a sharp explorer. The full extent of the crown was exposed by curetting away the overlying bone and soft tissue (Figure 4). Gentle elevation revealed that the tooth was not ankylosed. The tooth was cleaned, dried and isolated with a gauze sponge (Figure 5). The crown



Figure 6. Orthodontic bracket bonded on exposed canine.



Figure 7. Flap sutured in place.

was acid-etched and the bracket was bonded with an orthodontic bonding adhesive\* (Figure 6). An .010" ligature wire was tied into the bracket and passed through the flap in such a way that it would pass distally, but not place any stress on the flap when it was repositioned and sutured (Figure 7). An elastic tie\*\* was then placed between the ligature wire and a brass hook that had been soldered onto a .036" stainless steel transpalatal arch wire to activate retraction of the impacted canine. Three weeks postsurgery, the elastic tie was still activated (Figure 8). With carefully supervised movement by the orthodontist, fourteen-month postsurgery photos showed the impacted canine was fully erupted and in position in the arch (Figure 9).

## DISCUSSION

Proper flap design is important in the surgical exposure of the palatally impacted canine. Good surgical exposure is essential to pinpoint the location of the tooth and to provide adequate access for orthodontic intervention. Inadequate access as in the case of a small window flap may traumatize both hard and soft tissues and compromise the attachment apparatus of the tooth after it erupts in the arch.<sup>13</sup>

The type of flap design described in this procedure does not include the gingival margin or the interdental papillae. This was done to maintain the integrity of the



Figure 8. Three weeks postsurgery. Note healing of flap.

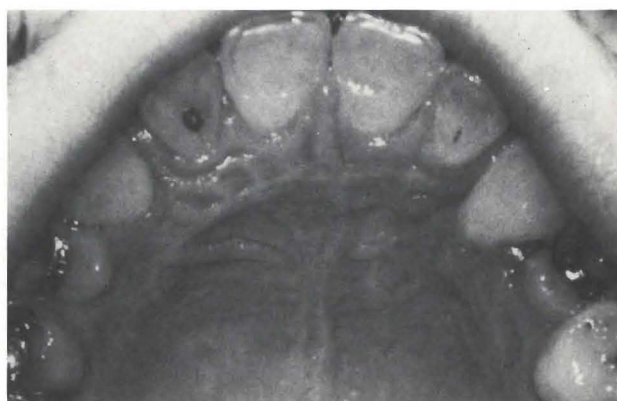


Figure 9. Fourteen months postsurgery. The canine is fully erupted and is in position in the arch.

periodontium of the adjacent teeth. Since postsurgical plaque control is often a problem, especially in the young adult patient, postsurgical inflammation in the marginal gingiva area could delay healing and result in loss of attachment.<sup>8</sup> The flap design utilized in this case resulted in minimal marginal inflammation and rapid healing of the surgical site.

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\*System 1, Ormco/Division of Sybron Corp., Glendura, CA.

\*\*Energy Chain, Rocky Mountain/Associate International Inc.

# Radicular cysts of primary teeth mimicking premolar dentigerous cysts: report of three cases

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**R**adicular cysts are the most common cyst of the jaws. They result from cystic degeneration of cell rests of Malassez, secondary to inflammatory stimulation resulting from necrotic teeth.<sup>1</sup> Dentigerous cysts, however, occur by way of fluid accumulation beneath the reduced enamel epithelium.<sup>2</sup> Radicular cysts arising from primary teeth were thought to be comparatively rare, until a recent report of twenty-three cases by Lustmann and Shear (1985).<sup>3</sup> Other reports of radicular cysts emanating from nonvital primary teeth include the twenty-two cases reported by Bloch-Jorgensen (1928) and the small series reported by Stafne (1937).<sup>4,5</sup>

Fourteen of the twenty-three cysts reviewed by Lustmann and Shear (1985) involved the primary molar teeth in areas immediately superior to developing premolars.<sup>8</sup> In light of this, we reviewed the museum radiographs of the Faculty of Dentistry, University of Stellenbosch for instances of radicular cysts arising from primary teeth. This search covered material gathered over a thirteen-year period and resulted in the accumulation of a number of cases of surgically and histologically verified radicular cysts. Patient histories, clinical diagnoses, radiological reports and histological examinations were reviewed. In all but three cases, the clinical diagnosis of radicular cyst from an infected pri-

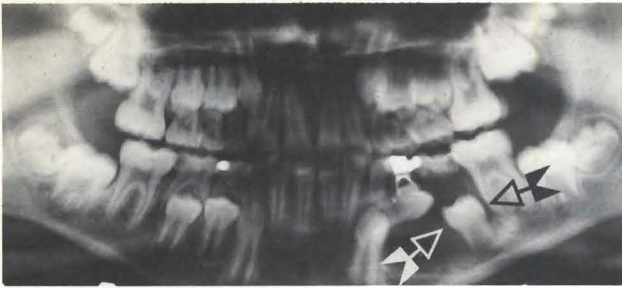
mary tooth was verified by surgery and histological examination. In the other three cases, the clinical diagnosis of dentigerous cyst was disproved by surgical exploration.

## CASE REPORTS

### Case 1

G.W., an eight year-old male patient presented to the Faculty of Dentistry, University of Stellenbosch for investigation of swelling and discharge in the region of the left second premolar. He was otherwise in good health, but had several carious lesions and poor oral hygiene. A panoramic radiograph taken at the time revealed that tooth 74 had previous root-canal therapy (Figure 1). Both 74 and 75 had extensive caries and areas of periapical rarefying osteitis. Initially it was believed that the periapical radiolucency associated with these primary teeth was a pericoronal lesion of the underlying premolar. Closer examination of the radiographs revealed that the normal follicular spaces on 34 and 35 were clearly visible, a feature which ruled out the possibility of dentigerous cysts. Furthermore the lamina dura adjacent to both the primary teeth and the second premolar had been effaced, a sign indicative of inflammation. A moderately dense band of sclerosing osteitis apical to the tooth 35 also suggested an infectious etiology. Surgical

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exploration led to confirmation of this lesion as a radicular cyst, arising from tooth 74. Extraction of both primary teeth and curettage led to resolution of the morbidity.

### Case 2

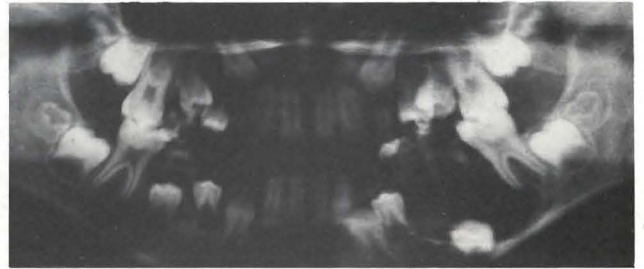
E.N., an eight-year-old female patient was referred to the Faculty of Dentistry, University of Stellenbosch for investigation of swelling of the premolar region of the left mandible. This patient was in a good state of health, although she admitted to having severe dental pain in this area previously. Her oral hygiene was poor and she had a high level of caries. Clinical examination revealed markedly mobile, carious teeth in the region 74 and 75 and the presence of a fluctuant swelling buccal to these same teeth. Panoramic radiography revealed a large radiolucency, coronal to tooth 35 (Figure 2). This tooth had been suppressed to the lower border of the mandible. The initial clinical diagnosis was dentigerous cyst involving the tooth 35. Surgical intervention revealed a radicular cyst involving the tooth 75. Extirpation of the cyst, and extraction of tooth 75 led to uneventful healing.

### Case 3

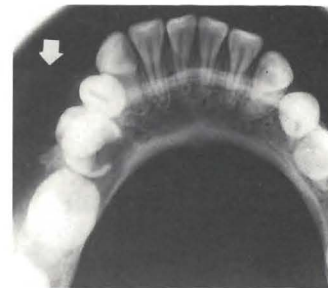
J.J., an eleven-year-old male, presented with a complaint of swelling and discharge, apical to the right primary molars. This otherwise healthy patient had a deep carious lesion in the tooth 85. Adjacent to this nonvital tooth, there was a large fluctuant swelling. This swelling appeared cystic on an occlusal radiograph (Figure 3). A panoramic radiograph revealed what appeared to be a coronal radiolucency about the crown of the tooth 45 (Figure 4). The working diagnosis in this case was dentigerous cyst. The lesion was treated surgically, at which time a cyst, firmly adherent, and intimately associated with the primary root tip was removed. The premolar tooth, part of which jutted into the radicular cyst cavity, was clinically nonviable and was removed as well. The gross specimen showing the radicular cyst with accompanying ingress of part of the premolar tooth is shown in Figure 5.

*Figure 5. Gross specimen of Case 3. The primary root tip with the cyst firmly attached is marked with an arrow. Part of the crown of the premolar tooth had invaginated into this cyst, but the follicle was separate from this cyst.*

*Figure 1. Panoramic radiograph of Case 1 revealing the destruction in 74 and 75, with associated periapical radiolucency. The follicular space about 35 is visible (arrow), ruling out a diagnosis of dentigerous cyst. Note also effacement of the lamina dura of the unerupted premolar and the surrounding sclerosis, peripheral to the radiolucent lesion.*



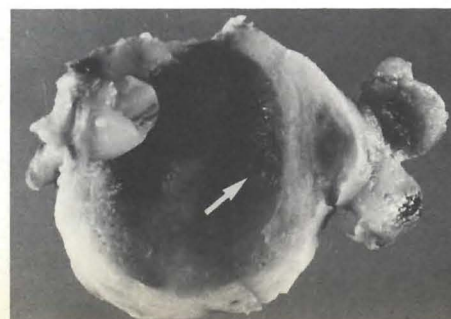
*Figure 2. Panoramic radiograph of Case 2 illustrating suppression of an immature 35. Note the large carious lesions in the overlying teeth.*



*Figure 3. Occlusal radiograph of Case 3. Note the finely etched opaque border of this radicular cyst.*



*Figure 4. Panoramic radiograph of Case 3 shows a pattern highly suggestive of dentigerous cyst.*



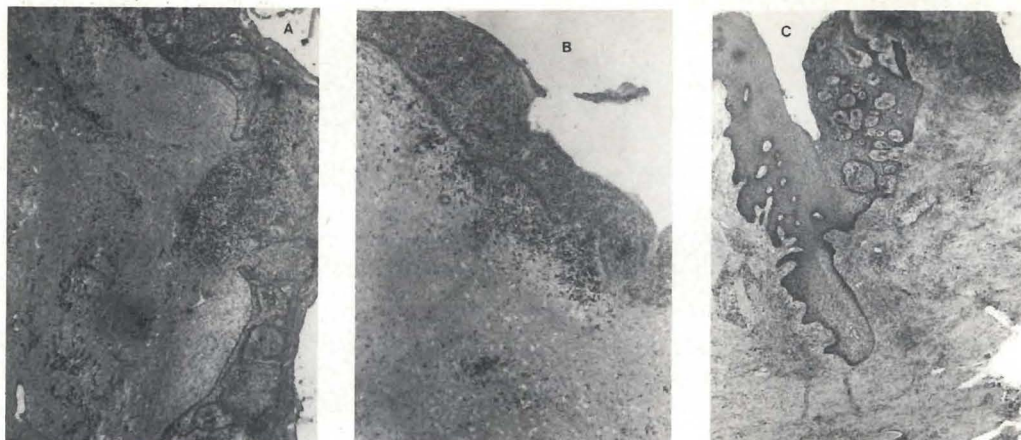


Figure 6. Histological specimens from Case 1, (a); Case 2, (b); and Case 3, (c) show varying degrees of stratified squamous epithelium which, depending on the circumstances, may be labelled as dentigerous or radicular cyst.

Histologic sections of all specimens revealed non-specific, epithelial-lined connective tissue cavities with varying degrees of inflammation (Figure 6). A definitive diagnosis in the absence of radiological and clinical information was not possible.

## DISCUSSION

Dentigerous cysts on mandibular second premolar teeth are comparatively rare, accounting for only two of ninety-one cases reported by Shear.<sup>2</sup> It seems unlikely, although not impossible, that dentigerous cysts would develop on these teeth in the short time since the completion of crown formation. The histological similarity of the linings of these cysts points out the difficulty of differentiating between these two cyst-types on the basis of their histological features alone.

These cases illustrate the necessity of careful evaluation of radiographs. If the lesions were misdiagnosed as dentigerous cysts, unwarranted extraction may have resulted. The differentiation is doubly important, because unless the specimen is submitted in toto to the pathologist, histological differentiation of radicular and dentigerous cysts may prove difficult.<sup>2</sup> The correct diagnosis of radicular cyst will lead the responsible clinician to perform the necessary conservative steps. The radiological signs that enable the clinician to differentiate the two are listed in the Table. Evaluation of these radiological signs is predicated upon an adequate number of films from various angles and of differing densities, where required. Although panoramic radiographs are used to illustrate these cases (for the purpose of allowing the reader to compare the affected and unaffected sides), periapical radiographs provide better

Table □ Differential radiologic diagnosis of primary tooth radicular cysts and dentigerous cysts on underlying premolar teeth.

1. If a radicular cyst is suspected there should be evidence of a carious, endodontically treated, or traumatized tooth.
2. If a radicular cyst is suspected the lamina dura around part (or all) of this said tooth should be attenuated.
3. If there is effacement of the following cortex and lamina dura of the unerupted teeth, the lesion is more likely to be of inflammatory etiology.
4. A very large radiolucency in a patient of tender age may help to rule out dentigerous cyst.
5. If the follicular space around the premolar tooth is intact and clearly visible within the confines of the greater radiolucency, the lesion is not a dentigerous cyst. A tooth cannot have a normal follicle space and a dentigerous cyst concurrently.
6. If there are areas of adjacent sclerosis, the cyst may be infected; which may lead to a diagnosis of radicular cyst, but does not exclude dentigerous cyst.
7. If there is interruption of root development as compared to adjacent or contralateral teeth, the lesion may be of infective origin; which may imply the presence of a radicular cyst.

image detail. Certain features of inflammation may be found in dentigerous cysts, which may become infected themselves. If an infectious process associated with a radicular cyst involves the underlying premolar tooth, vitality of this tooth may be lost. This is heralded by cessation of root development and complete effacement of follicular cortices.<sup>6</sup> This was observed in Case 3 in which complete loss of lamina dura was associated with a nonviable premolar tooth. These three cases also emphasize the importance of close cooperation between pediatric dentist, radiologist and pathologist.

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# The curved-bristle toothbrush: an aid for the handicapped population

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Limited data exist to substantiate the claim that the curved-bristle toothbrush is an effective plaque control device, especially for that segment of the population incapable of or requiring assistance to accomplish toothbrushing (Figure). According to Nowak, dental health care is the greatest unmet need of the institutionalized population.<sup>1</sup> A continuing challenge for the dental professional to encourage adequate plaque control measures, in an effort to prevent periodontal disease, the most serious dental problem affecting the institutionalized population. The etiology of this disease stems from bacterial activity and local irritants present in plaque and calculus.<sup>2</sup>

The purpose of this study was to compare the effectiveness of the curved-bristle toothbrush to that of a conventional toothbrush in plaque reduction among institutionalized, profoundly retarded individuals who are dependent on others for oral hygiene care.

## REVIEW OF THE CURRENT LITERATURE

A review of the literature revealed numerous publications on the subject of mechanical plaque removal. Fewer articles existed on the subject of mechanical pla-

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que removal in a handicapped population, however, and a very limited number were available on the use of the curved-bristle toothbrush, regardless of type of population investigated.

According to Avery, a statistically significant difference ( $p < .001$ ) in plaque removal with the curved-bristle toothbrush was demonstrated in a group of nor-



Figure. Two views of the type of curved-bristle toothbrush used in this study.





mal third graders in a West Virginia school system.<sup>3</sup>

Meckstroth and Weller evaluated the curved-bristle toothbrush according to its effectiveness in the removal of plaque and according to the user's attitudes toward the curved-bristle toothbrush with both assisted brushing and completely dependent patients.<sup>4</sup> Results revealed a reduction in plaque, especially in the posterior lingual areas. Acceptance of this type of toothbrush by long-term geriatric patients and facility personnel upon evaluation was favorable.

In a 1987 study by Allen and Evans of eighty-seven four-year-old subjects, brushing with either curved-bristle or conventional toothbrushes, a significant difference in the removal of plaque from the posterior lingual areas favored the curved-bristle toothbrush.<sup>5</sup>

A 1986 study by the Collis Curve® Research team at a Texas Boys' Home, (n16), evaluated the effectiveness of the curved bristle toothbrush, using the simultaneous random scrub technique, and the conventional toothbrush, using the Modified Stillman Method. It was reported that after one week, the curved-bristle toothbrush produced a significantly greater reduction in plaque as compared to the conventional toothbrush.<sup>6</sup>

An abstract by Maita reported use of the air driven vibratory toothbrush with curved-bristle tips for plaque control in the hospitalized handicapped population. Results revealed a decrease in plaque, but the report failed to show whether the scores were statistically significant.<sup>7</sup>

Findings of a 1987 study by Williams suggested that the curved-bristle toothbrush was as effective as the conventional toothbrush in reducing the amount of plaque present on the teeth of institutionalized, profoundly retarded individuals, when brushed by trained personnel (n24).<sup>8</sup>

## MATERIALS AND METHODS

From an institutionalized population of a state facility for the mentally retarded, individuals were selected according to the following criteria:

- Incapable of brushing one's own teeth.
- Profoundly mentally retarded.
- Poor oral hygiene as measured by the DI-S of the OHI-S.

They were then equally divided into control and experimental groups (n24) (Table 1). Baseline data were collected through utilization of the DI-S of the OHI-S by the facility's dentist.<sup>9</sup> The purpose of this index was to quantitate oral cleanliness by estimating the tooth surface area covered by debris. All six preselected teeth

Table 1 □ Demographics

Subjects	Age Range	Sex	Race	Level of Retardation	Self-Help Skills & Brushing
Experimental 12	11-36	Male-4 Female-8	White-7 Black-5	Profound	None
Control 12	4-31	Male-5 Female-7	White-9 Black-3	Profound	None
Entire Population 24	4-36	Male-9 Female-15	White-16 Black-8	Profound	None

Table 2 □ Mean DI-S scores of conventional toothbrush versus curved-bristle toothbrush

	Conventional toothbrush	Curved-Bristle toothbrush
Baseline	2.40	2.70
Follow-up	1.03	1.25

There was no statistically significant difference in the amount of plaque reduction between the two toothbrushes. ( $t = -.31, p < .76$ )

(numbers 3,8,14,19,24, and 30) were examined in this study. Once daily during the next three months, students in dental assisting provided treatments for the control and experimental groups with the conventional and curved-bristle toothbrushes, respectively. The toothbrushing method utilized for the control group was the Modified Stillman Method. The traditional Collis Curve® Scrub Method was utilized for the experimental group. For follow-up, data were collected by the same examiner.

## FINDINGS

At the end of the three-month study, evaluation and analysis of the data were accomplished by use of an independent t-test on the difference between the baseline and follow-up scores. No statistically significant difference was found in the amount of plaque reduction between the two toothbrushes ( $t = .31, p < .76$ ). The curved-bristle toothbrush was found to be as effective as the conventional toothbrush in achieving similar results for plaque removal (Table 2).

## DISCUSSION

When working with individuals who are dependent on others for their care, it is most important for the health care provider to take the initiative to create or investigate other devices that would allow these patients optimum oral care that is practical both for the patient and for the person who provides this service. The curved-bristle toothbrush, by its design, brushes the buccal,

lingual, and occlusal surfaces simultaneously. It has been shown, by this study, to achieve similar reductions in plaque with half the time required with conventional toothbrushes. Mentally or physically handicapped patients, or any patient with a weak or limited grasp, who requires varying degrees of assistance in toothbrushing, may benefit from the design of this toothbrush, as the literature suggests. Because the care taker can brush as effectively with this brush in the same amount of time as with the conventional toothbrush suggests a possibility of both manpower and financial savings to the institution. The decrease in time required to brush the residents' teeth may also encourage better oral hygiene for the patient who received little or no assistance from the facility's personnel, since they were previously neither inclined nor encouraged to do so, due to other time restraints required for other self-help skills in the institutionalized setting. Findings of this study should prove beneficial to the advancement of the dental profession, through the discovery and application of new knowledge in the delivery of care to the handicapped population, in alternative practice settings.

## CONCLUSION

Adequate plaque control for the institutionalized populations presents a continuous challenge to dental profes-

sionals. The findings of this study indicate that an effective, time-efficient method for plaque control exists in the curved-bristle toothbrush. Institutions may consider adoption of this toothbrush for patients incapable of self-brushing.

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## ERRATUM

In the article, "The role of coping in children's adjustment to the dental visit", by Sandra L. Curry et al, the name of one of the authors was submitted as Sandra W. Fuss, PhD. The name should be shown as Sandra W. Russ, PhD.

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# Case reports

## Separation of fused primary incisors: report of case

Deborah A. Himelhoch, DDS, MS

Double teeth comprise one of the more common anomalies of the primary dentition.<sup>1-4</sup> Prevalence has been reported as 0.14 - 5 percent, with most surveys showing less than 1 percent incidence.<sup>1-5</sup> In the primary dentition, double teeth are found with equal frequency in males and females, by most authors.<sup>2,4,6,7</sup> Reported maxillary to mandibular ratios vary and both unilateral and bilateral cases are found; furthermore they are found only in the anterior dentition.<sup>1-7</sup> Occurrence of double teeth in the permanent dentition is less common.<sup>2,3</sup>

Double teeth are usually described by the terms gemination and fusion. Conflicting definitions of these terms have appeared in the literature. Levitas defined gemination as follows: counting the bifid crown as one tooth, the normal number of teeth is present and the anomalous tooth has probably only one root canal. Fusion referred to a condition in which the bifid crown has probably two root canals; and a normal number of teeth was achieved by counting the anomalous crown as two teeth.<sup>8</sup> Tannenbaum and Alling placed greater emphasis on the radiographic appearance of the double tooth. Gemination was the diagnosis, when only one root canal was present, and fusion when two crowns were joined by enamel and/or dentin, but two separate roots or root canals were found. While these authors suggested counting teeth as an aid to diagnosis, they allowed for the possibility of fusion between a normal tooth and a supernumerary.<sup>9</sup>

Stewart defined gemination as an abortive attempt by



Figure 1. Note the double maxillary left lateral incisor.



Figure 2. The periapical radiograph showed complete separation of the roots, root canals, and pulp chambers.

a tooth bud to cleave, and fusion as the embryological union of normally discrete dental organs.<sup>5</sup> McDonald and Avery had a similar definition.<sup>10</sup> The problem with these definitions is that an embryological mechanism for the formation of double teeth has not been demonstrated. Further complicating the problem is the existence of families in which double teeth are common, but both apparent gemination and fusion are present.<sup>6,7</sup> Additionally, animal research has produced a strain of Lakeland terrier with double teeth that may be either geminated or fused, suggesting that the same genetic milieu may produce either an apparent division of one tooth bud or an apparent union of two separate tooth buds.<sup>6</sup>

More important than their origin, though, are the problems connected with double primary teeth. These anomalies have been associated with delayed exfoliation and caries formation in the groove dividing the bifid crown.<sup>6,11,12</sup> Abnormal permanent teeth are a sequela of primary double teeth, greater than 50 percent of the time.<sup>6</sup> Problems include missing permanent incisors, supernumerary incisors, double permanent teeth, malformation of permanent teeth, and delayed eruption of permanent teeth.<sup>8,11-14</sup> Treatments described for pri-

mary double teeth have included observation and extraction.<sup>11-15</sup> Composite restoration and reshaping has also been suggested.<sup>12</sup> Treatment of double permanent incisors tends to be more extensive.<sup>9,16-18</sup> Tannenbaum and Alling described a case in which bilateral geminated maxillary central incisors were esthetically restored with acrylic resin.<sup>9</sup> Delany and Goldblatt described treatment of bilateral fusion between maxillary central and lateral incisors, using a combination of endodontics, hemisection, and orthodontics, with planned prosthetic restoration of the properly aligned incisors.<sup>16</sup> Shapira *et al* reported on a double maxillary incisor treated by a two-step separation procedure with removal of the distal segment and restoration of the mesial segment, through a combination of endodontics and composite build-up.<sup>17</sup> Marechaux separated and extracted a supernumerary tooth fused to a maxillary central incisor. Orthodontic realignment of the teeth was planned.<sup>18</sup> Hasiakos *et al* unsuccessfully attempted separation of a central incisor fused to a supernumerary.<sup>19</sup>

#### REPORT OF A CASE

In December 1985, a twenty-month-old Caucasian female was brought to the dental office for evaluation and treatment. The child had been uncooperative for treatment using local anesthesia alone at another office and the mother was seeking alternative treatment methods. The child had not been eating properly and was losing weight. Dental history revealed ongoing use of a juice-filled nursing bottle at night. Medical history included one hospitalization, three months previously for asthma. This was the first such attack and none occurred following. The rest of the history was negative.

Dental examination was made by placing the child in the mother's lap and the child's head in the dentist's lap. In this fashion, a reasonably complete examination was accomplished. A single tooth crossbite of the left first molars was present and a 3mm overjet was noted in the anterior region. The size and shape of the palatal vault were normal and the mother had no knowledge of a thumb or finger habit. Large cavities and restorations were noted on several teeth. The maxillary right lateral and both central incisors were extensively decayed and both left primary first molars had defective amalgam restorations. The maxillary left lateral incisor was noted to be a double tooth with caries in both the labial and lingual groove of the anomalous crown (See Figures 1 and 2). A slightly blurry anterior periapical radiograph was obtained, while the mother held the child. The radiograph showed two apparently separate roots, both with open apices.



Figure 3. The fused crowns were separated using a long, thin carbide bur.

Treatment options were discussed with the mother. Due to the child's poor cooperation during the examination (kicking and crying) and the need for extensive restorative work, treatment under general anesthesia was chosen. An appointment was made with a pediatrician at the Wyler Children's Hospital in the University of Chicago Medical Center for a preoperative history, physical, and laboratory evaluation. The physical examination was entirely normal with no sign of respiratory problems. Copies of old dental radiographs and medical records were obtained.

The child was admitted to the pediatric day surgery unit at the University of Chicago Medical Center in February, 1986. Following induction of general anesthesia and nasotracheal intubation, a complete series of radiographs was obtained, the teeth were cleansed and reexamined, and a treatment plan was established. The double tooth was isolated, using a gingival retraction clamp and rubber dam. The fusion proved to extend only to the cemento-enamel junction and the two halves of the crown were separated, using a long, thin carbide bur. Caries was removed with a number 2, slow-speed bur, and calcium hydroxide was placed over the exposed dentin (Figure 3). These procedures were accomplished without exposure of the dental pulp or alveolar bone. Direct pressure was applied for a few minutes, to reduce gingival bleeding; then each newly separate tooth was restored with a stainless steel crown, cemented with zinc phosphate cement. Mandibular primary canine crowns proved to have the best fit following minimal preparation of the teeth. While the cement hardened, the remaining carious teeth were restored. The necrotic incisors were restored, using a pulpectomy technique with zinc oxide eugenol fill, CaOH liner, and composite crowns with composite posts. Placement of stainless steel crowns, to restore the carious molars corrected the crossbite. Finally, windows were cut in each anterior stainless steel crown and acid-etched composite facings were placed. A topical fluoride application completed the treatment. The child recovered uneventfully, had no respiratory difficulties, and was discharged that evening. The mother was given postoperative instructions and a follow-up appointment was made.

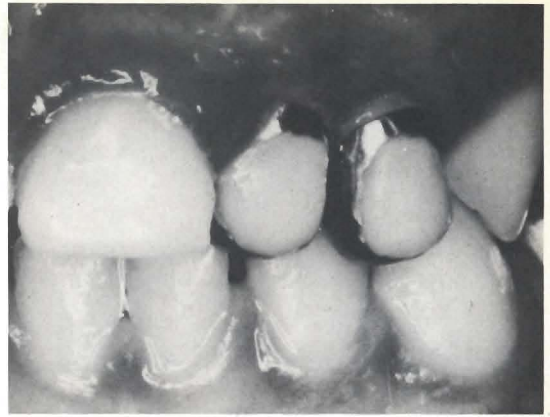


Figure 4. The dentition six months postoperatively.

Two weeks later, the child was examined and extensive toothbrushing lessons were given to the mother. The bottle had been discontinued and the child had gained three pounds since the surgery. All restorations were intact and the gingival tissues were healed, but the labial margin of the distal incisor crown was exposed. As the crown was well-adapted and the area was easily cleansable, no further treatment was deemed necessary.

At the six-month-recall appointment, examination revealed excellent oral hygiene and intact restorations (Figure 4). The patient was cooperative for prophylaxis and fluoride treatment and an anterior periapical radiograph, which showed closure of the apices of both separated teeth. At the one-year-recall appointment all restorations continued to be in good condition. The periapical radiograph of the separated teeth showed no morbidity (Figure 5).

## DISCUSSION

Radiographs taken by the first dentist and in the operating room showed sixteen primary teeth (counting the double tooth as one), four unerupted primary second molars, and the normal number of permanent tooth buds. Using Levitas' definitions, the double tooth would be described as a geminated lateral incisor with complete separation of the roots.<sup>8</sup> A more reasonable description for this case using the definition of Tannenbaum and Alling is fusion of a lateral incisor with a supernumerary.<sup>9</sup>

In either case, problems associated with this double tooth were caries in the labial and lingual grooves of the crown and excessive anterior overjet. There were, fortunately, no abnormalities in the development of the permanent teeth; but difficulties with properly timed exfoliation and eruption of teeth in the maxillary left lateral incisor region were anticipated. Treatment goals included minimization of exfoliation and eruption difficulties, elimination of caries maintenance of anterior arch-length, creation of a cleansable area and, if possible, esthetic restoration of the dentition.

With these goals in mind, several alternative treatment plans were considered and discarded. The sim-

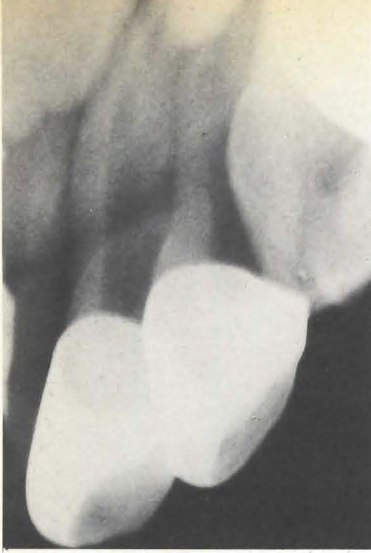


Figure 5. One-year postoperative radiograph showed the separated teeth to have normally developing apices.

plest treatment alternative would have been to extract the anomalous incisor. This would eliminate the caries and presumably allow for future normal eruption of the permanent incisors. It had the disadvantage of creating an unesthetic result and created the possibility of loss of arch-length in the anterior segment. It would have been the treatment of choice in an older child, where exfoliation of the other primary incisors was imminent, or in a situation where cooperation could not be achieved for more sophisticated procedures.

A second alternative was to remove the caries and fill in the grooves with acid-etched composite resin. This would have the dual disadvantages of leaving an irregularly shaped tooth with hard-to-clean, gingival contours, as well as not addressing the exfoliation and eruption problems.

A third alternative was to separate the fused teeth, remove one segment and restore the remaining segment. If the anterior dentition had been crowded or the overjet problem greater, this treatment plan would have been selected. Instead, primate spaces were present, anterior to the canines, and removal of a half of the fused tooth would have left a small lateral incisor in a large space, possibly leading to a shift of the maxillary midline to the left. Currently, the midlines are aligned (Figure 4).

More than one restorative material was considered as well. Simple composite restorations were rejected, due to the extensive area of exposed dentin on the proximal surfaces. Composite crowns were considered impractical, due both to limited space available for celluloid crown forms, as well as continued minor bleeding, which made isolation difficult. Stainless steel crowns were selected, because of the availability of a wide variety of sizes and shapes, and their relative insensitivity to poor moisture control. Composite facings were added to improve esthetics. Moisture control above the gingival seal of the crowns was achieved.

At the present time, the patient has an esthetic dentition with a fairly normal primary occlusion. The teeth and restorations are easily cleansable by the mother. Furthermore, the child is functioning well, as evidenced by her rapid weight gain, following the procedures. No exfoliation difficulties are anticipated, because each in-

cisor is free to resorb independently. The maxillary incisors will be checked periodically, however, to intercept exfoliation difficulties. Appropriate extractions will be done, if necessary.

## SUMMARY

A case of a child with a maxillary primary left lateral incisor fused to a supernumerary was presented. The teeth were separated and restored using stainless steel crowns with composite facings. The described treatment permitted a maximum level of esthetics, function, and cleansability of the primary dentition, without compromising the permanent dentition.

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## Triple teeth: case reports of combined fusion and gemination

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**F**usion and gemination are infrequent developmental abnormalities, usually located in the primary dentition and occurring in less than 1 percent of children.<sup>1-5</sup> Fusion is the partial or complete union of two adjacent tooth germs; the two roots, however, remain distinct. Gemination, on the other hand, is a division of a single tooth germ resulting in a bifid crown with a single root.<sup>6</sup> Despite these differences, the diagnoses are frequently transposed. Milazzo and Alexander suggest that the clinical teeth in the arch be counted and that the anomalous crown be counted as one; a full complement of crowns indicates gemination, whereas less than the expected number indicates fusion.<sup>7</sup>

The occurrence of primary triple teeth, as a result of a combination of fusion and gemination is an exceedingly rare phenomenon. Knapp and McMahon noted only six reported cases.<sup>8</sup> An epidemiologic study conducted by Ravin reported one case found in 4,564 examined children, a prevalence of 0.02 percent.<sup>9</sup> Long observed three connected primary mandibular incisor crowns, which were probably two normal incisors and a supernumerary tooth.

### REPORT OF CASES

While conducting a dental survey of 2,393 Head Start children, two cases involving a combination of fusion and

gemination within a two-month period were observed. Each case affected the primary dentition and the same teeth, namely, the right mandibular central and lateral incisors. The dual anomaly was observed in a three-year-old black male and in a six-year-old white male. The remaining primary dentition in each patient was normal. Neither had histories of debilitating disease nor unusual trauma. Prenatal data were not available. Parental histories with similar anomalies were not obtainable.

The clinical examination revealed that the crowns of the involved teeth were joined together. Both cases had distinct clinical lateral incisors; dental floss could not be passed, however, between the central and lateral incisors. The central incisor in Case 1 (Figure 1) had a distinct delineation of the two crowns on the buccal



Figure 1. Frontal view of Case 1, showing triple crown formed by combined fusion and gemination of the right mandibular primary central and lateral incisors.

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Figure 2. Frontal view of Case 2, showing the same anomaly as in Case 1.



Figure 3. Radiographic view of the anomaly in Case 1, confirming gemination of the central incisor and fusion with the lateral incisor.

surface and the lingual surface (not shown). The central incisor in Case 2 (Figure 2) had an incisal notch with invagination of the crown approximately one-third from the notch on the buccal surface and the entire length of the crown on the lingual surface (not shown).

The use of radiographs in distinguishing between fusion and gemination is generally difficult. Radiographs are recommended primarily as an aid to clinical observation. The radiographs of Case 1 and Case 2 (Figures 3 and 4, respectively) reveal three crowns in the central and lateral incisor regions. The central incisors have one root canal and two crowns. The lateral incisors have one crown and one root canal. The detection of concrescence (fusion of separate teeth along part or all of the roots) of the central and lateral incisors cannot be determined by the radiographs. The radiograph in Figure 3 appears to indicate the presence of succedaneous teeth; in Figure 4, however, this could not be determined.

## DISCUSSION

In order to distinguish between fusion and gemination, the general rule of counting crowns is used. The rule cannot be utilized, however, in the cases described in this report. Counting the anomaly as one tooth or crown, only fusion could be diagnosed. In both cases, however, there were extra crowns that had common roots with the



Figure 4. Radiographic view of the anomaly in Case 2, confirming the same finding as in Case 1.

central incisors. This finding aptly fits the description of gemination. Triple teeth present a condition that is an exception to the general rule. Thus, while the rule applies to either fusion or gemination, it is not appropriate, when both are combined in a single anomaly.

When this anomaly is clinically diagnosed in the primary dentition, appropriate radiographic evaluation should be employed to ascertain the status of the succedaneous teeth. If the anomaly is retarding the exfoliation of these teeth, extraction and space maintenance may be required.

## SUMMARY

The discovery of a rare combination of fusion and gemination in one clinical crown, involving the same primary teeth in two patients, within a short period of time, is described.

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# Scaphocephaly associated with other abnormalities: report of case

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Athanasios E. Athanasiou, DDS, MSD

**P**remature closure of the sutures of the skull results in deformity, the nature of which will reflect the course of the sutures involved. Scaphocephaly is a deformity of the head associated with premature closure of the anterior fontanelle and premature fusion of the sagittal suture.<sup>1</sup> Clinically it is characterized by a sagittal elongation of the skull with marked frontal and occipital protrusion as well as absence of the parietal eminences. The obliterated sagittal suture may be indicated by a prominent bony crest and the bridge of the nose is depressed. Exophthalmos is rare and vision seldom is implicated.<sup>2</sup> Few persons with scaphocephaly develop signs of intracranial pressure. Mental retardation has been reported, though superior intelligence has also been reported in connection with the anomaly.<sup>3</sup> Scaphocephaly has been observed in many races and is relatively frequent in Negroes. Occurrence is more frequent in males (ratio males/females 4:1).<sup>3</sup> A hereditary etiological factor has been described with the anomaly being inherited as an autosomal dominant trait, though in many cases no hereditary pattern can be established.<sup>2</sup>

Not all cases of scaphocephaly are detected, since parents or medical attendants can fail to observe the unusual skull contour in infancy. An objective method for determination of cranial deformity is the cranial

index (breadth/length x 100), which, according to Gray's anatomy, should be between 75 percent and 80 percent in Caucasians and in cases of scaphocephaly can be below 70 percent.<sup>4</sup>

Surgical correction of scaphocephaly can be attempted by linear parasagittal craniectomy or other modifications, preferably in infancy, and possibly by deliberate molding of the bone and dura in later developmental stages.<sup>3,5,6</sup>

The present paper presents and analyzes a benign case of scaphocephaly in a young female, which was neither detected nor treated.

## CASE REPORT

A fourteen-year, three-month-old Caucasian female (Figure 1) was examined in connection with routine orthodontic treatment of a minor malocclusion.

The patient was healthy, though her facial appearance and in particular the development in the region of the forehead suggested the tentative diagnosis of scaphocephaly.

At birth, the patient had weighed 3,600 gm and measured 56 cm, the birth having taken place naturally and without complications. Postnatal development was normal, though the patient complained several times of uncomfortable headache-like pains in the occipital region, at the age of eleven. The patient had at that time described the pain as a type of "pressing". No treatment was given and the symptoms subsided.

At birth, a congenital deformity of both feet, Talipes

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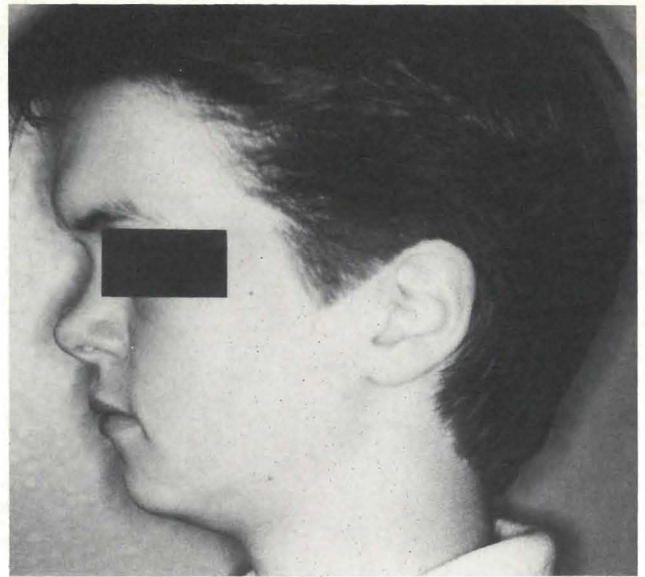
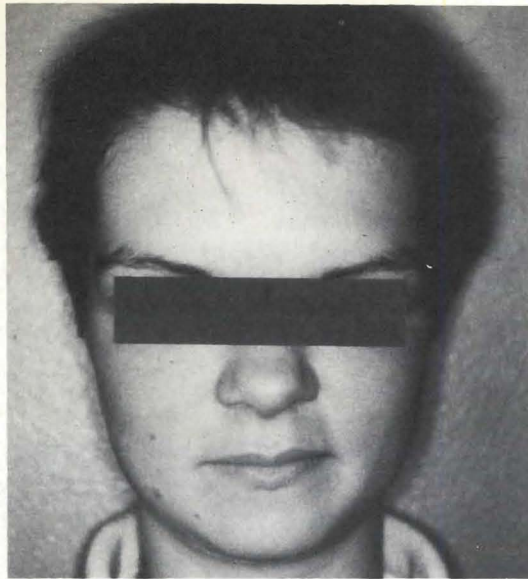


Figure 1. On-face and profile photographs of the patient.

congenitus aluis defnatus (Talus verticalis dexter), was observed and successfully treated by bandaging, at the age of six months.

At the time of examination (14 y 3 m) the patient's somatic development was normal for her age and she was four months postmenarche. The patient's and her parent's chief complaint was related to the malocclusion and did not imply any psychological or social problems related to the patient's facial appearance.

Examination of the patient's face (Figure 1) indicated slight convexity and retrognathism, though with a pleasant appearance. A more careful observation of the total skull detected, however, a strong and prominent frontal area combined with a clear depression of the bridge of the nose. The vertical dimensions were normal and the facial profile other wise harmonious. The oral soft tissues were normal, as was muscle balance and function. Intra-oral examination revealed a dentition in stage DS4 M2, though with aplasia of the upper right and both lower second premolars, which was confirmed on a panoramic radiograph (Figure 2).<sup>7</sup> The occlusion was normal with regard to overjet and overbite though the arches were small with incisor crowding. The lateral cephalogram (Figure 3) confirmed the impression of the clinical examination with a prominent frontal bone with characteristic thickness and no sinuses. The coronoid and parietal sutures were visible on the lateral cephalometric radiographs. The cephalometric analyses of the dentofacial skeleton (Table 1) revealed a slightly reduced sagittal jaw relationship, both evaluated angularly by means of Bjork analysis or linearly (Wits appraisal).<sup>8,9</sup> This was compensated for by the inclination of the maxillary and mandibular incisors. The flexure of the cranial base was increased both laterally and medially. No abnormality was seen in the vertical plane and both the metric and morphological analysis of the mandible suggested an anterior rotational growing pattern.<sup>10</sup>

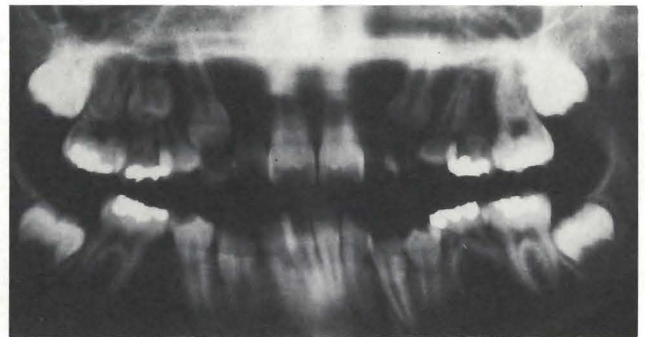


Figure 2. Panoramic radiograph of the patient.

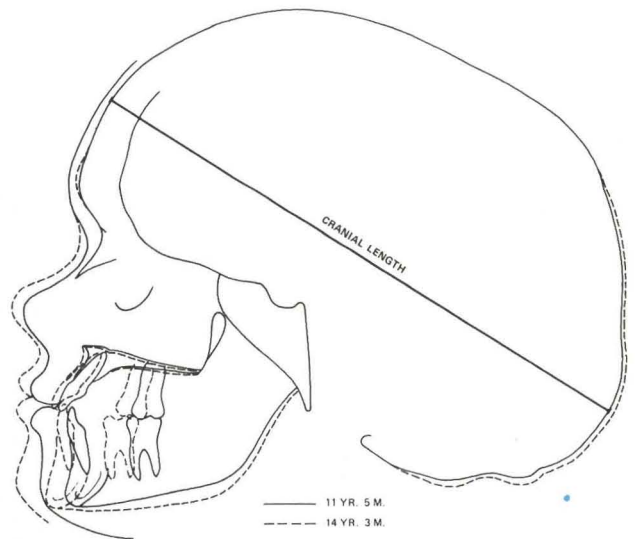


Figure 3. Lateral cephalogram.

A growth analysis was performed, based on a comparison with a cephalogram taken at the age of eleven years and five months. During the period of observa-

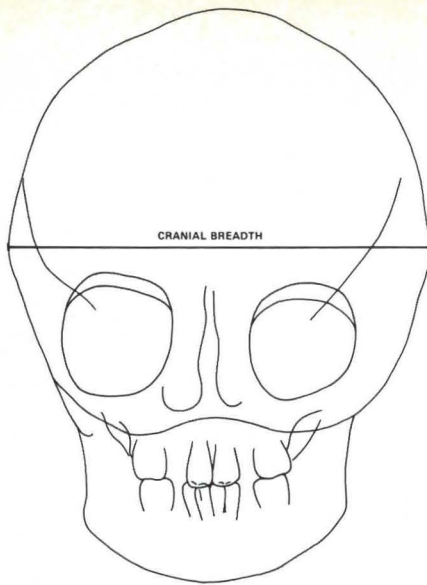


Figure 4. Frontal cephalogram.

tion, both jaws developed in anterior direction though the cephalometric values for jaw prognathism changed very little, due to a forward development of the point nasion. Only very slight changes in the shape and size of the calvarium were noted in the occipital region.

Analysis of the frontal cephalogram at the age of 14 y, 3 m demonstrated a symmetrical face, though subjectively shorter transverse dimension of the skull, when compared with normal subjects (Figure 4). The sagittal suture was also definable on the frontal cephalometric radiograph. Measurements of the maximal cranial breadth and cranial length revealed a cranial index of 68.32 which was noticeably small compared with normal values (75 percent to 80 percent)(Table 2).

Figure 6. Left and right hand-wrist radiographs showing development abnormalities. Left: 1, deformation of the capitate bone; 2,3, two small extra bones; 4,5, lack of epiphyses on the distal phalanges of the fourth and fifth fingers. Right: 1, slight deformation of the capitate bone; 2, one small extra bone; 3, osseous ankylosis between the trapezium and scaphoid bones; 4,5,6,7, lack of epiphyses on the distal phalanges of the first, second, third and fourth fingers.

### Examination of hands and hand/wrist radiographs

At the time of examination, a slight deformity of the hands was observed (Figure 5). The fingers of each hand varied in shape, the ring finger being slightly club

Figure 5. Photographs of hands.

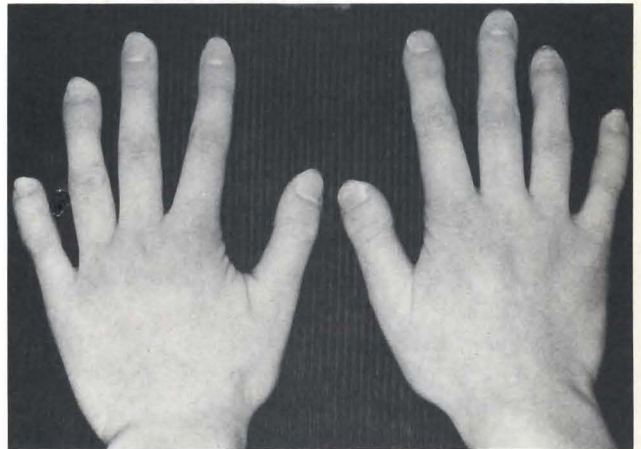


Table 1 □ Cephalometric analysis of the dentofacial skeleton.

		Mean	11 yr. 5 m.	14 yr. 3 m.
<b>Sagittal</b>				
Jaw relationship	ss-n-pg	2.0	-0.5	-2.0
	ss-n-sm	3.0	-1.5	-2.0
Incisor inclination	1Ls/NL	110.0	113.0	115.0
	1Li/ML	94.0	91.5	88.0
Jaw prognathion	s-n-ss	82.0	75.0	75.0
	s-n-pg	80.0	75.5	77.0
Alveolar prognathion	pr-n-ss	2.0	4.5	4.5
	s-n-pg	70.0	76.0	79.0
<b>Vertical</b>				
Jaw relationship	NL/ML	25.0	24.0	23.0
Cranial base flexure	n-s-ba	131.0	126.0	126.0

Table 2 □ Cranial index at age 14 yr. 3 m.

$$\text{Cranial index} = \frac{\text{breadth}}{\text{length}} \times 100 = \frac{151 \text{ mm}}{221 \text{ mm}} \times 100 = 68.32$$

shaped and the little finger thicker, corresponding to the medial and distal phalanges. The thumb on the right hand was shorter and more rounded than that on the left hand.

Examination of the hand-wrist radiographs taken at the age of 11 y and 5 m showed developmental abnormalities regarding the morphology and the phenomena of ossification between the left and right hand as well as in comparison with the normal pattern (Figure 6).<sup>11</sup>

The findings on the radiograph of the left hand-wrist were:

- Deformation of the capitate bone.
- Presence of two small extra bones; one of 6 mm x 5 mm dimensions, located between the hamate and the capitate bones and the other of 3 mm x 2 mm dimensions placed distally to the capitate bone.
- Lack of epiphyses on the distal phalanges of the fourth and fifth fingers.

The findings on the radiograph of the right hand-wrist were:

- Slight deformation of the capitate bone.
- Presence of one small extra bone of 5 mm x 5 mm dimensions, located between the capitate bone and the proximal side of the hamate bone.
- Presence of osseous fusion of the trapezium and scaphoid bones.
- Lack of epiphyses on the distal phalanges of the first, second, third and fourth fingers.

Allowing for discrepancies due to the developmental anomalies described, an attempt at determination of skeletal age using the Greulich and Pyle atlas was made and gave a result of 12 y (based on the left hand).<sup>11</sup>

## DISCUSSION

Variations in skull morphology are common among humans. In many cases, however, due to the premature closure of the sutures, abnormal skull configuration can be produced with the resulting deformity reflecting the sutures involved.<sup>12</sup> While it has been possible to close skull sutures in an animal experiment situation, the etiology of pathological early closure of the sutures of the skull is not understood. Assuming the morphology of the skull to be determined by the functional matrices which surround them, it is logical to suggest that compensation, development of open, active sutures can take place.<sup>13</sup> In the case of the premature closure of the sagittal suture, as in scaphocephaly, it could be expected, therefore, that elongation of the skull could take place. In like manner it is possible that change in the

functional matrix around the frontal bone, not least in connection with the developing brain could result in the lack of formation of the frontal sinuses.

The case presented demonstrates a benign malformation of the skull in a case where the same patient presented developmental abnormalities in the hand-wrist radiography and had minor malformations in the hands and one leg. No explanation of the combination of symptoms can be given. So that at the present time it is impossible to state whether the combination of symptoms is the result of coincidence, or the patient presented represents a developmental syndrome.

## SUMMARY

The clinical and radiological findings of a case of scaphocephaly have been presented and related to the patient's history. The main findings were:

- A small cranial index.
- Developmental abnormalities of the hands detected both clinically and radiographically.
- History of congenital deformities of the feet.
- Aplasia of three premolars.
- History of pain in the occipital region at earlier age.

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# Timing of orthodontic tooth movement in a case with traumatized and avulsed anterior teeth

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## CASE HISTORY

A thirteen-year-old male, undergoing orthodontic treatment for correction of a Class II, Division I malocclusion, received an injury to his upper anterior teeth. The buccal segments had been aligned and anterior retraction was almost complete, when an accident resulted in fracture of the maxillary central incisors, avulsion of the maxillary left central, and partial avulsion of the maxillary left lateral incisor. The patient was received for emergency treatment two hours after the accident occurred. At the time of the accident, a full 0.16 upper arch was in place with bonded attachments on three upper anterior teeth, namely left central and lateral incisors and right central incisor, and bands on the right lateral incisor and all remaining upper teeth. All three bonds, on the teeth mentioned above, were lost at the time of the accident. One might speculate that less damage would have resulted had all the anterior teeth been banded rather than bonded.

Clinical examination revealed:

- Lacerated and swollen upper lip and gingival tissue.

- Bleeding from the alveolar sockets of upper anterior teeth.
- Upper left central incisor avulsed and wrapped in cotton.
- Severe mobility of the upper lateral incisors and the upper right central incisor.
- Upper left lateral incisor dislodged from alveolus, but *in situ*.
- Fracture of clinical crown of upper right and left central incisors.
- Evidence of alveolar bending in area of upper central incisors.

Emergency treatment was instituted as follows:

- Upper left central incisor bathed in patient's saliva.
- Upper left central and lateral incisors were fully seated in their respective sockets.
- Upper right central and lateral incisors were checked to be sure of full seating in their respective sockets.
- The upper central incisors and left lateral incisor were bonded and a passive stabilizing .018 full upper arch wire was placed (Figure 1).

Two questions now had to be answered. Firstly, when should root canal treatment be instituted? And, secondly, how long should the traumatized and avulsed teeth be stabilized and rested before resuming orthodontic treatment?

Endodontic consultation resulted in a decision to begin root canal therapy for the upper central incisors and

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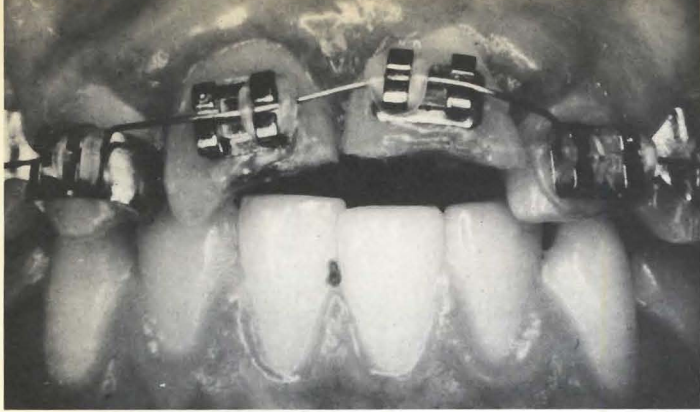
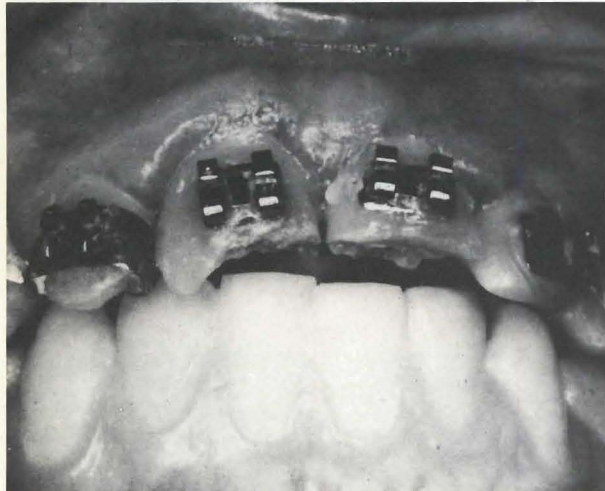
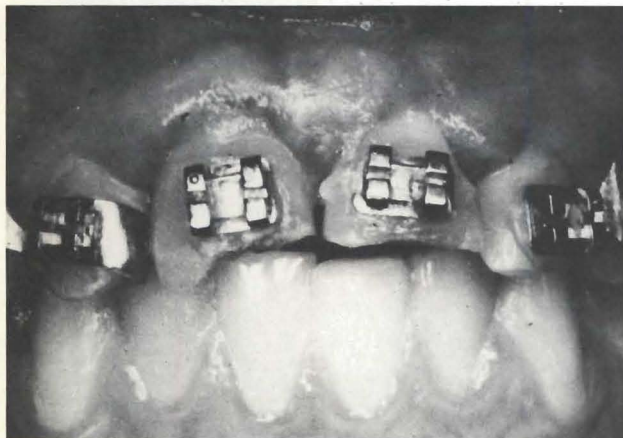


Figure 1. Placement of passive, stabilizing arch wire several hours after trauma to the upper anterior teeth.

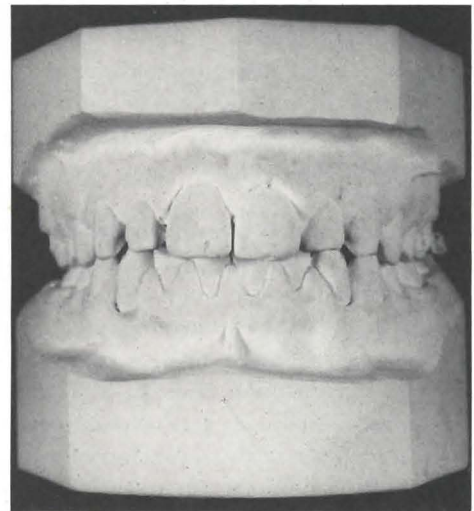


Figures 2, 3. Progressive improvement during the posttrauma orthodontic treatment.



the upper left lateral as soon as marked stabilization took place. The time required for this stabilization was two weeks. The root canal of the left central incisor received a calcium hydroxide paste for six months in order to reduce the chances of inflammatory root resorption. After six months, a conventional root filling was placed.

A literature search did not provide a definitive answer as to when orthodontic forces should be resumed. Orthodontic treatment was reinstated one week post endodontic completion, proceeded uneventfully, and was completed in a period of four months (Figures 2,3).



Figures 4, 5, 6. Completed orthodontic correction with temporary crowns in place.

Temporary restorations were placed for the upper central incisors and a Hawley retainer was used for final space closure and retention. The completed case is shown in Figures 4-6. Radiographs taken six months,

one year, and two years postorthodontic completion reveal the following (Figures 7-12):

*The upper right lateral incisor* — Six-month examination showed no signs of root resorption. One-year post-treatment, the vitality test with electric pulp tester and ice brought about a negative response. Root canal treatment had been suggested, but was not implemented. Two-year posttreatment revealed a negative response for the same vitality tests. Tooth color had not changed. The suggested root canal treatment had not yet been implemented, but no signs of root resorption were present.

*The upper right central incisor* — Six-month examination showed signs of resorption on the mesial and distal aspects of the middle third of the root. One-year posttreatment, there was a cessation of resorption. Two-year posttreatment, there was repair and healing of the resorption areas.

*The upper left central incisor* (previously avulsed) — Six-month examination showed signs of resorption on the mesial and distal aspects of the apical root area, and the mesial aspect of the cervical root area. A periapical radiolucency was present. One-year posttreatment, the mesial cervical resorption continued as did the periapical radiolucency. Two-year posttreatment, there was continued resorption of the mesial apical root area and signs of periapical root resorption.

*The upper left lateral incisor* (previously dislodged) — Six-month and one-year examination showed no signs of root resorption. Two-year posttreatment, there was evidence of blunting of the root apex.

## DISCUSSION

The decision to institute endodontic treatment early was supported by Andreason's conclusion that root canal therapy should be done within one to two weeks, in order to prevent inflammatory root resorption, and yet allow time for reformation of periodontal ligament fibers.<sup>1</sup>

When to begin orthodontic treatment of traumatized and avulsed teeth proved to be a more difficult question to answer. We are faced with the following dilemma. If tooth movement is begun too early, that is before reorganization of the fiber system of the PDL, there is danger of increasing the degree of root resorption.<sup>2,3</sup> If tooth movement is delayed for a long period (one year), as recommended by Goldson and Malmgren, we are

The authors wish to thank Dr. Aviad Tamse, Department of Endodontology, for his help in interpreting the radiographs, and to Mrs. Rita Lazar for her editorial assistance.



Figures 7, 8. Radiographic records six months postorthodontic completion.



Figures 9, 10. Radiographic records one-year postorthodontic completion.



Figures 11, 12. Radiographic records two-year postorthodontic completion.

faced with the possibility of ankylosis or external root resorption.<sup>4</sup> Andreason states that evidence of external root resorption and ankylosis appears within two to three weeks of the time of injury.<sup>1</sup> He recommends immediate orthodontic treatment of intruded permanent teeth, but no guides are provided for avulsed teeth. In a study of totally and partially avulsed permanent teeth from his own practice and that of twenty-six other orthodontic practices, Hines suggests a waiting period of two to three months.<sup>5</sup> He reported a 28.3 percent increase in root resorption to the avulsed teeth, after the completion of orthodontic treatment.

Based upon our interpretation of the above information, we decided to resume orthodontic treatment shortly after completion of the root canal therapy, which meant a total waiting time of three weeks from the time of the accident. Although a slightly higher frequency of root resorption has been reported after orthodontic movement of endodontically treated teeth, there is no contraindication to this movement, after clinical evidence of healing has taken place.<sup>6</sup>

## CONCLUSIONS

Early continuation of orthodontic forces does not seem to have adversely affected the prognosis for three of the

four traumatized upper anterior teeth. A positive prognosis for the avulsed tooth has been compromised, most probably due to the amount of time that expired (two hours) before reimplantation of this tooth took place.

More observations are needed to justify resuming orthodontic forces as early as three weeks posttrauma to avulsed and fractured anterior teeth.

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In a laboratory setting, Rogers and his associates have obtained evidence supporting the interpretation of these campaigns: the response needs to be seen as effective in removing the source of danger (and fear). Reassurance was varied by informing the subjects that the fear-arousing event was easily escaped or avoided if encountered versus informing subjects that there was no effective way to avoid the problem. Attitude change was facilitated in the high reassurance condition. This contradicts the results of earlier research.

Job, R.F. Soames: Effective and ineffective use of fear in health promotion campaigns. *Am J Pub Health*, 78: 163-167, February, 1988.

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\*From the American Academy of Pediatrics Committee on Nutrition statement. Fluoride Supplementation: Revised Dosage Schedule. Pediatrics 63(1):50-52, 1979.

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**ABSTRACTS**

**Romberg, Elaine; Cohen, Leonard A.; LaBelle, Ann D.: A national survey of sealant use by pediatric dentists. *J Dent Child*, 55:257-264, July-August, 1988.** A national survey of pediatric dentists was undertaken to determine their level of sealant use and the factors that affected level of use. A twelve-page mailed questionnaire was completed by 329 practitioners. Decision-making factors, attitudes and knowledge about sealants, sealant awareness, characteristics of sealant use, undergraduate dental school experience with sealants, auxiliary factors, impact of insurance, characteristics of dental practice, interaction with colleagues, and characteristics of patient populations were explored as they related to level of sealant use. Variables significantly associated with sealant use included: availability of insurance, ability to delegate sealant procedures, and patient income and acceptance. Frequent users were more knowledgeable about sealant issues and were more likely to be consulted by their peers.

**Sealants; Attitudes, practitioner (and) patient**

**Brown, Michael R.; Foreman, Frank J.; Burgess, John O.; Summitt, James B.: Penetration of gel and solution etchants in occlusal fissures. *J Dent Child*, 55:265-268, July-August, 1988.** The major clinical advantage of a phosphoric acid gel etchant is its superior control during placement. However, its viscosity can impede penetration into occlusal fissures, resulting in adequate etching and decreased pit-and-fissure sealant retention. This study examined the penetration of gel and liquid phosphoric acid etchants in occlusal fissures. The depth of fissure penetration of the acids was investigated using paired, sectioned samples and evaluated with a scanning electron microscope. The etch pattern was measured

from the base of the fissure to the first demonstrable evidence of etched enamel. A variable pattern of etched enamel was present at the base of the fissure to no pattern observable at distances of 15 microns from the base. A frequent finding was that debris partially or totally blocked the fissure orifice, preventing acid penetration. Utilizing a paired t-test, no statistically significant difference ( $0.5 < p < 0.8$ ) in the fissure penetration of gel or liquid phosphoric acid etchants could be shown.

**Etchants, phosphoric acid, gel (or) liquid**

**Parkin, Stanley F.: The assessment of two dental anxiety-rating scales for children. *J Dent Child*, 55:269-272, July-August, 1988.** A major problem in studying anxiety is the quantification of the emotion. Perhaps the most utilized method of assessing a child's anxiety in the dental situation involves the use of rating scales. This study tested the validity and reliability of published Complex and Simple rating scales by using them in a test-retest, inter-observer assessment, with standard video-recordings of children undergoing dental treatment. Three dental professionals, a dental surgeon and two dental surgery assistants, tended to equate a child's dental anxiety with his ability to accept dental treatment. The use of rating scales needs practice and experience, as some of the components are more difficult to interpret, involving dimensions of mood or ambiguity.

**Behavior; Rating scales; Pediatric dentistry**

**Allen, Keith D.; Stark, Lori J.; Rigney, Brooke A.; Nash, David A.; Stokes, Trevor F.: Reinforced practice of children's cooperative behavior during**

Continued on page 310

ABSTRACTS Continued from page 253

**restorative dental treatment. J Dent Child, 55:273-277, July-August, 1988.** A reinforced practice procedure was employed to teach cooperative behaviors to two 36-month-old children undergoing restorative dental treatment. The children were rewarded with temporary escape, praise, and stickers for practicing the use of cooperative behavior in the presence of the sights, sounds, and some of the sensations of the dental instruments, before the actual dental treatment. Observations of four classes of disruptive behavior during treatment indicated that baseline levels of disruptive behavior, typically greater than 95 percent, were reduced by more than 70 percent, following several practice visits. These changes were acceptable to the dentist—and to his assistant, who rated the children as more cooperative and less anxious.  
**Behavior modification; Pediatric dentistry**

**Shanchez-Woodworth, R.E.; Katzberg, R.W.; Tallents, R.H.; Guay, J.A.: Radiographic assessment of temporomandibular joint pain and dysfunction in the pediatric age-group. J Dent Child, 55:278-281, July-August, 1988.** During a five-year period, a total of 150 patients (131 girls and 19 boys) with an average age of 14 years (range 7-16 years), with signs and symptoms of temporomandibular joint dysfunction were referred for imaging in the diagnostic radiology department. These patients were evaluated by multi-directional tomography to both joints, arthrography, computed tomography (CT), or magnetic resonance (MR) of one or both joints. Fifty-six (37 percent) of the 150 patients had plain tomographic, CT or MR evidence of degenerative arthritis of one or both sides (18/150 12 percent with bilateral degenerative joint disease). Internal derangements of the TMJ related to meniscal displacements and dysfunction were detected in 128 patients (85 percent).

Twenty-nine patients (29/150: 20 percent) suffered from bilateral internal derangements. This clinical study demonstrates that internal derangements do occur in the pediatric age-group: the high percentages of both internal derangements and degenerative joint disease suggest a cautious clinical acceptance of imaging for internal derangements in the young patient. This reluctance to study these patients should be minimized by the new, noninvasive imaging modality available in magnetic resonance.

**Temporomandibular joint; Radiology, diagnostic; Arthritis; Computed tomography; Magnetic resonance imaging; Pediatrics**

**Ekstrand, Karl and Thomsson, Mats: Ectodermal dysplasia with partial anodontia: prosthetic treatment with implant fixed prosthesis. J Dent Child, 55:282-284, July-August, 1988.** In cases with severe hypodontia, it is necessary to make a treatment plan in collaboration with different disciplines in dentistry, with the treatment plan formed in such a way that many possibilities for treatment could be used in the future. Partial and full dentures combine simple methods with good esthetic and functional results in the growing individual. They also afford time to assess the patient with regard to more extensive restorative treatment. Patients suffering from severe hypodontia have so far been very dependent on their remaining teeth. The case reported covers a twenty-year period of dental treatment, and shows a new possibility provided by osseointegrated implants.

**Ectodermal dysplasia; Anodontia; Implants**

**Abrams, Herbert; Gossett, Steven E.; Morgan, William J.: A modified flap design in exposing the palatally impacted canine. J Dent Child, 55:285-287, July-August, 1988.** A modified flap design for exposing a palatally impacted canine before orthodontic intervention is described, which

utilizes an incision 4-5 mm apical to the free gingival margin. The reflected flap provides good surgical access without violating the integrity of the periodontium.

**Impaction, palatal; Canine tooth; Tooth eruption; Oral surgery; Orthodontics**

**Wood, Robert E.; Nortjé, Christoffel, J.; Padayachee, Arun; Grotepass, F.: Radicular cysts of primary teeth mimicking premolar dentigerous cysts: report of three cases. J Dent Child, 55:288-290, July-August, 1988.** In three cases, the clinical diagnosis of dentigerous cyst was disproved by surgical exploration. In all other cases reviewed from a thirteen-year period, the clinical diagnosis of radicular cyst from an infected primary tooth was verified by surgery and histological examination.

**Radicular cyst; Dentigerous cyst; Molars, primary**

**Williams, Nancy Johnson and Schuman, Norman J.: The curved-bristle toothbrush: an aid for the handicapped population. J Dent Child, 55:291-293, July-August, 1988.** This study was undertaken to assess the comparative effectiveness of two toothbrushes in the removal of plaque in an institutionalized, handicapped population. The two methods were: a conventional toothbrush using the Modified Stillman Method; and a curved-bristle toothbrush using the scrubbing technique recommended by the manufacturer. Subjects selected were profoundly retarded individuals, incapable of self-brushing skills. According to random selection, subjects' teeth were brushed by trained personnel with either the curved bristle or the conventional toothbrush. Results demonstrated that the curved-bristle toothbrush was as effective as the conventional toothbrush when used by trained personnel.

**Toothbrushing; Handicapped population; Oral hygiene; Plaque control**

**Himelhoch, Deborah A.: Separation of fused primary incisors: report of case. J Dent Child, 55:294-297, July-August, 1988.** A case involving separation and esthetic restoration of a maxillary primary left lateral incisor fused to a supernumerary is described. The literature on double teeth is reviewed and treatment alternatives discussed; stainless steel crowns with composite facings were used in this case.  
**Fused teeth; Double teeth; Gemination; Crowns, stainless steel**

**Trubman, Aaron and Silberman, Stephen L.: Triple teeth: case reports of combined fusion and gemination. J Dent Child, 55:298-299, July-August, 1988.** Fusion and gemination are infrequent dental anomalies. The combination of the two, which creates in effect a 'triple' tooth, is very rare, having seldom been reported in the dental lit-

erature. This report describes two cases seen with this rare combination-anomaly. Both were located in the primary dentition, involving the mandibular central and lateral incisors.

**Triple teeth; Fused teeth; Gemination**

**Williams, Stephen and Athanasiou, Athanasios, E.: Scaphocephaly associated with other abnormalities: report of case. J Dent Child, 55:300-303, July-August, 1988.** Clinically scaphocephaly is characterized by a sagittal elongation of the skull with marked frontal and occipital protrusion, as well as absence of the parietal eminences. The case reported here was detected during routine orthodontic treatment of a minor malocclusion.

**Scaphocephaly; Malocclusion; Cephalograms**

**Gazit, Esther; Sarnat, Haim; Lieberman, Myron: Timing of orthodontic tooth movement in a case with traumatized and avulsed anterior teeth. J Dent child, 55:304-307, July-August, 1988.** A traumatic injury to a patient undergoing orthodontic treatment resulted in avulsion, dislodgement, and fracture of upper anterior teeth. Deciding when to institute endodontic treatment and when to resume orthodontic treatment was based upon minimizing the chances for ankyloses and root resorption. Endodontic treatment was carried out two weeks after trauma, and orthodontic treatment continued three weeks after trauma. Radiographs taken six months, one year, and two years after orthodontic completion showed progressive root resorption to the avulsed tooth and minimum root resorption to the remaining anterior teeth.

**Avulsion; Tooth movement; Root resorption; Orthodontics**

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